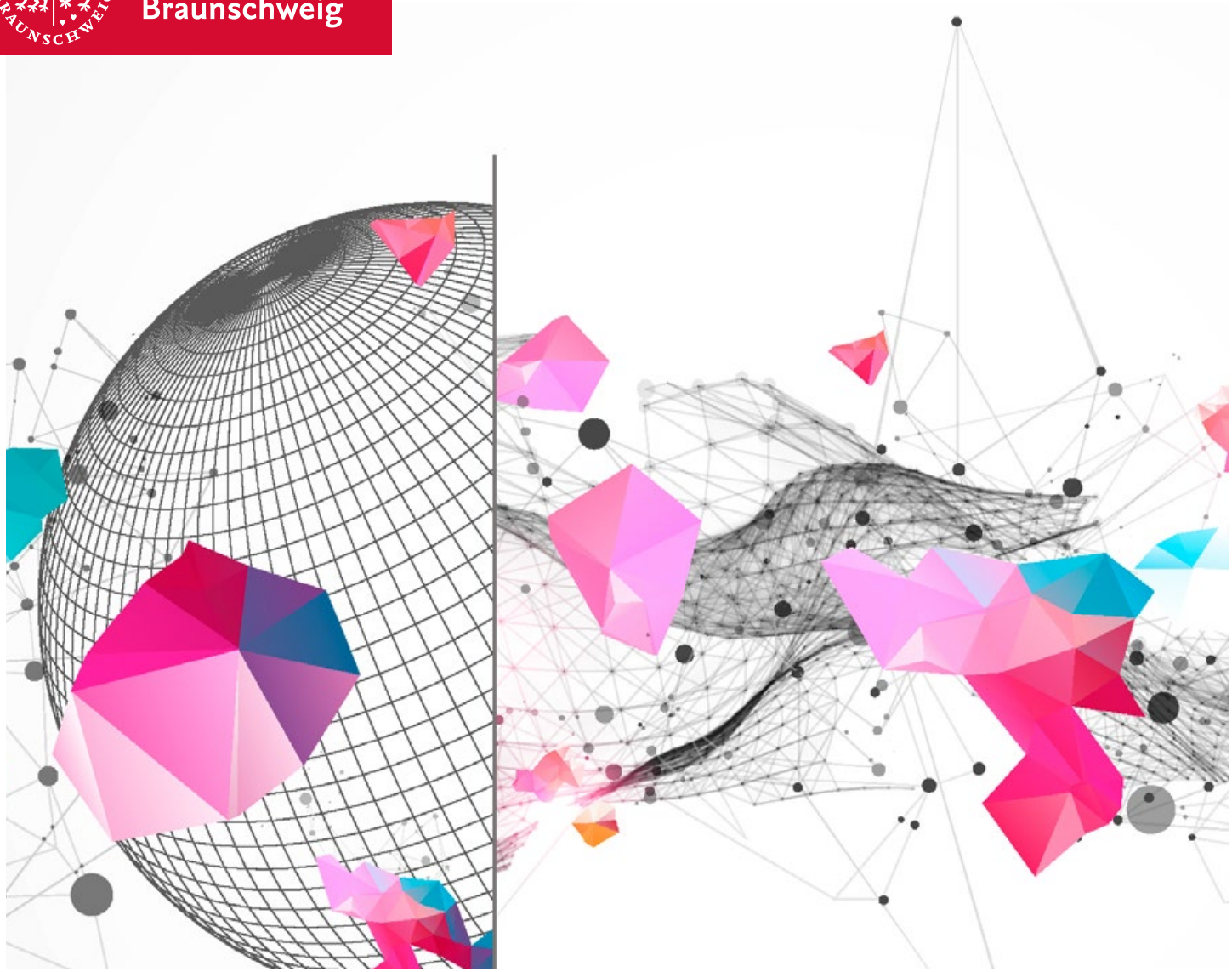
Technische Universität Braunschweig



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Technische Universität Braunschweig

Research

Technische Universität Braunschweig

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Preface

welcome

Historic central building of the university

Technische Universität Braunschweig – a short introduction

Welcome to a comprehensive compilation of the Technische Universität Braunschweig's scientific activities. Founded in 1745, our university is the oldest technical institute in Germany and is part of the German Universities of Technology e. V. (TU9). With close to 18,500 students (41% female and 18% International students), 3,700 employees (42% female) and 241 professors (24% female), the Technische Universität Braunschweig is a mid-sized public university with a strong tradition in STEM research and teaching and a strong focus on humanities and teacher education. Our 120 institutes are organized in 6 faculties and provide 71 different bachelor's and master's degree programmes. Our research is organized in 4 core research areas that provide a structure for interdisciplinary research to find answers to global challenges.

Our faculties:

1. Carl-Friedrich-Gauß-Fakultät: *Mathematics, Computer Science, Business Science, Social Science*
2. Faculty of Life Sciences: *Biology, Chemistry, Pharmacy, Psychology*
3. Faculty of Architecture, Civil Engineering and Environmental Sciences
4. Faculty of Mechanical Engineering
5. Faculty of Electrical Engineering, Information Technology, Physics
6. Faculty of Humanities and Education

Our curricula are highly research-oriented. Consequently, teaching and leveraging world-class science go hand in hand. As a STEM-oriented University, we co-operate with numerous industry partners from around the world. Several research centres as part of the 4 core research areas facilitate this science-oriented educational process. The graduate academy Grad[TUBS] provides tailor-made training courses for our doctoral students, as well as contacts to potential employers outside of academia.

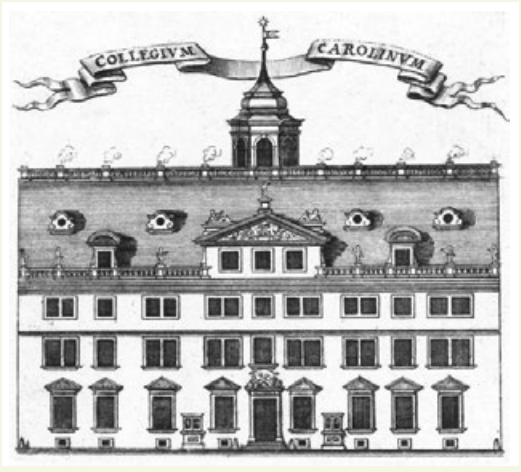
The Braunschweig Research Region

Several colleagues from local research institutions are an integral part of our scientific network in Braunschweig, with our university as the integrative heart. The Braunschweig/Wolfsburg region is one the most active research regions in Europe, with more than 15,000 researchers living and working in the area. The local research institutions listed below are closely linked to our university through cooperation agreements, facilitating joint research and the coordination of human resources development.

Special issue stamp on the occasion of the 250th birthday of our university

Our local research partners:

Braunschweig University of Art
Federal Research Institute for Rural Areas, Forestry and Fisheries (Thünen Institute)
Federal Research Centre for Cultivated Plants (Julius Kühn Institute)
Fraunhofer Institute for Wood Research (WKI)
Fraunhofer Institute for Surface Engineering and Thin Films (IST)
Fraunhofer Institute for Toxicology and Experimental Medicine (ITEM)
Friedrich-Loeffler-Institut: Federal Research Institute for Animal Health (FLI)
Leibniz Institute for Educational Media | Georg Eckert Institute
Helmholtz Centre for Infection Research (HZI)
Leibniz Institute German Collection of Microorganisms and Cell Cultures (DSMZ)
German Aerospace Center (DLR)
National Metrology Institute of Germany (PTB)
Ostfalia – University of Applied Sciences
Volkswagen AG and many other companies



Collegium Carolinum around the year 1746

Our research strategy as part of our mission statement

Integrating partners from regional research institutions into the university's scientific activities is part of our overall strategy at the TU Braunschweig. At the same time, we are dedicated to our many international partners. The strategy was developed in 2012 as part of a general concept and mission-statement building process that involved all members of the university. Not only did we define our aims in research, teaching, governance, internationalisation as well as equity and diversity, we also agreed on the values that we share at the TU Braunschweig, such as a strong commitment to respecting diversity, participative leadership, and transparency. A new university wide strategy process is currently under way, so please have a look at our website to find out more about the TU Braunschweig's aims and values.

Our core research areas

The research governance of the TU Braunschweig is based on 4 core research areas:

1. Mobility
2. Metrology
3. Engineering for Health
4. City of the Future

The various research centres and clusters of excellence are part of these core research areas. They are complemented by numerous other excellent scientific activities.

Our clusters of excellence

The programme Excellence Strategy jointly administered by the German Research Foundation (Deutsche Forschungs Gemeinschaft DFG) and the German Research Council for Science and Humanities (Wissenschaftsrat, WR) supports cutting-edge research at German universities and is intended to strengthen Germany's position as an outstanding place for research in the long term and further improve its international competitiveness. The TU Braunschweig has been successful in the Excellence Strategy 2018 with two clusters:

1. QuantumFrontiers – Light and Matter at the Quantum Frontier: Foundations and Applications in Metrology “QuantumFrontiers" is dedicated to the fundamentals of quantum and nanometrological phenomena in order to achieve precision at the limits of measurability through quantum technologies. QuantumFrontiers involves the TU Braunschweig, LUH and the PTB.
2. SE²A – Sustainable and Energy Efficient Aviation. In “SE²A” scientists from aerospace, electrical, energy and chemical engineering are working on the reduction of emissions and noise, as well as recycling and life-cycle concepts for airframes and improvements in air traffic management. The TU Braunschweig, the DLR, LUH, HBK and PTB have joined forces in this extraordinary scientific undertaking.

These two world-wide visible Clusters of Excellence are shaping the international science approach of our university.

Our research centres and research associations

To strongly facilitate our research strategy, various joint research centres with new buildings have been erected throughout the last decade that host scientific working groups from the TU Braunschweig and their external partners under one roof. These centres provide a basis for joint research within the framework of publicly and commercially-financed consortia:

BLB – Battery LabFactory

BRICS – Braunschweig Integrated Centre of Systems Biology

LENA – Laboratory for Emerging Nanometrology

NFF – Automotive Research Centre Niedersachsen

NFL – Aeronautics Research Centre Niedersachsen

PVZ – Center of Pharmaceutical Engineering

ZeBra – Center for Fire Research

To cover interdisciplinary topics that provide anchor points for cooperation with research centres or individual institutes, additional research associations have been created that function across departmental boundaries:

FZK – Forschungszentrum Küste (with LUH)

IST.hub – Intelligent Systems Technologies hub

MUSEN – Center of Mechanics, Uncertainty and Simulation in Engineering

OHLF – Open Hybrid LabFactory

Our Internationalisation strategy

Research is international by nature. In order to attract excellent researchers from abroad and give our students, scientists and administrative personnel the chance to study, conduct research and work outside of Germany and get international experience at home or abroad, a continuous internationalisation process has been established. The TU Braunschweig has successfully completed the Internationalisation Audit/Re-Audit offered by the German Rectors' Conference (HRK) to organise and validate this process. A new process is currently being defined with the HRK to continue these efforts. All activities are organised within the framework of the "International House" and steered by the Internationalisation Committee headed by the President.

Our equality and diversity strategy

The TU Braunschweig strongly and actively supports equal opportunities for all scientists, for students and employees, and finally the equal treatment of people regardless of diversity status. This commitment is the basis of comprehensive equality and a strong anti-discrimination policy.

Digitalisation and sustainability strategy

The digitalisation of our society is the primary goal of teaching and research at the TU Braunschweig. Thus, this cross-sectional science is a major topic of all core research areas of our university. Employing high-end informatics approaches, our research aims to develop innovative solutions for our future information society. This goes hand in hand with the demand for sustainability in all our research and teaching in engineering, natural sciences, humanities and administration. We do not only contribute to corresponding innovative technologies, but also to the awareness of future generations.

Conclusion

During the last decade, the Technische Universität Braunschweig has undergone a significant transformation to establish an even more innovative, inspiring and strongly competitive research environment. 4 core research areas have been defined during a comprehensive strategic process and host several new Research Centres and two Clusters of Excellence for joint research with local and international research partners in academia and industry. The university's infrastructure and our internationalisation strategy as well as our strategy to support equality and diversity are continuously being adapted to match new challenges. Our state-of-the-art research infrastructure is instrumental in educating students in a unique science- and practice-oriented way. TU Braunschweig is an attractive place to live, study and conduct research. It is also a competent partner for national and international academia and the industry.

Please feel free to contact any researcher included in this catalogue or our central governance board with ideas and suggestions if you want to join the dynamic and highly successful researchers at the Technische Universität Braunschweig (TU BS).

Prof. Dr. Angela Ittel
President

Prof. Dr.-Ing Peter Hecker
Vice President for Research and Early Career Scientists

Prof. Dr. Dieter Jahn
Director of BRICS (Editor)

Photos: Ittel: Kristina Rottig/TU Braunschweig; Hecker: Stantien Fotostudio/TU Braunschweig; Jahn: Puls/Jahn/TU Braunschweig.

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Institute of Management Control & Business Accounting (ICU)

Prof. Dr. Heinz Ahn

- TU Braunschweig: Full Professor and CEO of the Institute of Management Control & Business Accounting

Researcher's Career

RWTH Aachen University:

- Teacher at the Chair of Technology and Innovation Management
- Research Assistant at the Chair of Environment Economy and Industrial Control
- Stand-In Professor for Operations Research and Logistic Management
- PhD and Postdoc at the Chair of Environment Economy and Industrial Control
- Study of Business Administration

Funding

DFG, BMBF, Small and Medium-Sized Enterprises, Industry

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Mission Statement

Our group focuses on instruments for planning, measuring and managing the performance of companies, their subunits and their actions. The respective research comprises the following three topics and exemplary problems:

Research

Cost accounting and cost management:

- cost analysis in research & development
- cost-oriented process analysis and optimization
- customization of cost accounting systems

KPI-based planning concepts:

- strategic planning with Balanced Scorecard – BSC
- operationalization of objectives in complex decision scenarios
- implementation of value-based management concepts

Performance control:

- multidimensional measurement of effectiveness and efficiency
- benchmarking with Data Envelopment Analysis – DEA
- behavioral effects of performance control mechanisms

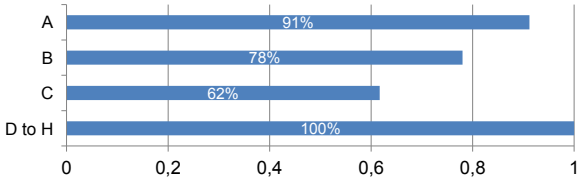
Benchmarking with DEA: An Example from the Health Sector

Comparison of the effiency of 8 maternity clinics

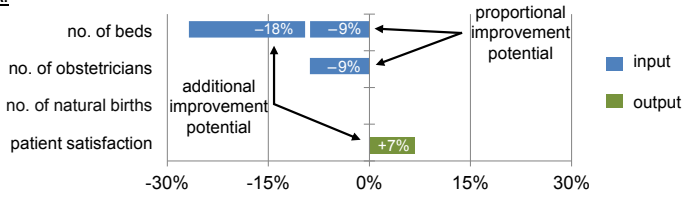
performance criteria

input 1: number of beds
input 2: number of obstetricians
→ output 1: number of natural births
output 2: patient satisfaction

achieved efficiency of the clinics:



improvement potential of clinic A:



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- Afsharian, M./Ahn, H./Lopes, A./Vilela, B. (2019): Pitfalls in estimating the X-factor – The case of energy transmission regulation in Brazil, in: Socio-Economic Planning Sciences 65, No. 1, pp. 1–9.
- Afsharian, M./Ahn, H./Thanassoulis, E. (2019): A frontier-based system of incentives for units in organisations with varying degrees of decentralisation, in: European Journal of Operational Research 275, No. 1, pp. 224–237.
- Ahn, H./Bogetoft, P./Lopes, A. (2019): Measuring potential sub-unit efficiency to counter the aggregation bias in benchmarking, in: Journal of Business Economics 89, No. 1, pp. 53–77.
- da Silva, A. V./Costa, M./Ahn, H./Lopes, A. (2019): Performance benchmarking models for electricity transmission regulation – Caveats concerning the Brazilian case, in: Utilities Policy, https://doi.org/10.1016/j.jup.2019.100960.

Institute for Information Systems (IfIS)

Prof. Dr. Wolf-Tilo Balke

- Chair, Department of Computer Science
- Director of L3S Research Center, Hannover
- Member of the Academy of Europe – Academia Europaea
- Member of the DFG Committee on Inquiry on Allegations of Scientific Misconduct
- Member of the Commission of the Elite Network of Bavaria by the Bavarian State Ministry of Science and the Arts

Researcher's Career

- Full Professor for Computer Science, TU Braunschweig
- Emmy Noether Fellow, LUH Hannover
- Research Fellow, University of California at Berkeley, CA, USA
- PhD in Computer Science, University of Augsburg
- Studies of Mathematics, University of Augsburg

Funding

DFG, EU, Industry

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http://www.ifis.cs.tu-bs.de

Mission Statement

The process of generating, disseminating, and archiving information has changed fundamentally. Information systems are at the heart of this development. IfIS innovates new paradigms for search, access, and exchange: digital information is discovered, interlinked, annotated, commented upon, adapted, and shared in Web-based collaborative infrastructures.

Research

Query Processing in the Age of Big Data: With growing numbers and output of data producers, the processing and analysis of Big Data has become a central concern. Data production, data storage, and data processing have to work hand-in-hand to form effective chains that also need a tight linkage between software components for managing data flows and the hardware used for processing. To tackle these issues IfIS works hand-in-hand with some of the world's largest information providers and producers, such as CERN for scientific data.

Digital Libraries: Digital libraries are constantly growing and the amount of digital content currently available gives everybody a unique opportunity to explore, extend, learn, and solve complex problems in a diversity of disciplines. However, this availability raises a central question: How to find information that is valuable? Utilizing intelligent methods like semantic embeddings or narrative information systems, IfIS develops ways to focus the metadata generation and subsequent annotation to those specific aspects where the real value lies.

Proactive Information Services: Specialised information services (SIS) are an ongoing collaboration of IfIS and the university library. The first aims at sustainable improvements of access to literature and curated databases in the field of pharmacy (http://www.pubpharm.de). Documents requested are made accessible immediately and directly in electronic form. Moreover, within an extensible and personalizable information infrastructure, customizable value-added services can be established.

Crowd Evolution: In the era of Big Data, crowdsourcing has emerged as a flexible solution, which helps to manage the flood of data and provides a process of structuring it. Harnessing human intelligence from the crowd steers many applications into seamlessly combining the best of both worlds: state-of the-art algorithms' unmatched computational power integrated with humans' cognitive abilities and intellectual insights. IfIS shapes the vision of robust impact sourcing by creating novel quality measures for reliable results.

Publications

- S. Mennicke, J.-C. Kalo, D. Nagel, H. Kroll, and W.-T. Balke, "Fast Dual Simulation Processing of Graph Database Queries", IEEE 35th International Conference on Data Engineering (ICDE), Macau, China, 2019.
- K. Ostaszewski, P. Heinisch, I. Richter, H. Kroll, W.-T. Balke, D. Fraga, and K.-H. Glaßmeier, "Pattern Recognition in Time Series for Space Missions: A Rosetta Magnetic Field Case Study", Acta Astronautica, vol. 168, Elsevier, 2019.
- K. El Maarry, K. Milland, and W.-T. Balke, "A Fair Share of the Work? The Evolving Ecosystem of Crowd Workers", 10th ACM Conference on Web Science (WebSci), Amsterdam, The Netherlands, 2018.
- J. M. Gonzalez-Pinto and W.-T. Balke, "Demystifying the Semantics of Relevant Objects in Scholarly Collections: A Probabilistic Approach", ACM/IEEE Joint Conference on Digital Libraries (JCDL), Knoxville, TN, USA, 2015.
- J. Selke, C. Lofi, W.-T. Balke: "Pushing the Boundaries of Crowd-Enabled Databases with Query-Driven Schema Expansion." 38th International Conference on Very Large Data Bases (VLDB), Istanbul, Turkey, 2012.

Institute of Comparative Politics and Public Policy

Prof. Dr. Nils C. Bandelow

- Department of Social Sciences
- Head of the Transfer Center "Sustainable Innovation Research" at iTUBS
- Co-editor of European Policy Analysis (EPA)
- Co-editor of Review of Policy Research (RPR)
- Co-editor of the series "Policy Analysis" (Nomos publishing)

Researcher's Career

- Full Professor of Political Science, TU Braunschweig
- Acting Professor at the Heinrich-Heine-Universität Düsseldorf
- Habilitation "Political Science" Ruhr University Bochum
- DFG Research Fellow and Honorary Research Fellow at the University of Birmingham
- PhD at the Ruhr University Bochum

Funding

DFG, BMBF, BMVI, Lower Saxony, Volkswagen Foundation, Hans Böckler Foundation

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Mission Statement

Understanding public policies, their effects and underlying governance processes is at the core of policy analysis. We undertake empirical studies in different sectors and for societal transitions (e. g. towards sustainability), innovations and new technologies, placing emphasis on inter- and transdisciplinary approaches which combine qualitative and quantitative research methodology.

Research

Mobility and Transport: One of our main research foci is the field of mobility and transport policy. This encompasses urban development and urban-rural relations, acceptance and participation in the planning, new construction and expansion of infrastructure (InnoPart project), and environmentally oriented transport policy. We offer scientific analyses and policy advice for all levels of governance: local, regional and national levels, as well as the European Union.

(Public) Health Policy: Within the cross-national research project funded by the DFG and the French equivalent ANR, we analyze and compare health policy in Western democracies. Since the COVID-19 pandemic, we extended this research to the sources and effects of measures related to the outbreak of this virus. We are involved in several research endeavours that also shed light on the role of digitalization in health policy, as well as care policy. Here, too, we provide policy advice to different health political actors, e.g. with regard to the reform and innovation capacity of the German health care system.

Policy Process Research: Beyond and within our main research areas, we apply various theoretical frameworks to explain policy change and stability. With the Programmatic Action Framework (PAF), we have ourselves developed an innovative perspective on policy-making, which sees a main driver of policy change in programmatic groups. Assuming that these form on the basis of shared biographies around policy programs, we state that programmatic groups shape a social identity that guides the group members in their preferences and behaviour in the policy process. We use these theoretical perspectives to shed light on all processes of policy-making, also in other fields of action, such as farm animal welfare policy, environmental policy, and labour market policy.

Policy Evaluation: Our research efforts not only touch upon theoretical perspectives to explain policy-making, but also aim at evaluating existing processes and outcomes. Our Institute is therefore strongly involved in the generation of indicators to assess the performance of governments in different European countries according to pre-defined scores. We also work together closely with regional actors in and around Braunschweig, which we advice regularly and for which we evaluate different policy measures with regard to their effectiveness.

Publications

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- Möck, M./Vogeler, C. S./Bandelow, N. C./Schröder, B. (2019): Layering Action Situations to Integrate Spatial Scales, Resource Linkages, and Change over Time: The Case of Groundwater Management in Agricultural Hubs in Germany. Policy Studies Journal (PSJ), early view. doi: https://doi.org/10.1111/psj.12377
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Institute Computational Mathematics – AG Numerik

Prof. Dr. Matthias Bollhöfer

Researcher's Career
- Associate Professor for numerical mathematics, TU Braunschweig, 2006
- Habilitation: TU Berlin, 2003
- Ph.D: (advisor V. Mehrmann), Chemnitz University of Technology, 1998
- Diploma in Mathematics: University of Bielefeld, (advisor A. Bunse-Gerstner), 1992

Employments
- Associate Professor at TU Braunschweig
- Senior Research Assistant, Institute of Mathematics, TU Berlin
- Temporary acting as professor for Numerical Mathematics at TU Braunschweig
- Research Assistant, Institute of Mathematics, TU Berlin
- Research Fellow at the University of Minnesota supported by the DFG
- Research Assistant, Department of Mathematics, Chemnitz University of Technology

Funding
DFG, BMBF, DAAD, ABB

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Mission Statement

The focus of the work of the AG Numerik in research and teaching is on state-of-the art numerical mathematics. It is devoted to the development of novel numerical techniques for the simulation of, for example, physical, engineering and economic processes. We cover all aspects, from basic research to easy-to-use software. Our research and development activities are application driven. We cooperate with many different national and international researchers to foster interdisciplinary exchange and scientific advance.

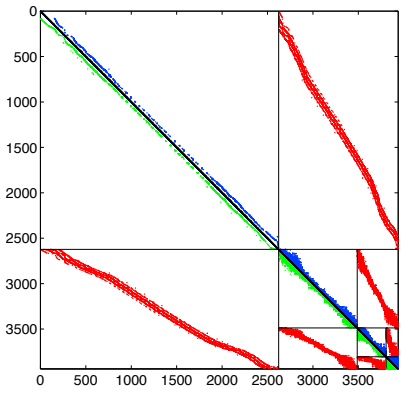
Research

Numerical Analysis, in Particular Fast Solvers for Systems Equations and Eigenvalue Problems, Particulary for Partial Differential Equations: The focus of our research here is the development and theoretical analysis of scalable solvers that allow for efficient solutions for the underlying equations. The solvers are typically based on preconditioning techniques, particulary algebraic multilevel techniques, hierarchical methods.

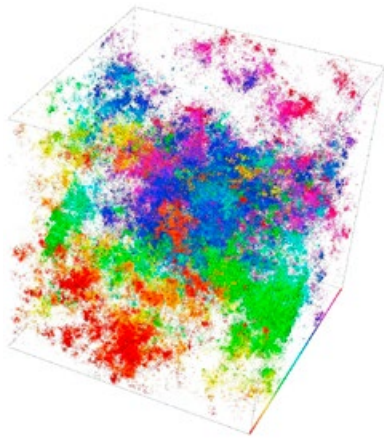
Model Order Reduction for Maxwell Equations: For the large-scale equations reduced-roder models are developped. Our focus lies on moment-matching type approach.
Scientific Parallel Computing: The design of efficient numerical algorithms often requires parallelization and efficient cache-optimized versions of the underlying numerical methods.

Numerical Linear Algebra: As a general approach for many applications, numerical linear algebra techniques are at the heart of most numerical methods.

Development of Numerical Software: Several mathematical challenges require not only the theoretical analysis and model implemenation of numerical methods, but also the development of numerical software. Here two software packackes **ILUPACK** and **JADAMILU** have been developped and further numerical software will be developed as by-products for other research topics.



multilevel factorization



wave function probabilities

Publications

- M. Bebendorf, M. Bollhöfer, and M. Bratsch. On the spectral equivalence of hierarchical matrix preconditioners for elliptic problems. Mathematics of Computation, 2016.
- J.I. Aliaga, R.M. Badia, M. Barreda, M. Bollhöfer, E. Dufrechou, P. Ezzatti, E.S. Quintana-Orti. Exploiting task and data parallelism in ILUPACK's preconditioned CG solver on NUMA architectures and many-core accelerators. Parallel Computing 54:97-107, 2016.
- Andre Bodendiek and Matthias Bollhöfer. Adaptive expansion point selection for rational Arnoldi-type methods in model order reduction of Maxwell's equations. BIT Numerical Mathematics 54(2):357-380, 2014.
- O. Schenk and M. Bollhöfer and R.A. Römer. On Large Scale Diagonalization Techniques for the Anderson Model of Localization. SIAM Review, 50(1):91-112, 2008.
- M. Bollhöfer and Y. Saad. Multilevel preconditioners constructed from inverse-based ILUs. SIAM J. Sci. Comput., 27(5):1627-1650, 2006.

Peter L. Reichertz Institute for Medical Informatics

Prof. Dr. Thomas M. Deserno

- Director, PLRI Campus Braunschweig
- Adjunct Faculty, Hannover Medical School
- Fellow, International Society for Optics and Photonics (SPIE)
- Senior, Institute of Electrical and Electronics Engineers (IEEE)
- German Representative, International Medical Informatics Association (IMIA)
- Member, World Health Organization (WHO) Roster of Experts for Digital Health

Researcher's Career

- Full Professor of Medical Informatics, Department of Computer Science, TU Braunschweig
- Visiting Faculty, National Library of Medicine, National Institutes of Health, USA
- Associate Professor of Medical Informatics, RWTH Aachen University
- Ph.D. in Computer Science at RWTH Aachen University
- Studies of Electrical Engineering, RWTH Aachen University

Funding

BMBF, BMVI, DFG, EU, Industry, State of Lower Saxony

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Mission Statement

Medical informatics means information engineering applied to health care and the meaningful use of patient health data. In my vision, we shall move Reichertz' paradigm from 1970: "The right information at the right place at the right time" towards: "An accurate forecast for a specific individual longest before the predicted event", i.e. the use of medical informatics to support the transformation from curative towards preventive and personalized medicine.

Research

Accident & Emergency Informatics (A&EI): A novel and trans-disciplinary science of systematically collecting and managing medical data (e.g., electronic health records), as well as sensor data from the human environment (e.g., event data recorder (EDR) such as acceleration sensors in the vehicle). A&EI focusses on syntactic and semantic data integration and analytics in order to forecast, prevent, or lower the impact of adverse health events on the subject.

Private Diagnostic Spaces: We all know EDRs from aviation (flight recorder), but we can consider such systems on various levels:

- Environment (e.g., smart cities)
- Living space (e.g., smart homes)
- Vehicle (e.g., smart cars)
- On-body (e.g., smart wearables)
- In-body (e.g., smart implants)

Smart home and smart cars are private spaces with autonomous power supply, data storage, and processing capacities, and they connect to the Internet. We work on transforming these environments into diagnostic spaces.

International Standard Accident Number (ISAN): When we buy books, the International Standard Book Number (ISBN) is a valuable resource, since it provides a unique identifier disregarding different publishers or editions. Accordingly, the ISAN aims at establishing a unique identifier for adverse events such as accidents and emergencies. We will establish such a token and will use it to establish secure communication between all IT systems in use at different rescue providers:

- Alarm system (e.g., smart home, smart car, smart clothes)
- Rescue team (e.g., street, air, water)
- Health care (e.g., emergency room, general hospital, stroke unit)

The rescue team equipped with tablet computer is provided with a floor plan as well as the key code to open the door.

Accident and emergency informatics combines environmental, behavioral, and physiological data for improved health care.

Publications

- Spicher N, Barakat R, Wang J, Haghi M, Jagieniak J, Öktem GS, Hackel S, Deserno TM. Proposing an International Standard Accident Number (ISAN) for interconnecting ICT systems of the rescue chain. Methods Inf Med. 2021; in press.
- Wang J, Spicher N, Warnecke JM, Haghi M, Schwartze J, Deserno TM. Unobtrusive health monitoring in private spaces: the smart home. Sensors. 2021;21(3):864.
- Wang J, Warnecke JM, Haghi M, Deserno TM. Unobtrusive health monitoring in private spaces: the smart vehicle. Sensors. 2020;20(9):2442.
- Deserno TM, Jakob R. Accident & emergency informatics: terminologies and standards are needed for digital health in the early rescue chain. Proc IEEE AICT. 2020;17-21.
- Deserno TM. Transforming smart vehicles and smart homes into private diagnostic spaces. Proc ACM APIT 2020;165-171.

Institute of Sociology

Prof. Dr. Christian Ebner

- Full Professor of Sociology (Research Focus: Work and Organisations), Institute of Sociology, Technische Universität Braunschweig

Researcher's Career

- Full Professor of Sociology (Subject: Work and Organisations) at the Technische Universität Braunschweig
- Deputy Professor of Sociology, Karlsruher Institute of Technology (KIT)
- Junior Professor, University of Cologne and Federal Institute for Vocational Education and Training, Bonn
- Postdoc at Berlin Social Science Center (WZB), Berlin
- Dr. phil. at Humboldt Universität Berlin in Cooperation with Berlin Social Science Center (WZB)
- Researcher at Institute for Employment Research (IAB), Nuremberg
- Study of Social Sciences, University of Erlangen-Nuremberg

Funding
BMBF; HBS; Volkswagen Stiftung

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Mission Statement

Analysing and understanding the world of work and organisations based on sociological theory and state-of-the-art qualitative and quantitative research methods. Empirical results are of interest to the international and national scientific community as well as to the broader public.

Research

Occupations and working conditions:
Depending on the occupation exercised (car mechanic, engineer, farmer, IT specialist, lawyer, policeman etc.) working conditions may vary significantly. We analyse and aim at explaining occupational differences with regard to monetary aspects (wages) as well as non-monetary factors (job stability, autonomy, work-life-balance, physical exhaustion etc.).

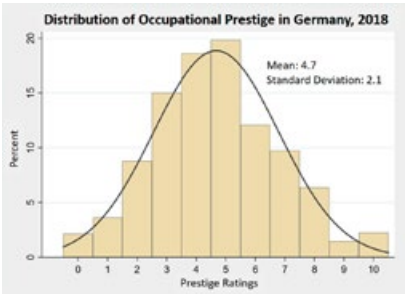
Workaholism:
Analysing representative survey data, we investigate the prevalence, causes and effects of work addiction in Germany (project funded by Hans-Böckler-Stiftung).

Social prestige and attitudes towards work:
We have conducted a large-scale representative survey in order to analyse the social standing of housewives, househusbands, several occupational groups, and the unemployed in Germany (project funded by BIBB/BMBF). Moreover, we analyse how attitudes towards the division of labour between women and men have changed over the decades.

Labour market inequalities and discrimination:
Access to valuable resources on the labour market (wages, management positions, job stability) is clearly linked to social group membership according to gender, nationality, age or education. Our aim is to uncover such inequalities and provide explanations for their occurrence.

Digitisation and the world of work:
Digitisation impacts the world of work and organisations in many ways. Our research focuses on the increasing prevalence of telework/ homeoffice and the use of artificial intelligence in organizations.

Vocational education and training / Further training:
We analyse equality of opportunity when it comes to accessing vocational education and training (VET) systems and investigate careers of VET graduates as well as further training participants.



Bilderquelle: http://www.freepik.com

Publications

- Ebner, C., Haupt, A. & Matthes, B. (eds.) (2020) Berufe und soziale Ungleichheit [Occupations and social inequality]. Springer.
- Ebner, C., Kühhirt, M., Lersch, P. (2020) Cohort Changes in the Level and Dispersion of Gender Ideology after German Reunification: Results from a Natural Experiment. European Sociological Review (online first).
- Ebner, C., Ehlert, M. (2018) Weiterbilden und Weiterkommen? Non-formale berufliche Weiterbildung und Arbeitsmarktmobilität in Deutschland. Kölner Zeitschrift für Soziologie und Sozialpsychologie, 70: 213-235.
- Ebner, C., Helbling, M. (2016) Social distance and wage inequalities for immigrants in Switzerland. Work, employment and society, 30: 436-454.
- Ebner, C. (2015) Labour market developments and their significance for VET in Germany: An overview. Research in Comparative and International Education, 10: 576-592.

Institute Computational Mathematics – AG Algebra und Diskrete Mathematik

Prof. Dr. Bettina Eick

Researcher's Career

- Professor for Mathematics, TU Braunschweig
- Scientific Assistent, University of Kassel
- Scientific Assistent, University of Würzburg
- Scientific Assistent, RWTH Aachen
- PhD at the RWTH Aachen
- Diplom at the RWTH Aachen
- Studies of Mathematics and Computer Science at the RWTH Aachen and the University of London

- Feodor-Lynen Fellow of the Alexander von Humboldt Foundation
- Member of the Council of the computer algebra system GAP
- Member of the Scientific Advisory Board of FIZ Karlsruhe

Funding

DFG, DAAD, Lower Saxony, Alexander von Humboldt Stiftung

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Mission Statement

Algebra is one of the oldest and most central disciplines in mathematics. Our work combines the methods of formal abstract algebra with modern computational methods to advance the research in algebra and its applications.

Research

Group Theory: Groups are the mathematical formalization of symmetries. They play a central role in algebra and have various applications in other areas, as, for example, cryptography or crystallography. We develop new theory and new algorithms to investigate and classify groups. In particular, our research team is well known for the explicit classification of groups of small order.

Computer algebra: Computer algebra is a modern branch of algebra. It seeks to combine the methods of formal abstract algebra with modern tools from computer science to develop efficient algorithms for the investigation of algebraic objects. Our group is a well-established German center for computer algebra. It takes part in the development of the international computer algebra system GAP.

Cryptography: Crytography has been used for thousands of years to transmit secret information. In modern times it is used in many places of our daily life: for example, cryptography is used in ATM cards, computer passwords and electronic commerce. Many crytosystems are based on algebraic concepts and it is a branch of applied algebra to design new cryptosystems and to investigate the established ones. Our work includes the design of new cryptosystems based on group theory.

Cystallography: Crystallographic groups are the symmetry groups of crystals. Their investigation and classification has applications in crystallography. Our work includes the design of algorithms to investigate crystallographic groups with a view towards possible applications in crystallography.

Publications

some selected publications (see www.ams.org/mathscinet for a complete publication list)

- D.F. Holt, B. Eick, E. O'Brien. Handbook of computational group theory. Chapman & Hall 2005 (514 pages)
- B. Eick, Metabelian p-groups and coclass theory. J. Algebra 421, 102-118 (2015)
- B. Eick, A. Hulpke. Computing Hall subgroups of finite groups. LMS J. Comput. Math. 15, 205-218 (2012)
- B. Eick, T. Hofmann, E. O'Brien. The conjugacy problem in GL(n,Z). J. London Math. Soc. 100, 731-756 (2019)
- B. Eick, T. Moede. A nilpotent quotient algorithm for finitely presented associative Z-algebras and its application to inegral group rings. In '75 years of Mathematics of Computation', Math. Comp. (2020)

Institute for Numerical Analysis

Prof. Dr. Heike Faßbender

Researcher's Career

- Head of Institute for Numerical Analysis
- Former Vice President for Teaching, Studies and Further Studies at TU Braunschweig
- Former Dean of Carl-Friedrich-Gauß-Fakultät at TU Braunschweig
- Full Professor for Numerical Mathematics, TU Braunschweig
- Full Professor for Numerical Mathematics, TU München
- Scientific Assistant at University of Bremen
- Habilitation in Mathematics at University of Bremen
- PostDoc at University of Bremen
- Dr. rer.nat. in Mathematics at University of Bremen
- Master of Science in Computer Science at SUNY at Buffalo, NY, USA
- Diplom in Mathematics at University of Bielefeld

Funding

BMBF, DFG, BMWi, Fulbright, Industry

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Mission Statement

The focus of the work of the Institute for Numerical Analysis in research and teaching is on state-of-the art numerical mathematics. It is devoted to the development of novel numerical techniques for the simulation of, for example, physical, engineering and economic processes. We cover all aspects from basic research to easy-to-use software. Our research and development activities are application driven. We cooperate with many different national and international researchers to foster the interdisciplinary exchange and scientific advance.

Research

The common theme of our research is "Numerical Linear Algebra": The following problems are considered to be the standard problems of numerical linear algebra:

- Linear systems of equations: Solve $Ax=b$, where A is a given n-by-n nonsingular real or complex matrix, b is a given column vector of length n, and x is a column vector with n entries that we wish to compute.
- Least squares problems: Compute the vector x that minimizes $\| Ax - b\|_2$ where A is a given m-by-n matrix, b is a given vector of length m, x is of length n, and $\| y\|_2$ is the two-norm of the vector y.
- Eigenvalue Problems: Given an n-by-n matrix A find an n-by-1 vector x and a scalar λ such that $Ax = \lambda x$.

These standard problems often arise in engineering and scientific practise, they are at the heart of most calculations in scientific computing. There are also many variations of these standard problems, e.g.

- Nonlinear eigenvalue problems: $f(\lambda)x = 0$, where f is a given function which depends on some coefficient matrices, e.g., a quadratic eigenvalue problem $f(\lambda) = \lambda^2 M + \lambda C + K$, where the stiffness matrix K and the mass matrix M are real symmetric and positive (semi-)definite and the damping matrix C is real.
- Nonlinear equations $F(x) = 0$ for $F: \mathbb{R}^n \to \mathbb{R}^n$.
- Nonlinear least-squares problem $\|F(x)\| = \min$ for $F: F: \mathbb{R}^n \to \mathbb{R}^n$.
- Matrix equations, like the linear Sylvester equation $AX - XB = C$ or the nonlinear rational discrete-time Riccati equation $X = A^TXA - A^TXB(R + B^TXB)^{-1}B^TXA + Q$.

The applications from which these problems stem come from all kinds of applied sciences; mechanical and electrical engineering as well as medical, pharmaceutical and biological problems. The ever increasing complexity and size of the problems to be solved require a steady progress in developing new algorithms and/or implementations. Especially, the availability of advanced-architecture computers has a significant impact on all fields of scientific computations including algorithm research and software development in numerical linear algebra. New implementations of known algorithms or new algorithms are needed for each new architecture in order to exploit its features.

Publications

- T. Damm, H. Faßbender. Simultaneous hollowisation, joint numerical range, and stabilization by noise. SIAM Journal on Matrix Analysis and Applications, 2020.
- T. Bonin, H. Faßbender, A. Soppa, M. Zäh. A fully adaptive rational global Arnoldi method for the model-order reduction of second-order MIMO systems with proportional damping. Mathematics and Computers in Simulation, Volume 22, pp. 1-19, 2016.
- P. Benner, H. Faßbender. Model Order Reduction: Techniques and Tools in Baillieul, Samad (Eds.), Encyclopedia of Systems and Control, Springer ISBN 978-1-4471-5057-2 (Print), ISBN 978-1-4471-5102-9 (Online), pp. 1-10, 2014.
- H. Faßbender. Structured Eigenvalue Problems - Structure-Preserving Algorithms, Structured Error Analysis in Handbook of Linear Algebra, Second Edition, CRC Press, Taylor and Francis Group, Chapter 63, 22 Seiten, 2014.
- A. Vendl, H. Faßbender, S. Görtz, R. Zimmermann, M. Mifsut. Model Order Reduction for Steady Aerodynamics of High-Lift Configurations. CEAS Aeronautical Journal, Volume 5, Issue 4, pp. 487-500, 2014.

Institute of Operating Systems and Computer Networks

Prof. Dr. Sándor Fekete

Researcher's Career
- Full Professor for Computer Science, TU Braunschweig
- Associate Professor for Mathematics, TU Braunschweig
- Associate Professor for Mathematics, TU Berlin
- Scientific Assistant at the Center for Parallel Computing, University of Cologne
- Postdoc at Stony Brook University, USA
- Ph.D. at the University of Waterloo, Canada, Department of Combinatorics and Optimization
- Studies of Mathematics and Physics, University of Cologne

Funding
DFG, BMBF, EU, Industry

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Mission Statement
Algorithms and optimization are the core of our modern digital world. Our work combines state-of-the-art fundamental research in theoretical computer science with a wide range of interdisciplinary cooperations with areas such as robotics, distributed systems, electrical engineering, traffic management, biology and economics.

Research
Computational geometry: Our group has grown into one of the leading German centers for computational geometry, a branch of computer science devoted to the study of algorithms dealing with geometry. This includes problems arising from explicitly geometric settings, such as motion planning, geographic information systems, or computer graphics. Our specialty are approximation algorithms for NP-hard geometric problems, as well as exact methods.

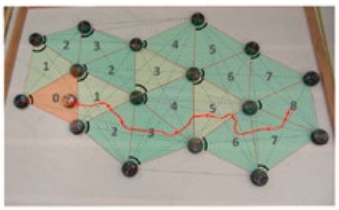
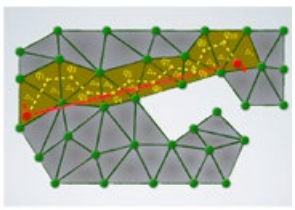
Robot navigation: An algorithmic application area with particularly strong interaction between theory and practice arises from exploring, searching or mapping of a geometric region by one or many autonomous devices. We have developed a range of new algorithmic approaches for a wide spectrum of challenges.

Graph algorithms: Many optimization problems can be formulated in a discrete setting, often by generalizing geometric problems to more abstract scenarios. On the other hand, discretizing continuous geometric setups often leads to a simplified problem. We have made a number of significant contributions to the relationship between geometric and graph problems, in particular to the theory of algorithmic complexity.

Distributed algorithms: While traditional algorithms consider single processors, many new challenges in our modern world arise from combining the local information and local actions of many processors. We continue to make contributions to many related areas, e.g., to distributed sensor networks, which combine the limited capabilities of numerous sensors and actors.

Algorithmics of self-organization: Dealing with many small collaborating agents ultimately leads to the algorithmic theory of programmable matter. We have made a number of contributions to the theory of tile self-assembly, which is based on using DNA as building material. Other recent work considers programming huge particle swarms.

Game theory: How can we understand and improve collaboration between selfish agents? This is a recent research area.

Publications

- A.T. Becker, S.P. Fekete, P. Keldenich, D. Krupke, C. Rieck, C. Scheffer, and A. Schmidt. Tilt Assembly: Algorithms for Micro-Factories that Build Objects with Uniform External Forces. In: Algorithmica, 82(2), pp. 65-187, 2020.
- E.D. Demaine, S.P. Fekete, P. Keldenich, H. Meijer, C. Scheffer. Coordinated Motion Planning: Reconfiguring a Swarm of Labeled Robots with Bounded Stretch. SIAM Journal on Computing, Vol. 48, No. 6, pp. 1727-1762, 2019.
- S.P. Fekete, S. Morr, C. Scheffer. Split Packing: Algorithms for Packing Circles with Optimal Worst-Case Density. Discrete and Computational Geometry, 61(3), 2019, pp. 562-594.
- A. Becker, E.D. Demaine, S. P. Fekete, J. Lonsford, R. Morris-Wright. Particle Computation: Complexity, Algorithms, and Logic. Natural Computing, 18(1), 2019, pp. 181-201.
- Z. Abel, V. Alvarez, E.D. Demaine, S. Fekete, A. Gour, A. Hesterberg, P. Keldenich, C. Scheffer. Conflict-Free Coloring of Graphs. SIAM Journal on Discrete Mathematics, 32(4), 2018, pp. 2675-2702.

Institute of Marketing

Prof. Dr. Wolfgang Fritz

- Director of the Institute of Marketing at TU Braunschweig
- Head of the Department of Business Administration and Economics at TU Braunschweig
- Director of the international dual degree master program "MiBA/ToM – Braunschweig-St. Petersburg, Russia" at TU Braunschweig

Researcher's Career

- Full Professor of Marketing at TU Braunschweig
- Honorary Professor at University of Vienna, Austria
- Associate Professor of Marketing at Hamburg University of Economics and Politics
- Ph.D., Habilitation, and Venia Legendi for Business Administration at University of Mannheim
- Research Assistant and Lecturer at the Marketing Department, University of Mannheim
- Studies of Business Administration and Economics at University of Mannheim

Funding

DAAD, BMBF, Industry

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Mission Statement

Our mission is to research empirically relevant perspectives of market-oriented management of firms that are of scientific as well as practical importance. Our research is internationally oriented and uses advanced data analysis techniques.

Research

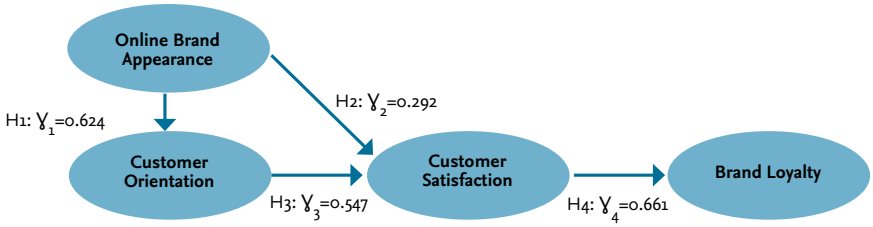
Brand Management: Our large-scale empirical research on brand relationships in the Business-to-Consumer (B2C) area shows four generic types of consumer-brand relationships: "Best friendship", "unemotional purpose-based relationship", "loose contact", and "happy partnership". Against this background, the brand-positioning strategies of firms can be evaluated. Another subject is the online brand communication in Business-to-Business (B2B) settings. According to our findings, online brand communication supports the positive impact of customer satisfaction on brand loyalty of industrial customers.

Online and Mobile Marketing: Since 1997, many topics of Internet marketing have been researched empirically. For example, we have analyzed the satisfaction of consumers within multi-channel marketing systems of retailers during the steps of the consumers' decision process. In addition, research on mobile marketing activities on smartphones and tablets are carried out. We address research questions involving topics like mobile shopping, mobile advertising, and mobile market research. In particular, the impact of mobile online shop atmospherics and complexity on consumers' behavior are analyzed by using experimental designs.

Sustainability: Sustainability represents an important guideline for future-oriented marketing and management. We have introduced and empirically validated a multidimensional concept and scale of sustainable consumption. Furthermore, we have empirically identified important drivers as well as consequences of sustainable consumption for firms, consumers (e.g., anti-consumption), and society as a whole.

Intercultural Communications: Intercultural challenges for business communications between German and Chinese managers are empirically researched in cooperation with international partners, as well as the impact of global educational tools on intercultural awareness and sensitivity of business students in Germany, USA, Russia, and China.

B2B Online Brand Communication and Brand Loyalty (Fritz & Wille-Baumkauff, 2016)



Publications

- W. Fritz, B. Seegebarth, & S. Sohn (Eds.), "Mobile Marketing", Special Issue, Psychology & Marketing, Hoboken, NJ, Wiley, USA, 2017.
- W. Fritz & B. Wille-Baumkauff, "B2B Online Brand Communication and Brand Loyalty", Proceedings of the 2016 Global Marketing Conference, Hong Kong, China, 2016.
- W. Fritz, S. Sohn & B. Seegebarth, "Broadening the Perspective on Mobile Marketing", Psychology & Marketing, Vol. 34, No. 2, pp. 113-118, USA, 2017.
- I. O. Trushnikova, W. Fritz, N. Mundorf, & W. Lu, "Online Debates as a Tool to Promote Global Awareness of Culture and Sustainability in Business and Communication", China Media Research, Vol 11 (4), pp. 100-109, East Lansing, MI, USA, and Hangzhou, Zhejiang, China, 2015.
- S. Sohn, E. Karampournioti, K.-P. Wiedmann & W. Fritz, "Sources of the Many Faces of Emotional Smartphone Attachment: A Value-in-Use Perspective", Computers in Human Behavior, Amsterdam, Elsevier, The Netherlands, 2021 (forthcoming).

Institute of Finance

Prof. Dr. Marc Gürtler

Researcher's Career
- Full Professor of Finance, TU Braunschweig
- Habilitation, RWTH Aachen University
- Assistant Professor at the School of Business and Economics, RWTH Aachen University
- Assistant Professor at the Department of Economics, University of Bonn
- Dr. rer. pol., University of Bonn
- Scientific Assistant at the Department of Economics, University of Bonn
- Scientific Assistant at the Mathematical Institute Cologne, University of Cologne
- Studies of Mathematics, University of Cologne

Funding
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Mission Statement

Our mission is to expand knowledge and understanding of financial risks. We investigate potential risk drivers as well as market behavior and develop methods to assess and control risks in financial institutions and economics.

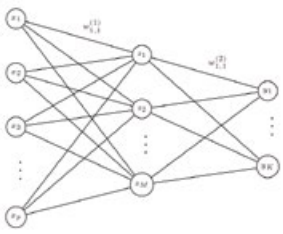
Research

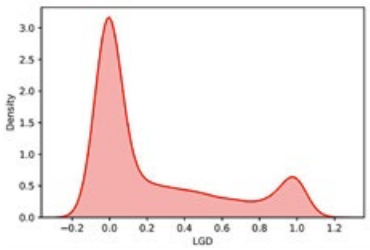
Credit Risk: The emergence of the last global financial crisis can be attributed to the poor incentive for banks to carefully select borrowers and their monitoring. This is due to the fact that banks resold large volumes of loans immediately after they were granted in the form of asset-backed securities without participating in subsequent loan defaults. An important regulatory measure was the introduction of a mandatory risk deductible to alleviate the incentive problem. We examine how the design of the deductible can optimally resolve the trade-off between monitoring incentive and risk transfer. In addition, we investigate how banks can accurately assess and estimate borrowers' default risks before granting a loan.

Machine learning methods in Finance: Empirical models for forecasting in finance are predominantly based on linear regression models, whose strength lies in the interpretability of the relationship between the variables in the model, but whose forecasting accuracy is sometimes quite low. In this context, machine learning methods represent a potentially valuable tool to achieve more accurate forecasts, as they allow a large number of possible model specifications compared to conventional methods. Therefore, we compare different machine learning models and linear regression models with respect to their forecasting performance in different areas of finance.

Catastrophe Risk: The increasing frequency and severity of catastrophic events confront (re-) insurance companies with new challenges. In the context of financial risk management, we investigate catastrophe (CAT) bonds empirically and theoretically as an alternative risk transfer instrument. CAT bonds offer the possibility of transferring underwriting risk from the insurance markets to the capital markets and thus alleviating availability problems on the insurance markets.

Labor Market Signaling: There are various events (e.g., a promotion) that lead to an adjusted assessment of employee abilities in the labor market. We investigate different events that can serve as information signals to gain an understanding of the information transfer in the labor market and, on this basis, to be able to provide recommendations for action for companies and policy makers. We analyze these issues both theoretically in equilibrium models and empirically, using data from European soccer leagues.





Publications

- Deutscher, C., Gürtler, M., Gürtler, O., DeVaro, J. (2020): Firm Choice and Career Success - Theory and Evidence, European Economic Review, Vol. 127, 103470.
- Hibbeln, M., Norden, L., Usselmann, P., Gürtler, M. (2020): Informational Synergies in Consumer Credit, Journal of Financial Intermediation, Vol. 44, 100831.
- Götze, T., Gürtler, M. (2020): Risk Transfer and Moral Hazard: An Examination on the Market for Insurance-Linked Securities, Journal of Economic Behavior and Organization, Vol. 180, pp. 758-777.
- Götze, T., Gürtler, M., Witowski, E. (2020): Improving CAT Bond Pricing Models via Machine Learning, Journal of Asset Management, Vol. 21, pp. 428-446.
- Gürtler, M., Gürtler, O. (2019): Promotion signaling, discrimination, and positive discrimination policies, RAND Journal of Economics, Vol. 50, pp. 1004-1027.
- Gürtler, M., Hibbeln, M., Usselmann, P. (2018): Exposure at Default Modeling - A Theoretical and Empirical Assessment of Estimation Approaches and Parameter Choice, Journal of Banking and Finance, Vol. 91, 2018, pp. 176-188.

Peter L. Reichertz Institute for Medical Informatics (PLRI)

Prof. Dr. Reinhold Haux

- Past Executive Director of PLRI (2007-2017)
- Fellow, International Academy of Health Sciences Informatics (2017)
- Honorary Member, International Medical Informatics Association (2010)
- Member, Braunschweig Scientific Society (2009)
- Adjunct Faculty, Hannover Medical School (2008)
- Honorary Professor, University of Heidelberg (2002)
- Fellow, American College of Medical Informatics (1999)

Researcher's Career

- Full Professor of Medical Informatics, Department of Computer Science, TU Braunschweig
- Full Professor of Medical Informatics at UMIT, Hall in Tyrol, President of UMIT
- Full Professor of Medical informatics, Medical Faculty, University of Heidelberg
- Associate Professor of Medical informatics, Medical Faculty, University of Tübingen
- Ph.D. at the University of Ulm
- Studies of Medical Informatics, University of Heidelberg and University of Applied Sciences Heilbronn

Funding

BMBF, DFG, Deutsche Rentenversicherung, State of Lower Saxony

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Mission Statement

Informatics in medicine and health care contributes significantly to high-quality as well as affordability of healthcare for people worldwide. PLRI, a joint institute of TU Braunschweig and Hannover Medical School, carries out research and education in this key and exciting field.

Research

We collaborate in interdisciplinary projects with health care centers, research institutes, enterprises and public organizations in order to shape the future of healthcare and medicine. Our activities range from the local level, as with institutions in Braunschweig and Hannover, to regional, national, and global levels involving the World Health Organization. My main research fields are:

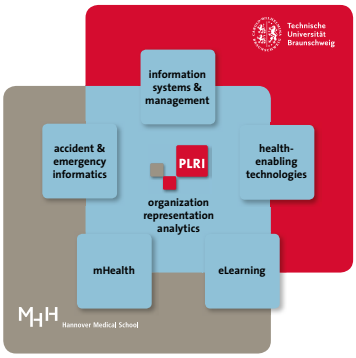
Health-Enabling Technologies: We are engaged in the development and analysis of information and communication technologies for creating sustainable conditions for self-sufficient and self-determined lifestyles. Health-enabling and ambient assistive technologies (AAL technologies) for new methods of living and health care play a major role. Research includes methods for pervasive computing for prevention, diagnosis and therapy, development and investigation of sensor technology as well as their appropriate embedding in health information systems.

Health Information Systems and Management: We are working on information system architectures and infrastructures as well as information management strategies for trans-institutional health information systems. Research includes the analysis, application and further development of information management principles for planning, monitoring, analysis and evaluation of cooperative structures and processes in health care, design and implementation of applications for patient-centered shared care as well as for management of health care networks, analysis and further development of methods for the strategic management of information systems (e.g. eHealth strategies).

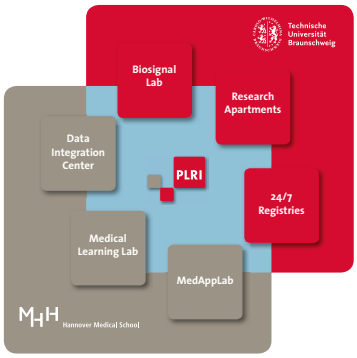
Medical Data Management: Analysis and representation of medical data.

Synergy and Intelligence: Extended interaction of living and non living entities.

For more information on PLRI's research fields please visit www.plri.de.



PLRI is a joint Institute of TU Braunschweig and Hannover Medical School focusing on organization, representation, and analytics of data in five method-related research areas.



PLRI runs six labs to foster process-related research. The research apartments are real homes with real humans, which spread over the City of Braunschweig.

Publications

- Haux R. Health Information Systems – Past, Present, Future. Int J Med Inform. 2006; 75: 268-81.
- Haux R. On Determining Factors for Good Research in Biomedical and Health Informatics. Some Lessons Learned. Yearb Med Inform. 2014; 9: 255-64, discussion 265-72.
- Haux R, Hein A, Kolb G, Künemund H, Eichelberg M et al; Lower Saxony Research Network GAL. Information and Communication Technologies for Promoting and Sustaining Quality of Life, Health and Self-sufficiency in Ageing Societies – Outcomes of the Lower Saxony Research Network Design of Environments for Ageing (GAL). Inform Health Soc Care. 2014; 39: 166-87.
- Haux R, Koch S, Lovell NH, Marschollek M, Nakashima N, Wolf KH. Health-Enabling and Ambient Assistive Technologies: Past, Present, Future. Yearb Med Inform. 2016; Suppl 1: S76-91.
- Winter A, Haux R, Ammenwerth E, Brigl B, Hellrung N, Jahn F. Health Information Systems – Architectures and Strategies. London: Springer. 2011.

Institute of International Relations (IIR)

Department for the Social Sciences

Prof. Dr. Anja P. Jakobi

- Professor of Political Science and International Relations

Researcher's Career

- Professor of International Relations, TU Braunschweig
- Senior Lecturer/Associate Professor, Royal Holloway, University of London, UK
- Senior Researcher, Leibniz-Institute Peace Research Institute Frankfurt
- Research and teaching positions at the universities of Bielefeld, Bremen, Darmstadt, Frankfurt, Giessen
- Visiting researcher at the universities of Bristol, UK, and Stanford, US

- Higher Doctorate (Habilitation) TU Darmstadt
- PhD University of Bielefeld
- MA (Dipl.-Pol.) Free University of Berlin

Funding

BMBF, DAAD, DFG, ISA, ECPR, EU, ZIF Bielefeld

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Mission Statement

We analyze international institutions, organizations and norms and how they relate to state and non-state actors. Our specialization is the governance of global crime, of non-traditional security threats and of illegal markets. We develop novel theoretical explanations with an empirical focus, including interdisciplinary perspectives and links to policy and application.

Research

Global Crime Governance: Global crime governance is today manifested in national and international agendas, the proliferation of global regulations, growing international budgets, and the enlarged mandates of international organizations. Analyzing cases like human trafficking, corruption, cybercrime or money laundering, this research strand examines the conditions under which global crime governance emerges, the institutional design it takes and the impact it has.

The Governance of Global Illegal Markets: Illegal markets show commonalities with legal market mechanisms and a significant overlap, making the prevention of transactions across legal and illegal market spheres a central task of governance. Yet, we face huge institutional variance from completely state-based forms of governance to completely private regulations. By comparing different cases of illegal markets and the public-private interplay in governing them, we aim to resolve the question of why specific forms are established and how this impacts on the overall governance aim**.**

Non-Traditional Security Threats: Criminals and gangs, rebels or hackers are increasingly defined as new types of security threat and have become a central concern in world politics. At the same time, issues like climate change, water scarcity or weak governance capabilities have been identified as potential triggers of conflict. Our research in this field analyses the impact of these actors and issues on the societal, national and international order.

Global Governance, International Institutions and Policy Diffusion in World Society: Our different research strands feed into research on the current state of international affairs and world society. We are interested in the systematic exploration of norms and policies on the international level and of the actors involved in promoting or implementing them. This includes research on global governance and international organizations, transnational governance, global norms and policy diffusion.

Selected Publications

- Anja P. Jakobi (2020) Crime, Security and Global Politics. An Introduction to Global Crime Governance. London: Palgrave Macmillan/Red Globe Press.
- Anja P. Jakobi (2021) Informal Markets. In: L. Seabrooke & J. Pevehouse (Hrsg.) The Oxford Handbook of the International Political Economy. Oxford: Oxford University Press, forthcoming.
- Anja P. Jakobi & Katharina Mann (eds.., 2020) Forum: Ethik und Methoden in den Internationalen Beziehungen. In: Zeitschrift für Internationale Beziehungen 27(2).
- Anja P. Jakobi & Bastian Loges (2021) Urbanising Norms? Cities as Local Amplifiers in Global Norm Dynamics on HIV/AIDS Policies. In: Journal of International Relations and Development, forthcoming.
- Bastian Loges & Anja P. Jakobi (2020) Not More Than the Sum of its Parts: De-Centered Norm Dynamics and the Governance of Plastics. In: Environmental Politics, 29(6) 1004-1023.

Institute for Application Security (IAS)

Prof. Dr. Martin Johns

Researcher's Career

- Full Professor of Computer Science, TU Braunschweig
- Research Expert, SAP SE
- Research Associate, Universities of Passau and Hamburg
- PKI Developer, TC Trustcenter
- Software Engineer, Infoseek Germany
- Software Engineer, Acht:G
- Studies of Computer Science and Mathematics, Universities of Göttingen, Hamburg and UC Santa Cruz (CA), USA

Funding

BMBF, EU, DFG, industry

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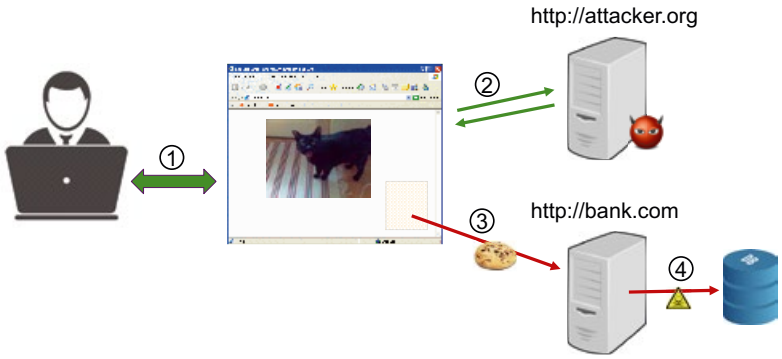
Mission Statement

The Institute of Application Security is interested in the full spectrum of security and privacy that exist on the application level. This includes the detection of vulnerabilities in source code or protocols, identification of novel security issues, and the creation of procedures and tools to prevent future vulnerabilities.

Research

Attack resilient systems: Insecure programming is the root of most security problems nowadays. However, the past has shown that the current approach of developer awareness and training is not sufficient to address this problem. Instead IAS actively researches methods to create systems which are resilient against whole classes of attacks, either via removing necessary preconditions, which enable the corresponding vulnerabilities in the first place, or through transparent mitigation of potential attacks. Regardless of the underlying defensive approach, the shared objective of these research activities are systems that do not depend on the security expertise of the developers to be secure.

Web Security: Since its inception in 1989, the WWW has evolved to be the dominant platform for large scale distributed applications. However, the evolution of the web platform is far from finished: In the recent past, the Web's client side gained various powerful new capabilities, browsers left the strict client/server paradigm and can now communicate directly in a peer-to-peer fashion, and through emerging operating systems, such as ChromeOS, client-side web technologies have left the confines of the web browser. Each new web technology increases the significant complexity of the platform and the consequences of the novel capabilities in respect to the overarching security model are often not foreseeable: New components may negate established security assumptions, new security mechanisms might be incomplete, or new capabilities may enable new, previously impossible attack methods. For this reasons, it is of paramount importance to actively monitor the ongoing development of the platform and evaluate the security implications of the novel additions to the paradigm in an overarching context. IAS constantly surveys the Web platform via ongoing large scale studies to uncover new and emerging security problems, followed by developing dedicated fundamental techniques to address the identified security issues.



Publications

- Marius Musch, Marius Steffens, Sebastian Roth, Ben Stock, and Martin Johns: ScriptProtect: Mitigating Unsafe Third-Party JavaScript Practices, in ACM Asia Conference on Computer and Communications Security (ASIACCS '19), July 2019
- Sebastian Lekies, Krzysztof Kotowicz, Samuel Groß, Eduardo Vela, Martin Johns: Code-reuse attacks for the Web: Breaking Cross-Site Scripting Mitigations via Script Gadgets, in 24th ACM Conference on Computer and Communications Security, 2017 (CCS 2017), November 2017
- Sebastian Lekies, Ben Stock, Martin Wenzel and Martin Johns: The Unexpected Dangers of Dynamic JavaScript, in 24th USENIX Security Symposium (USENIX Security '15), August 2015
- Ben Stock, Sebastian Lekies, Tobias Mueller, Patrick Spiegel und Martin Johns: Precise Client-side Protection against DOM-based Cross-Site Scripting, in 23rd USENIX Security Symposium (USENIX Security '14), August 2014
- Martin Johns, Sebastian Lekies, Ben Stock: Eradicating DNS Rebinding with the Extended Same-Origin Policy, in 22nd USENIX Security Symposium (USENIX Security '13), August 2013

Peter L. Reichertz Institute for Medical Informatics (PLRI)

Division Data Science in Biomedicine

Prof. Dr. Tim Kacprowski

Researcher's Career

- Professor for Data Science in Biomedicine, Department of Computer Science, TU Braunschweig
- Group Leader at Technical University of Munich
- Postdoc at University of Southern Denmark
- Dr. rer. nat. at University of Greifswald
- Study of Bioinformatics / Computational Molecular Biology

Funding

BMBF, DZHK, Industry

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Mission Statement

The overarching goal of our research is to understand molecular mechanisms behind human diseases and to translate data science techniques into improved healthcare. After joining PLRI and BRICS, our research bridges computer science and life sciences, and joins bioinformatics with medical informatics.

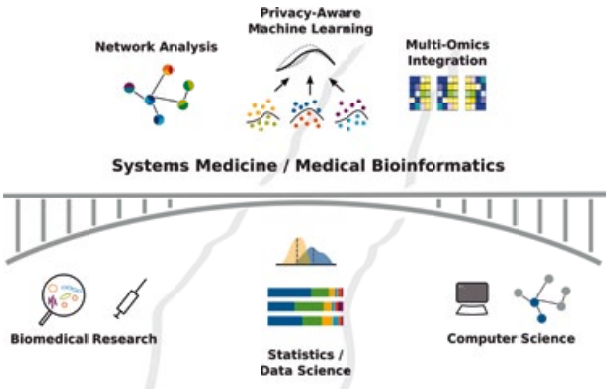
Research

Modern omics technologies are rapidly becoming cheaper, more exhaustive, and more precise. There is an immense growth in public databases on molecular interactions, comorbidities, drug effects, etc. Integrative bioinformatics methods can leverage this situation to change future clinical decision-making. We develop network-biology and machine learning methods complementing (multi-)omics studies.

Among important research goals of **systems medicine** are mechanistic understanding of diseases, drug repurposing, and the identification of novel disease subtypes. Systems medicine is highly inter-disciplinary and can only strive when biologists, clinicians, and computer scientists work closely together. We develop systems medicine approaches for de novo patient stratification elucidating common molecular features within and across diseases. To this end, we develop and apply **machine learning techniques in concert with network-biology**.

We also apply and develop strategies for **biomarker mining** and molecular data analysis. A recent focus lies on statistical and network-aided methods for **genetic epidemiology**, in particular the detection of epistasis, i.e. the interaction of multiple genetic markers.

Since medical data needs particularly strict protection, we investigate approaches for **federated machine learning**, which allow for analyzing large distributed data sets, without having to share any primary data with other parties.



Our research bridges computer science and life sciences, employing data science focussed methods from and applying them to diverse scientific disciplines.

Publications

- Blumenthal DB, Baumbach J, Hoffmann M, List M, Kacprowski T. A framework for modeling epistatic interaction. Bioinformatics [Internet]. 2020 Nov 30; http://dx.doi.org/10.1093/bioinformatics/btaa990
- Lazareva O, Canzar S, Yuan K, Baumbach J, Blumenthal DB, Tieri P, List M, Kacprowski T. BiCoN: Network-constrained biclustering of patients and omics data. Bioinformatics [Internet]. 2020 Dec 26; http://dx.doi.org/10.1093/bioinformatics/btaa1076
- Louadi Z, Yuan K, Gress A, Tsoy O, Kalinina OV, Baumbach J, List M, Kacprowski T. DIGGER: exploring the functional role of alternative splicing in protein interactions. Nucleic Acids Res. 2021 Jan 8; 49(D1):D309–18; https://doi.org/10.1093/nar/gkaa768
- Sadegh S, Matschinske J, Blumenthal DB, Galindez G, Kacprowski T, List M, et al. Exploring the SARS-CoV-2 virus-host-drug interactome for drug repurposing. Nat Commun. 2020 Dec;11(1):3518–3518. http://dx.doi.org/10.1038/s41467-020-17189-2
- Kacprowski T, Bouter Y, Weissmann R. Deciphering the molecular profile of plaques, memory decline and neuron loss in two mouse models for Alzheimer's disease by deep sequencing. Frontiers in aging [Internet]. 2014; https://www.frontiersin.org/articles/10.3389/fnagi.2014.00075/full

Department of Social Sciences – Sociology

Prof. Dr. Dirk Konietzka

- Chair Social Structure and Empirical Research Methods

Researcher's Career

- Full Professor of Sociology, TU Braunschweig
- Habilitation, Bremen University
- Senior Lecturer at Bielefeld University
- Researcher at Max Planck Institute for Demographic Research, Rostock
- Research Assistant at Rostock University
- Dr. phil., FU Berlin
- Doctoral Student at Max Planck Institute for Human Development, Berlin
- Study of Sociology at Hamburg University

Funding

DFG, BMUB, BMVI

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Mission Statement

Studying life course dynamics and cohort change is crucial to understand social inequality in contemporary society. We focus on educational transitions, labor market careers and family dynamics, applying a wide range of research methods. Our research primarily rests on large-scale longitudinal survey data and official microdata.

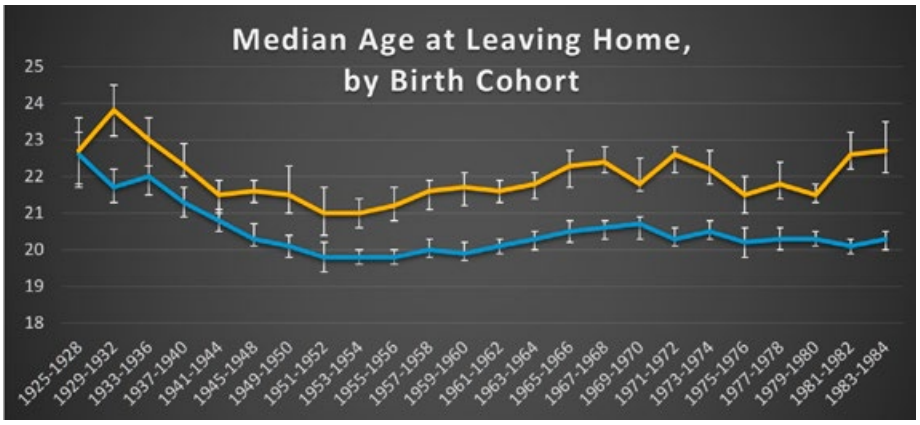
Research

Family Dynamics in Germany and Europe: We analyze family dynamics, living arrangements and the socio-economic backgrounds of family behavior in contemporary Germany and Europe. We focus on demographic processes, such as leaving home, family formation and childlessness in the life course. We analyze long-term cohort change as well as persisting differences in demographic behavior between East and West Germany.

Standardization and De-Standardization of the Life Course: Life Courses in contemporary society are structured by complex patterns of states and transitions in different life domains. While most empirical research is concerned with single transitions, our research focuses on sequence patterns and pathways within the life course. We review and further develop methods of sequence data analysis, which we apply to analyze social change of life course patterns in European societies.

Occupational and Class Mobility: We use micro-census data to assess social discrepancies in labor market opportunities for women and men, natives and migrants from the 1970s to present in Germany.

Chains of Mobility in Everyday Life: An aging society and increasing social discrepancies between and within regions make it necessary to develop new concepts of intermodal mobility that help to improve social participation over the life course. Our research focuses on modes of integration of public transport with pedestrian and bicycle traffic. We analyze patterns of mobility in private households, particularly focusing on how elderly integrate different modes of transport in their daily lives.



Publications

- Konietzka, D., Feldhaus, M., Kreyenfeld M, Trappe, H. (2021): Family and Intimate Relationships. In: B. Hollstein et al. (Eds): Soziologie - Sociology in the German-speaking world. Special Issue Soziologische Revue 2020: 99-115.
- Zimmermann, O., Konietzka, D. (2020): Die Heterogenität familialer Lebensverläufe. Kölner Zeitschrift für Soziologie und Sozialpsychologie 72: 651-680.
- Konietzka, D., Tatjes, A. (2018): "Hotel Mama" revisited. Stabilität und Wandel des Auszugs aus dem Elternhaus im langfristigen Kohortenvergleich. Kölner Zeitschrift für Soziologie und Sozialpsychologie 70: 105-129.
- Zimmermann, O., Konietzka, D. (2018): Social Disparities in Destandardization. Changing Family Life Course Patterns in Seven European Countries. European Sociological Review 34: 64-78.
- Kreyenfeld, M, Konietzka, D. (Eds), 2017: Childlessness in Europe. Contexts, Causes, and Consequences. Springer.

Institute for Partial Differential Equations

Prof. Dr. Dirk Langemann

Researcher's Career

- Professor for Mathematical Modeling and Applied Analysis, TU Braunschweig
- Postdoc, University of Lübeck
- Scientific Assistant, Universitary Clinic Schleswig-Holstein
- Dr. habil., Rostock University, University of Lübeck
- Dr. rer. nat., Rostock University
- Study of Mathematics, Rostock University, Université de Rennes, France

Funding

DFG, EU, Industry

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Mission Statement

Mathematical modeling is the bridge between theoretical research and applied problems. Particularly, the life sciences look forward to gaining insight into complex mechanisms by means of mathematical methods. The intrinsic uncertainty of life-science applications feeds back to the development of appropriate mathematical methods.

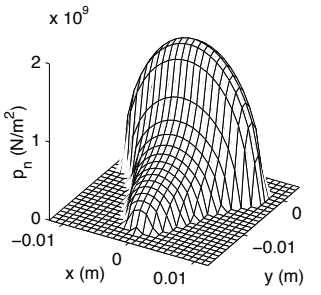
Research

Modeling of the chronification of liver infections: The interaction between pathogens and the immune response can be described as locally resolved predator-prey systems. Mathematical properties of the resulting reactions-diffusions equations mirror medical properties, e.g. the chronification of infections is related to the existence of non-trivial stationary solutions. The mathematical model allows in-silico experiments for the development of therapeutic approaches.

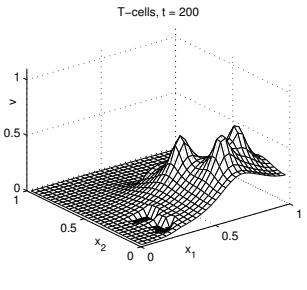
Multi-gene loci models of metabolic resistance: Resistant pathogens and resistant weeds are severe problems in agriculture and medicine. Modeling the development of metabolic resistances requires the combined description of population growth and inheritance. Our tensor product approach allows the automated generation of ordinary differential equations for the population size of each biotype depending on arbitrary many gene-loci and opens the door for a mathematical analysis of this combined process.

Models of mathematical modeling: Mathematical modeling itself is widely applied as a process but rarely analyzed. Particularly, life science applications lead to questions of model selection, robust model components and hierarchical model families. Beside epistemological questions, models of the mathematical modeling process help to discuss and evaluate models and augment their acceptance in new areas.

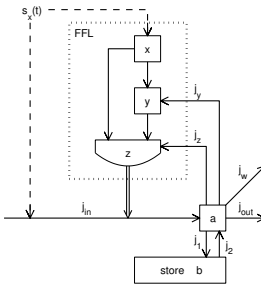
Communicative aspects of teaching: Teaching in lectures with a large number of students leads to the discussion of its communicative aspects. The analysis of present individual conceptions allows an adaptation in, and improvement of, the communication with the heterogeneous students.



normal pressure in a rail-wheel contact



T-cell population in a chronic infection



supply chain with aerobic and anaerobic metabolisation

Publications

- L. Roselius, D. Langemann, J. Müller, B. Hense, S. Filges, D. Jahn, R. Münch, Modeling and analysis of gene-regulatory feed-forward loop with basal expression of the second regulator, J. Theor. Biol. 363, 290-299, 2014
- D. Langemann, O. Richter, A. Vollrath, Multi-gene-loci inheritance in resistance modeling, Math. Biosci. 242, 17-24, 2013
- B. Kubera, A. Bosy-Westphal, A. Peters, W. Braun, D. Langemann, S. Neugebohren, M. Heller, M.J. Müller, Energy allocation between brain and body during ontogenetic development, Am. J. Hum. Biol. 25, 725-732, 2013
- H.-J. Kerl, D. Langemann, A. Vollrath, Reaction-diffusion equations and the chronification of liver infections, Math. Comput. Simulat. 82, 2145-2156, 2012
- K. Frischmuth, D. Langemann, Numerical calculation of wear in mechanical systems, Math. Comput. Simulat. 81, 2688-2701, 2011

Institute of Economics

Prof. Dr. Christian Leßmann

- Professor of Economics, TU Braunschweig
- Research Professor, Ifo Institute – Leibniz Institute for Economic Research at the University of Munich
- Member, CESifo Research Network

Researcher's Career

- Professor of Economics, in particular Development Economics, FAU Erlangen-Nuremberg
- Dr. rer. pol. habil., TU Dresden
- Visiting Researcher, Simon Fraser University, B.C.
- Dr. rer. pol., TU Dresden
- Junior Researcher and PhD candidate, Ifo Institute Dresden Branch
- Studies of Economics, Leibniz University Hanover

Funding

MWK, DFG, DAAD, Deutsche Bundesbank Regional Office Bremen, Lower Saxony, and Saxony-Anhalt, Braunschweiger Landes-sparkasse

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Mission Statement

Economic theory is useful for a better understanding of global, national and local issues that confront our societies. We aim to contribute to the scientific discussion on the fundamental determinants of long-run economic and human development. Our ultimate goal is to give evidence-based scientific policy advice.

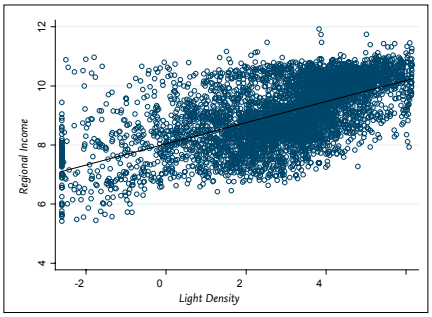
Research

The Institute of Economics employs theory-based empirical research on several topics related to economic development. We use state-of-the-art econometric methods to investigate the fundamental determinants of economic and human development. We focus on, amongst others, the development of units smaller than national states suchs as regions or ethnicities.

One main innovation of our research is to use physical data such as satellite night-time lights, energy network load or traffic data on ships, airplanes, and trucking to construct objective indicators for economic development. We aim to investigate economic issues at levels of disaggregation, where reliable statistical data does not exist.

Our research interests are:

- Development Economics
- Public Economics
- Political Economy
- Environmental and Resource Economics
- Economic Geography



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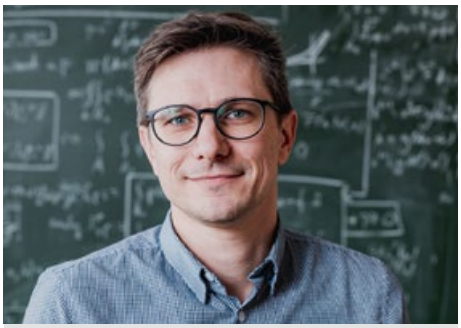
Publications

- Hirte, G., Lessmann, C. & Seidel, A. (2020) International Trade, Geographic Heterogeneity and Interregional Inequality, European Economic Review
- Määttä,I. & Lessmann, C. (2019) Human Lights, Remote Sensing 11(19), 2194
- Fabian, M., Sofke, T. & Lessmann, C. (2019) Natural Disasters and Regional Development – The Case of Earthquakes, Environment and Development Economics 24(5), 479-505, 2019
- Lessmann, C. & Steinkraus, A. (2019) The Geography of Natural Resources, Ethnic Inequality and Civil Conflict, European Journal of Political Economy 59, 33-51
- Achten, S., Beyer, L., Dietrich, A.-M., Ebeling, D., Lessmann, C. & Steinkraus, A. (2019) Large Scale Infrastructure Investment and Economic Performance – A Case Study of Oresund, Applied Economics Letters 26(1), 2019, 21-26

Institute for Analysis and Algebra – AG Inverse Problems and Imaging



Prof. Dr. Dirk Lorenz

Researcher's Career

- Full Professor for Applied Analysis, TU Braunschweig
- Research Fellow at the Institute for Pure and Applied Mathematics, Los Angeles
- Assitant Professor for Applied Analysis, TU Braunschweig
- Post-Doctoral researcher at the Center for Industrial Mathematics, University of Bremen
- Phd in Mathematics, University of Bremen

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Mission Statement

In inverse problems one tries to obtain reliable information from indirect observations. We analyze inverse problems and develop mathematical models to overcome their inherent instability. We use and develop large scale optimization methods and learning algorithms and apply our techniques to problems from imaging, engineering and life science.

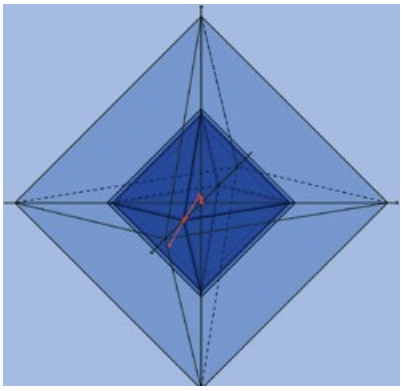
Research

Regularization of inverse ill-posed problems: Inverse problems often have annoying properties: solutions need not exist or may be unstable with respect to perturbations in the data. This calls for new notions of "solutions" and also for "regularization". We develop and analyze such methods to obtain solution algorithms that even come with error estimates in the case of ill-posedness. Recent fields of research include sparse regularization and regularization in measure spaces.

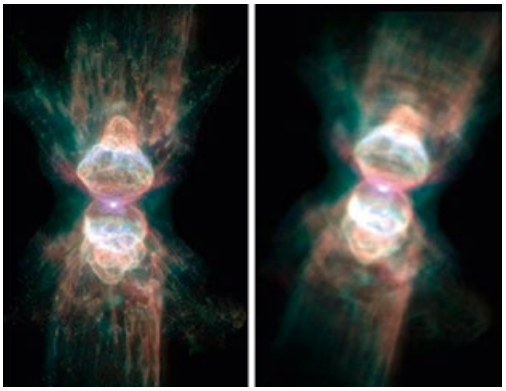
Mathematical imaging: We use mathematics to describe and develop methods to manipulate images. We are primarily concerned with low level vision, e.g. with methods for noise removal, deblurring, image decomposition or inpainting. We use, for example, variational methods and tools from optimal transport.

Convex optimization: Inverse problems and problems in imaging often lead to convex optimization problems with millions of variables. We develop computational methods that can scale up to these large numbers and can run with low memory demands.

Applications in life science and engineering: We are curious to apply our methods in other sciences. This has been done successfully in computer graphics, measurement technology, pharmacology or astronomy, for example.



The solution path of a convex optimization problem.



Three dimensional reconstruction of a planetary nebula (joint work with the Computer Graphics Lab, TU Braunschweig).

Publications and Patents

- Quadratically regularized optimal transport, Dirk A. Lorenz, Paul Manns und Christian Meyer Applied Mathematics and Optimization, 2020.
- Linear convergence of the Randomized Sparse Kaczmarz method Frank Schöpfer und Dirk A. Lorenz Mathematical Programming,173(1-2):509-536, 2019
- Learning to Dequantize Speech Signals by Primal-dual Networks: an Approach for Acoustic Sensor Networks, Christoph Brauer, Christoph, Ziyue Zhao, Dirk Lorenz, and Tim Fingscheidt, ICASSP 2019.
- An inertial forward-backward method for monotone inclusions, Dirk A. Lorenz and Thomas Pock, Journal of Mathematical Imaging and Vision, 51(2): 311-325, 2015.
- Imaging with Kantorovich-Rubinstein discrepancy, Jan Lellmann, Dirk A. Lorenz, Carola Schönlieb and Tuomo Valkonen, SIAM Journal on Imaging Sciences, 7(4): 2833-2859, 2014.

Computer Graphics Lab

Prof. Dr.-Ing. Marcus Magnor

- Associate Editor Computer Graphics Forum
- PI in EXC "PhoenixD"
- L3S Research Center Directorate
- IEEE Senior Member
- Braunschweigische Wissenschaftliche Gesellschaft
- Wissenschaftspreis Niedersachsen
- ERC Starting Grant
- Fulbright Scholar
- Feodor Lynen Scholar – Alexander von Humboldt Foundation

Researcher's Career

- Adjunct Professor for Physics and Astronomy, University of New Mexico, USA
- Full Professor for Computer Science, TU Braunschweig
- Habilitation in Computer Science, Saarland University
- Independent Research Group Leader, MPI Informatik
- Research Associate, Stanford University, USA
- Ph.D. in Electrical Engineering, Erlangen University

Funding

DFG, Excellence Strategy – BMBF, Industry

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Mission Statement

We pursue interdisciplinary research that draws on computer graphics, computer vision, applied optics, and visual perception. Our goal is to find answers to fundamental scientific questions that help us devise practical, new visual processing algorithms.

Research

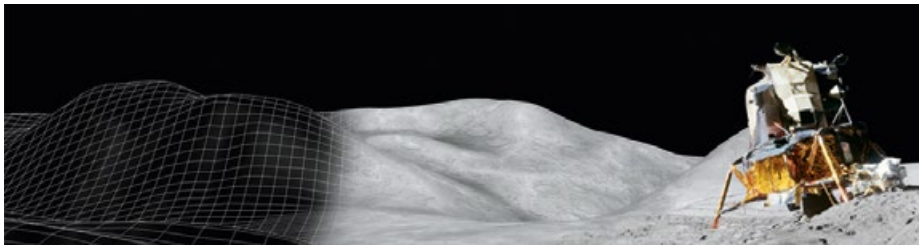
Digital image processing, analysis, and synthesis are driving research and innovation in many domains. Our group develops practical solutions for visual computing challenges.

Measuring & Modeling: A photo is a physical measurement, a digital camera is a measuring device: by taking a picture, millions of samples are being measured simultaneously, from a distance and without interference. In our lab we research new imaging techniques in conjunction with advanced image processing and analysis algorithms to measure and model real-world objects, scenes and phenomena, in space and in time.

Fast & Realistic Image Synthesis: Pictures are the most intuitive means to communicate information. At the same time, we have a keen eye for what is real and what is not. Our group devises fast algorithms to create photo-realistic renderings of virtual as well as real-world scenes, for display on screen and in immersive environments.

Perception and Cognition: Any visual impression is the result of our brain's interpretation of what we see. From perceptual psychology, we know the rules by which our brain interprets visual information. We make use of these rules to develop quantitative perceptual models that allow us to enhance the quality of computer-generated images and videos.

Digital Gauss: 3D digital model from conventional photos



Moonshot: reconstruction of the Apollo 15 landing site from vintage lunar probe images

Publications

- M. Magnor, A. Sorkine-Hornung (Eds.): Real VR – Immersive Digital Reality: How to Import the Real World into Head-Mounted Immersive Displays, Springer, March 2020
- T. Alldieck, M. Magnor et al., "Learning to Reconstruct People in Clothing from a Single RGB Camera", in IEEE CVPR, June 2019
- S. Grogorick, G. Albuquerque, J.-P. Tauscher, M. Magnor, "Comparison of Unobtrusive Visual Guidance Methods in an Immersive Dome Environment", in ACM TAP, 15(4), pp. 27:1-27:11, October 2018
- T. Alldieck, M. Magnor et al., "Video Based Reconstruction of 3D People Models", in IEEE CVPR, June 2018
- M. Mustafa, S. Guthe, J.-P. Tauscher, M. Goesele, M. Magnor, "How Human Am I? EEG-based Evaluation of Animated Virtual Characters", in Proc. ACM CHI, pp. 5098-5108, May 2017

Institute of Business Information Systems – Decision Support Group

Prof. Dr. Dirk C. Mattfeld

- Vice president of Braunschweiger Hochschulbund (BHB)
- Coordinator of the student exchange program of the University of Nebraska at Omaha and TU Braunschweig

Researcher's Career

- Full Professor of Business Information Systems and Decision Support, Technische Universität Braunschweig
- Associate Professor at Institut für Logistik und Transport, Universität Hamburg
- Assistant Professor at Chair of Logistics, Methods of OR and Information Systems, Universität Bremen, Germany
- PhD at the Universität Bremen
- Study of economics, Universität Bremen

Funding

DFG, State of Lower Saxony, DAAD, Volkswagen Research, Volkswagen Financial Services AG

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Mission Statement

The Decision Support Group works on models, methods and systems for planning and control of processes. The work focuses the application domain of logistics, transportation and traffic.

Research

Information systems in logistics, transportation and traffic are analyzed with regard to strategic, tactical and operative aspects. Decision Support in logistics and transportation requires the modeling of the domain-specific tasks and processes as well as the support of these models by means of integrated information systems. Methods from the field of Business Intelligence and Data Mining provide information models. These serve the derivation of optimal decision-making through Operations Research.
Working fields include anticipatory planning in vehicle routing, control of city logistics processes, fleet management and management of shared mobility systems.

Anticipatory Planning in Vehicle Routing: Road networks, especially in urban areas, are characterized by high uncertainties resulting from the dynamics of traffic. Advanced traveler information systems acquire, analyze and present information about the road network traffic system in order to assist travelers in moving from their starting location to a desired target location (routing). To improve routing, future traffic conditions must be anticipated. A reliable and efficient anticipation considers the uncertainties for the optimization of routing. Stochastic and dynamic routing explicitly models uncertainties and incorporates them for the optimization of routing.

Control of City Logistics Processes: City logistic providers face several challenges due to increasing importance of e-commerce and rising customer expectations as well as high uncertainties of urban traffic systems. The control of city logistics processes significantly contributes to the efficiency of city logistic providers, since it deals with the optimization of the most important and expensive parts of the supply chain. Optimizing the control of city logistics processes enables the providers to improve the efficiency in these parts of the supply chain. This requires the derivation of efficient information models and their integration into optimization models.

Fleet Management: Increasing digitalization and propagation of telematics enables the management of fleets with regard to microscopic and macroscopic aspects. The former includes supporting the driver with respect to future activities such as personalized navigation and improved infotainment systems. The latter includes remote prescriptive maintenance of vehicles. In order to do so, various data sources (e.g. extended floating car data, social media data) are fused and analyzed using models from business intelligence and data mining.

Management of Shared Mobility Systems: Shared mobility gains in importance due to growing environmental as well as economic concerns and due to technological advances in electronic and wireless technology, which enables easier sharing of assets. Especially bike-sharing systems receive increasing attention in shared city transportation, because they allow individual transportation. A common issue observed in modern bike-sharing systems is imbalance in the spatial distribution of bikes over time caused by varying mobility demand. Understanding the imbalances allows derivation of information models that enable efficient and appropriate measures alleviating these imbalances.

Publications

- Yannick O. Scherr, Mike Hewitt, Bruno A. Neumann-Saavedra, Dirk C. Mattfeld (2020): Dynamic discretization discovery for the service network design problem with mixed autonomous fleets. Transportation Research Part B: Methodological, 141, pp. 164-195.
- Patrick-Oliver Groß, Jan F. Ehmke, Dirk C. Mattfeld (2020): Interval travel times for robust synchronization in city logistics vehicle routing. Transportation Research Part E: Logistics and Transportation Review, 143.
- Ninja Soeffker, Marlin Ulmer, Dirk C. Mattfeld (2019): Adaptive State Space Partitioning for Dynamic Decision Processes. Business & Information Systems Engineering (BISE), 61(3), pp. 261-275.
- Bruno A. Neumann-Saavedra, Teodor G. Crainic, Bernard Gendron, Dirk C. Mattfeld, Michael Römer (2019): Integrating Resource Management in Service Network Design for Bike Sharing Systems. Transportation Science 54 (5) 1251-1271
- Felix Köster, Marlin Ulmer, Dirk C. Mattfeld, Geir Hasle (2018): Anticipating emission-sensitive traffic management strategies for dynamic delivery routing. Transportation Research Part D: Transport and Environment, 62, pp. 345-361.

Department of Social Sciences

Prof. Dr. Herbert Oberbeck

- Full professor for sociology of work and organizational studies, TU Braunschweig, Germany
- Head of the Department of Social Sciences, TU Braunschweig, Germany
- Coordinator of excellent mobile further education project for engineering

Researcher's Career

- Dean of the faculty of Economic and Social Sciences, TU Braunschweig
- Research Director of the Sociological Research Institute (SOFI) Göttingen, Germany
- Dr. rer. pol., University of Göttingen, Germany
- Study of law, social sciences and social economy, University of Göttingen, Germany

Funding
BMBF, EU, Volkswagen-Stiftung

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Mission Statement

In the sociology of work and employment, we aim to understand social relations between people during their working lives. We analyze human behavior within organizational structures in modern societies with sociologically well-informed organizational theories.

Research

Future of Work: The future of work is related to some major questions which developed and developing societies have to deal with as emerging challenges in the 21st century. These challenges are connected to major industrial and economic changes. While availability of work stays important, the quality of work, as well as work-life-balance become fundamentally important to employees. Meanwhile rationalization of the self becomes a general demand. Individual skills are of more importance than ever, because a shortage of skills leads to a lack of productivity within companies and/or to unemployment.

Automotive Industries: There are major challenges caused by consequences of economic, social and environmental changes. Reorganization, rationalization processes and practices as well as technological innovations lead to shifts of sectors and to new job profiles and requirements for employees as well as companies. With a changing global environment, transportation and organization challenges, accompanied by emancipated customers, automotive industries need to adjust their strategies.

Service Industries: More than two-thirds of all employees in Germany work in the service sector. Continually, we provide research knowledge concerning the developmental perspectives of relevant service industries. In addition, we focus our research on business-to-business services, which are, as innovators, strongly related to the industrial sector in Germany and its productivity.

Corporate Governance: In Corporate Governance research, we analyse structures, processes and institutions networks, and organization cultures within and between organizations. Main questions in organizations are how power and control are shared, distributed and fulfilled, as well as how organizations deal with challenges and dynamics in a globalized world.

Further Education in Universities: In this field we try to understand and help to shape the organization of the contemporary university. In the 21st century universities have to deal with new education markets and new structural situations. They have to adjust their services and open to concepts of lifelong learning.

Publications

- Oberbeck, H.; Geisler, G. (2016, i.E.) Effizienz von Aufsichtsräten: bisherige und künftige Schwerpunkte in der Arbeit von Unternehmenskontrolleuren. Braunschweig
- Oberbeck, H. (2006) Die komplizierte Suche nach Produktivität bei Dienstleistern. (The complicated Search for Productivity in Services.) In: Moderne Dienstleistungen 307-314.
- D'Alessio, N.; Oberbeck, H. (2002) Call centres as organizational crystallization of new labour relations, working conditions and a new service culture? Holgrewe, U., Kerst, C., Shire, K.A. (eds.), Re-Organizing Service Work Call Centres in Germany and Britain. Aldershot: Ashgate, 86-101.
- Oberbeck, H. (2000) Rationalisierung in Eigenregie. Ansatzpunkte für den Bruch mit dem Taylorismus bei VW, Hamburg: VSA.
- D'Alessio, N.; Oberbeck, H. (1999) The end of institutional stability? The German banking industry in transition. In: Regini, Kitay, Baethge (eds.) From Tellers to Sellers. Changing Employment Relations in Banks. Cambridge (Mass.)/London, 287-316.

Institute of Management and Organization

Prof. Dr. Dietrich von der Oelsnitz

Researcher's Career

- Head of the Institute for Management at the TU Braunschweig
- Full Professor for Management and Human Resources, Technical University Ilmenau
- Postdoc at TU Braunschweig, Institute for Marketing
- Dr. rer. pol.
- Study of Business Administration in Göttingen and London

Funding

AWT Thuringia, DAAD, Industry

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Mission Statement

State-of-the-art management and leadership research using a mainly qualitative access and pronounced interdisciplinary approach. We strive for scientific progress and recognition in the following fields: important manager characteristics; productive organizational features and resilient systems; antecedents of successful strategic alliances and emphatic teamwork.

Research

The main research priorities and domains are:

Leadership

What makes the difference between good and bad leadership?

Cooperation in Teams and between independent Companies ("strategic alliances")

What are the key points in designing and leading successful alliances – especially in knowledge driven environments?

Management of Innovation & Technology

Which tools and systems are fruitful in supporting disruptive innovations in products or procedures? Are there such things as good mental characteristics of founders or ideal founding ecosystems?

Working in the Digital Platform World (Gig-economy and Crowd-working)

What are the motives and most useful skills of freelancers in a digital economy? How to balance performance and mental health in the VUCA-world?

Publications

- Innovative Business Development: Identifying and supporting future radical innovators, in: Leadership, Education, Personality. An Interdisciplinary Journal; Wiesbaden 2020 (zusammen mit Schmidt, S.)
- Crowdworking: Neue Realitäten der Führung. Von digitalen Tagelöhnern und Dienern vieler Herren, in: Gruppe – Interaktion – Organisation (GIO), 89 Jg.;), Nr. 4, Wiesbaden 2020 (zusammen mit Staiger, A. und Schmidt, J.)
- Teammanagement: Grundprinzipien erfolgreicher Zusammenarbeit (2019)
- Interorganizational Learning between Convergence and Cospecialization: A Knowledge-Based Typology of Strategic Alliances, in: Kersten, W./Wittmann, J. (Hrsg.): Kompetenz, Interdisziplinarität und Komplexität in der Betriebswirtschaftslehre. Wiesbaden 2013, S. 243-258. (zusammen mit Lorenz, M.)
- Die Bedeutung transaktiver Gedächtnissysteme für die Informationsproduktion in Teams, in Zeitschrift für Betriebswirtschaft (ZfB), 78. Jg. (2008), Nr. 4, S. 367-396. (zusammen mit Busch, M.).

Institute of System Security

Prof. Dr. Konrad Rieck

Researcher's Career

- Full Professor of Computer Science, TU Braunschweig
- Associate Professor of Computer Science, University of Göttingen
- Junior Professor of Computer Science, University of Göttingen
- Research Associate (Postdoc), TU Berlin
- PhD at TU Berlin
- Research Associate, Fraunhofer Institute FIRST
- Study of Computer Science FU Berlin

Awards

- LehrLeo: Best Lecture at TU Braunschweig 2019
- LehrLeo: Best Practical Course at TU Braunschweig 2019
- DLS Outstanding Reviewer Award 2018
- German Prize for IT-Security 2016 (2nd Place)
- RAID Outstanding Reviewer Award 2015
- Google Faculty Research Award 2014
- CAST/GI Dissertation Award IT-Security 2010

Funding

BMBF, DFG, BSI, Industry

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Mission Statement

The Institute of System Security conducts fundamental research at the intersection of computer security and machine learning. We are interested in the development of intelligent systems that can learn to protect computers from attacks and identify security problems automatically.

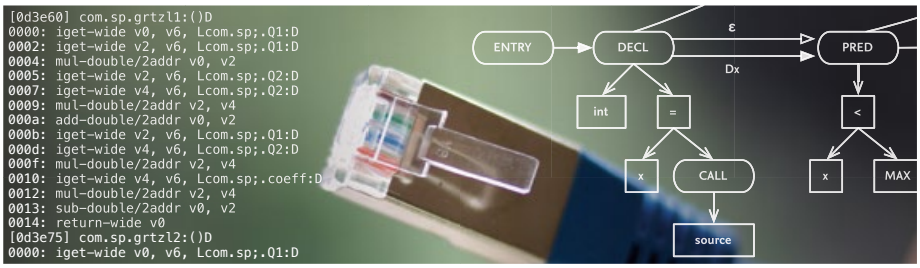
Research

Threat Detection and Analysis: The automatic detection of attacks and threats is a challenging task. To tackle this problem, we develop self-learning methods that adapt to changing conditions and enable inferring patterns of malicious activity automatically. This research ranges from network intrusion detection to mobile threat analysis.

Adversarial Machine Learning: We are interesting in analyzing and understanding the security of machine learning. We aim at constructing learning-based systems that are resilient to different forms of adversarial inputs, such as evasion and poisoning attacks. Our work ranges from robust malware detection to general concepts of adversarial learning.

Analysis of Malicious Code: Analyzing and understanding malicious software is a time-consuming task. We develop methods for automatically analyzing the structure and behavior of code. Our methods allow for efficiently screening and examining large amounts of malicious code, such that new threats can be better identified and contained.

Vulnerability Discovery: We develop method for discovering and analyzing vulnerabilites in computer systems. For this research, we blend methods of code analysis with machine learning. This combination enables us to create intelligent methods that can locate security flaws and privacy issues in software with little human intervention.



Publications

- E. Quiring, D. Klein, D. Arp, M. Johns and K. Rieck. Adversarial Preprocessing: Understanding and Preventing Image-Scaling Attacks in Machine Learning. Proc. of the 29th USENIX Security Symposium, August 2020.
- A. Warnecke, D. Arp, C. Wressnegger and K. Rieck. Evaluating Explanation Methods for Deep Learning in Computer Security. Proc. of the 5th IEEE European Symposium on Security and Privacy (EuroS&P), June 2020.
- E. Quiring, A. Maier and K. Rieck. Misleading Authorship Attribution of Source Code using Adversarial Learning. Proc. of the 28th USENIX Security Symposium, August 2019.
- A. Kellner, M. Horlboge, K. Rieck and C. Wressnegger. False Sense of Security: A Study on the Effectivity of Jailbreak Detection in Banking Apps. Proc. of the 4th IEEE European Symposium on Security and Privacy (EuroS&P), June 2019.
- H. Gascon, S. Ullrich, B. Stritter and K. Rieck. Reading Between The Lines: Content-Agnostic Detection of Spear-Phishing Emails. Proc. of the 21st Symposium on Research in Attacks, Intrusions, and Defenses (RAID), September 2018.
- C. Wressnegger, A. Kellner and K. Rieck. ZOE: Content-based Anomaly Detection for Industrial Control Systems. Proc. of the 48th Conference on Dependable Systems and Networks (DSN), 127–138, June 2018.
- E. Quiring, D. Arp and K. Rieck. Forgotten Siblings: Unifying Attacks on Machine Learning and Digital Watermarking. Proc. of the 3rd IEEE European Symposium on Security and Privacy (EuroS&P), April 2018.
- D. Arp, E. Quiring, C. Wressnegger and K. Rieck. Privacy Threats through Ultrasonic Side Channels on Mobile Devices. Proc. of the 2nd IEEE European Symposium on Security and Privacy (EuroS&P), 35–47, April 2017.

Institute of Business Information Systems

Prof. Dr. Susanne Robra-Bissantz

- Representative Campus Community
- Chair Business Information Systems / Information Management

Researcher's Career

- Full Professor for Information Systems Research, TU Braunschweig
- Habilitation at University Erlangen-Nürnberg
- Research Assistant (Postdoc), University Erlangen-Nürnberg
- Ph.D. at University Erlangen-Nürnberg (summa cum laude)
- Studies of Business Administration at University Erlangen-Nürnberg

Funding

Bundesministerium für Bildung und Forschung (BMBF), Volkswagen Foundation, EU, Leibniz-Association, Industry

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Mission Statement

Information Technology (Hardware, Software and Systems) is one critical success factor in today's companies and markets. wi2 works on scientific basics, artefacts and hands-on concepts for successful information systems in organizations, on markets and in long lasting relationships with customers and other business partners.

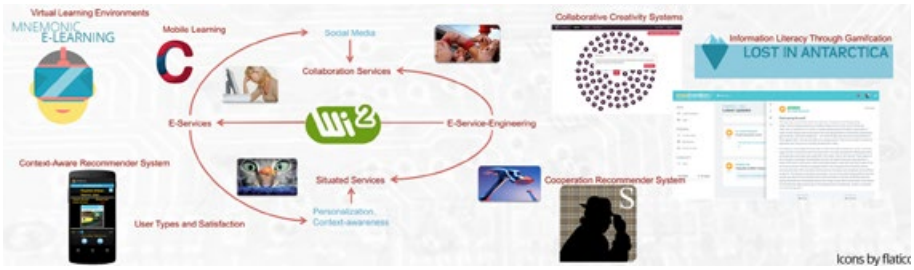
Research

wi2 follows the typical approach of research in business information systems. Empirical explanation leads to new theoretical insights into human acceptance, satisfaction or, in general, success of Information Systems. Combined with concepts of Design Science we build artefacts and prototypes in our focus areas of research. As information systems increasingly affect societal developments, we add typical research methodologies of social sciences, such as action research.

Our basic paradigm is the view of software, websites, apps as user-centric e-Services. We work on innovative Service-Ecosystems – from creation to innovation and design, to engineering, implementation and test. This includes new concepts for customer interaction as well as business models and design methodologies. As enabler of innovative information systems, we focus on new information technologies – social media collaboration and context sensitivity. Here especially mechanisms and platforms for collaboration in companies and beyond lead to new forms of services, customer relationships, innovation processes and knowledge management.

Typical research areas:

- Business-IT-Alignment and Information Systems Success
- Design and engineering of customer oriented e-services
- Situated, context-oriented, individualized, mobile and automotive e-Services
- Collaboration and Participation Mechanisms and Platforms
- Gamification, Nudging and Citizen Science
- Collaborative Creativity, Innovation and Knowledge Management
- New Models of Consumption, Learning and (Co-)Working
- Sharing-/Maker-Economy and Service-Ecosystems



Publications

- Ahmad, R., Siemon, D., & Robra-Bissantz, S. (2021) Communicating with Machines: Conversational Agents with Personality and the Role of Extraversion. In Proceedings of the54th Hawaii International Conference on System Sciences (p. 4043).
- Lohrenz, L., Michalke, S., Robra-Bissantz, S., & Lattemann, C. (2021) Fostering Visibility, Commitment and Trust on Digital Platforms: Insights into Personal Engagement Platforms from the DACH Region. In Proceedings of the 54th Hawaii International Conference on System Sciences (p. 1161).
- Strohmann, T., & Robra-Bissantz, S. (2020). A Virtual Companion for the Customer – From Conversation to Collaboration. In Automatisierung und Personalisierung von Dienstleistungen (pp. 253-271). Springer Gabler, Wiesbaden
- Siemon, D.; Strohmann, T.; Robra-Bissantz, S. (2019). The Virtual Collaborator - A Definition and Research Agenda. International Journal of e-Collaboration. 14 (4)
- Siemon, D.; Becker, F.; Robra-Bissantz, S. (2019). How Might We? From Design Challenges to Business Innovation. Journal of Creativity and Business Innovation
- Eckardt, L., Robra-Bissantz, S. (2018) Playtesting for a Better Gaming Experience: Importance of an Iterative Design Process for Educational Games. In Proceedings der Pacific Asia Conference on Information Systems (PACIS), Yokohama, Japan, S. 1220-1227.

Institute of Software Engineering and Automotive Informatics (ISF)

Prof. Dr.-Ing. Ina Schaefer

Researcher's Career

- Head of Department, Department of Computer Science
- Co-Head of Research Area "Digitalization" at Automotive Research Center Lower Saxony (NFF)

- Full Professor for Software Engineering and Automotive Informatics, TU Braunschweig
- Acting Chair for Software Systems Engineering, TU Braunschweig
- PostDoc at Chalmers University of Technology, Gothenburg, Sweden
- Dr.-Ing. at TU Kaiserslautern, Software Technology Group
- Study of Computer Science, Rostock University

Funding

DFG, BMBF, EU, State Lower Saxony, Industry

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Mission Statement

Modern software systems are very complex and individually configured for different customers to fulfill their needs. This variability within software-systems leads to software families, which introduces new challenges for software engineering. We work on new techniques to design, implement, analyze and test these complex software systems in effective and efficient ways.

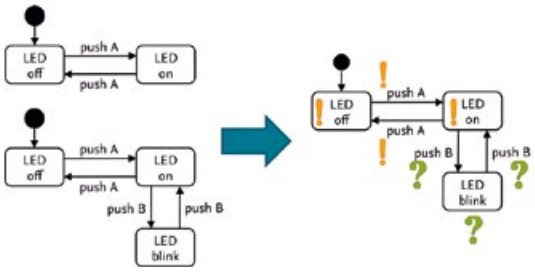
Research

Software Product Lines: These types of software systems allow for mass customization of software systems according to customer demands. We investigate how to cope with the complexity that software product lines introduce, as the number of potential product variants grows exponentially fast. To this end, we create novel techniques to program, analyze, verify and test these variant-rich systems in new ways, that exploit the variability information and reduce redundancy compared to existing software engineering techniques. We also work on techniques how to extract a software product line from an existing set of legacy variants and evolve this as a long-living software product line.

Programming Languages: In the last decades, hundreds of programming languages have evolved according to trends and advances in computer science. We investigate ways to adapt existing programming languages using new frameworks to be variability-aware. To this end, we introduce different delta-oriented dialects, such as DeltaJava. After the modification, these types of languages can be used to define families of software variants.

Performance Analysis of Large-Scale Systems: We develop multi-perspective modeling approaches covering different views and apply a delta-oriented modeling approach which integrates performance annotations to allow for a model-based performance analysis. We devise family-based performance analysis techniques in order to efficiently evaluate a large set of possible system variants.

Software Quality Assurance: Making sure that software works as intended, especially in safety-critical domains such as the automotive industry, is a fundamental task in software engineering. We make novel contributions to effective and efficient testing of software product lines and black-box systems using machine learning techniques. We investigate scalable verification techniques which prove that a software system fulfills its specification. In addition, we develop methods and tools how to build software such that it is correct-by-construction, satisfying its functional as well as its security requirements.



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- T. Thüm, S. Apel, C. Kästner, I. Schaefer, G. Saake. A Classification and Survey of Analysis Strategies for Software Product Lines. ACM Comput. Surv. 47(1): 6, 2014.
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- I. Schaefer, R. Rabiser, D. Clarke, L. Bettini, D. Benavides, G. Botterweck, A. Pathak, S. Trujillo, K. Villela. Software diversity: state of the art and perspectives. Internal Journal on Software Tools for Technology Transfer Vol. 14, Springer, pp. 477-495, 2012.
- I. Schaefer, L. Bettini, V. Bono, F. Damiani, N. Tanzarella. Delta-oriented programming of software product lines. In: Software Product Lines: Going Beyond, Springer Berlin Heidelberg, pp. 77-91, 2010.

Institute of Automotive Management and Industrial Production (AIP)

Prof. Dr. Thomas S. Spengler

- Director of the Institute of Automotive Management and Industrial Production (AIP)
- Board member of the Automotive Research Centre Niedersachsen (NFF)
- Adjunct Professor and Member of the Graduate School of Engineering of the University of Rhode Island, USA
- Deputy Chairman of the Scientific Commission Production Management of the German Academic Association for Business Research (VHB)
- Department Editor "Operations Management" of Schmalenbach Journal of Business Research (SBUR)
- Member of the editorial board of European Journal of Operational Research and Production and Operations Management

Researcher's Career

- Chair of Production and Logistics
- Full Professor for Business Administration at the Technische Universität Braunschweig
- Habilitation at the Karlsruhe Institute of Technology (KIT)
- Dr. rer. pol. at KIT
- Study of Industrial Engineering and Management at KIT

Funding

Ministerial (BMBF, BMU, BMWi), DFG, Industry

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Mission Statement

My research interests are the development and application of techno-economic models and quantitative methods for decision support in production, logistics, and sustainable management. I emphasize interdisciplinary cooperation with researchers from engineering and natural sciences, industrial partners, and political decision makers.

Research

For more than 20 years now, the Chair of Production and Logistics has been recognised for its research expertise in sustainable design, planning, and control of industrial production and logistics systems. Focusing on a technology and decision-oriented business administration, we address research questions related to the following topics:

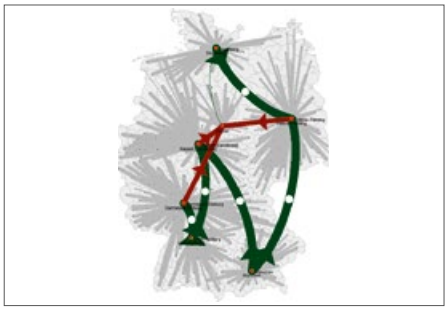
Energy- and resource-efficiency: Industrial Production and logistics require the efficient use of energy and materials. We develop mathematical optimization models for the design, planning and control of sustainable production systems and supply chains.

Digitization: The digitization in production and logistics (also Internet of Things or Industry 4.0) leads to new business models (e. g., predicted maintenance) and to new technologies in production and logistics systems (e. g., interaction between robots and workers). In this field, we concentrate on the selection, planning, and control of such new business models and technologies.

Mobility: Emissions and resource consumption of passenger and freight transport have to be cut down significantly. To support a sustainable mobility, we address, amongst others, research questions regarding the market introduction of electric vehicles, the production and recycling of innovative powertrains, and the economic operation of e-car-sharing fleets.

Circular economy: Against the background of resource scarcity, the closed-loop circulation of products, materials, and substances is becoming more and more important. We conduct research on the economic design of closed-loop supply chains and recycling concepts, as well as recycling planning and control.

We strive to derive recommendations for industry and policy. To this end, our interdisciplinary team develops and applies tools for decision support, which are based on methods of Operations Research such as optimization and simulation – often directly on-site with our partners from practice.



Publications

- Thies, C.; Kieckhäfer, K.; Spengler, T. S.; Sodhi, M. S. (2019): Operations Research for sustainability assessment of products – A review, in: EJOR, 274 (1), pp. 1–21.
- Wichmann, M. G.; Johannes, C.; Spengler, T. S. (2019): An extension of the General Lot-sizing and Scheduling Problem (GLSP) with time-dependent energy prices, in: JBE, 89 (5), pp. 481–514.
- Müller, C.; Grunewald, M.; Spengler, T. S. (2018): Redundant configuration of robotic assembly lines with stochastic failures, in: IJPR, 56 (10), pp. 3662–3682.
- Müller, C.; Kieckhäfer, K.; Spengler, T. S. (2018): The influence of emission thresholds and retrofit options on airline fleet planning: An optimization approach, in: Energy Policy, 112, pp. 242–257.
- Thies, C.; Kieckhäfer, K.; Spengler, T. S. (2016): Market introduction strategies for alternative powertrains in long-range passenger cars under competition, in: Transp. Res. D, 45 (June), pp. 4–27.

Institute for Mathematical Optimization

Prof. Dr. Sebastian Stiller

Researcher's Career
- Professor for Mathematical Optimization at TU Braunschweig
- Junior Faculty at Berlin Mathematical School
- Junior Faculty of DFG-Research Center MATHEON, Berlin
- Postdoctoral Associate MIT (Cambridge, USA)
- EU Marie Curie Fellow
- Dr. rer. nat. at TU Berlin
- Diplommathematiker and MA in Philosophy at Friedrich-Alexander-Universität Erlangen

Funding
EU, DFG, EFRE, Industry

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Mission Statement

We conduct in-depth mathematical research in combinatorial optimization to solve challenging network and scheduling problems in engineering, other sciences, and industry. From our long and successful track record we are confident that best solutions in practice stem from strong mathematical foundations.

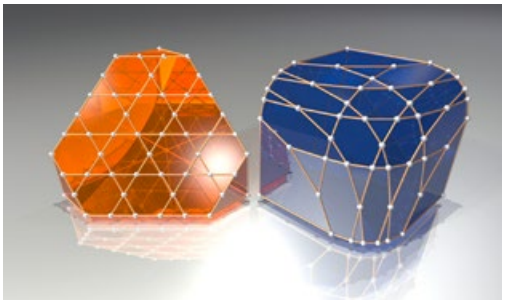
Research

The following applications currently drive our research.

Real-time Systems: Digitalization and Industry 4.0 depend on safe and predictable computing. With industry and engineering we develop analysis, feasibility tests, and algorithms to exploit the power of systems with large number of processors and large on-board networks.
Individual Mobility: We develop collaborative and co-modal routing algorithms and robust shortest path methods with partners in science and industry.
Efficiency in **Logistics** reduces cost and resource conflicts on public roads. We develop integer programming and heuristic methods for logistics used in industry, e.g., robust routing.
Networks for gas-transport pose highly complex, non-linear, and large-scale network optimization problems. We research network infeasibilty problems in this context.
Public Transport: We develop optimization methods for delay resistant timetabling and platforming.

Our expertise is based on theoretical research in the following areas:

Optimization under uncertainty / Robust optimization: The input data for optimization is almost never certain. As the type of uncertainty and the certainty requirements in the solution vary, different models are necessary. We develop models that are amenable to fast optimization algorithms, and at the same time show enough detail for practice.
Network flows and routing: We work on structural analysis, complexity theory, and algorithms for network flows and routing problems. We study approximation algorithms based on combinatorial and semi-definite methods for robust flows and algorithm engineering techniques for fast, shortest-paths computations. We also study fixed parameter tractability of infeasibility in network flows.
We study **scheduling** under uncertainty.
Algorithmic game theory allows us to analyze and to shape situations with self-interested agents influencing an optimization problem. We work on game theoretic network problems – in particular for logistics.



Disturbance polytope of balanced (left) solution is smaller than unbalanced (right).

Publications

- David Adjiashvili, Sebastian Stiller, Rico Zenklusen: Bulk-Robust combinatorial optimization. Mathematical Programming 149(1-2), pages 361-390, 2015.
- Vincenzo Bonifaci, Alberto Marchetti-Spaccamela, Sebastian Stiller, Andreas Wiese: Feasibility Analysis in the Sporadic DAG Task Model. ECRTS 2013, pages 225-233, 2013.
- Dimitris Bertsimas, Ebrahim Nasrabadi, Sebastian Stiller: Robust and Adaptive Network Flows. Operations Research 61(5), pages 1218-1242, 2013.
- Vincenzo Bonifaci, Alberto Marchetti-Spaccamela, and Sebastian Stiller. A constant-approximate feasibility test for multiprocessor real-time scheduling. Algorithmica, 62 (3-4), pages 1034–1049, 2012.
- Laura Galli, Sebastian Stiller: Strong Formulations for the Multi-module PESP and a Quadratic Algorithm for Graphical Diophantine Equation Systems. European Symposium on Algorithms, 2010, pages 338-349, 2010.

Institute for Communication Science

Prof. Dr. Monika Taddicken

Researcher's Career

- Full Professor for Communication Science, Technische Universität Braunschweig
- Research Fellow at University of Wisconsin, Madison
- Senior Researcher and Leader at the Cluster of Excellence CliSAP and the Department of Communication Science and Journalism, Universität Hamburg
- Dr. rer soc at Universität Hohenheim (summa cum laude)
- Research Assistant and Coordinator at the Department of Communication Science, Universität Hohenheim
- Research Assistant at the Department of Marketing, Otto-Friedrich-Universität Bamberg
- Study of Social Sciences, degree Diplom-Sozialwirtin, Georg-August-Universität Göttingen and National University of Galway.

Funding

German Research Foundation (DFG), DAAD, Alcatel Lucent Foundation, Volkswagen-Stiftung, German Society of Online Research (DGOF)

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Mission Statement

The Institute for Communication Science conducts fundamental and applied research about media and communication processes in all their facets. We aim to understand and conceptualize the individual as well as social relevance and impact of the diverse forms of communication and media in our contemporary mediatized society.

Research

New Media: Media environments have changed significantly in recent decades. The advent and rise of the Internet and so-called social media have radically modified the communicative landscape. Communicative roles – such as communicator and recipient – are converging. New forms of communication patterns, information-seeking behaviors, media repertoires, public spheres and debates have been arisen – as well as innovative media formats, outlets and technologies. We explore and analyze the use of these new media environments and effects on individuals and society as a whole.

Science Communication: Sciences are increasingly specializing themselves, but pervade society more and more. Individual as well as societal decisions often rely on scientific findings. However, scientific processes and topics are regularly complex, uncertain and tentative and therefore often difficult for laypeople to understand. Thus, the media are crucial for the social construction and public perception of scientific issues. Particularly the Internet gains importance for understanding and discussing sciences. Algorithm-based and network-focused hybrid media environments lead to dissonant public spheres. Our research focuses on usage and coping processes as well as on effects on knowledge, opinions and behaviors.

Methods and Methodology: Researching and analyzing human-behavior is a complex and dynamic challenge. The Internet offers new and innovative methods and tools to cope with this task (e. g. web surveys, online experiments, netnography, big data analyses), but requires new ethic guidelines. With our methodological research we try to overcome bridges between traditional and new research instruments and modes as well as between quantitative and qualitative methods. Thus, we focus on methodological triangulations by combining different perspectives.

Publications

- Wicke, N. & Taddicken, M. (2020). Listen to the audience(s)! Expectations and characteristics of expert debate attendants. Journal of Science Communication, 19(04), A02.
- Taddicken, M., Wicke, N. & Willems, K. (2020). Verständlich und kompetent? Eine Echtzeitanalyse der Wahrnehmung und Beurteilung von Expert*innen in der Wissenschaftskommunikation. Medien & Kommunikationswissenschaft, 68(1-2), 50–72.
- Taddicken, M., & Wolff, L. (2020). 'Fake News' in Science Communication: Emotions and Strategies of Coping with Dissonance Online. Media and Communication, 8(1), 206-217.
- Schmidt, J.-H. & Taddicken, M. (2015). Handbuch Soziale Medien [Handbook Social Media]. Wiesbaden: Springer.
- Schäfer, M. & Taddicken, M. (2015). Mediatized Opinion Leaders: New Patterns of Opinion Leadership in New Media Environments? International Journal of Communication, 9, 960-981.

Institute of Automotive Management and Industrial Production (AIP)

Prof. Dr. David M. Woisetschläger

- Chair of Services Management and Director of the Institute of Automotive Management and Industrial Production, TU Braunschweig

Researcher's Career

- Positions as Visiting Professor of Marketing at the Newcastle University Business School (UK, 2015), Visiting Professor of Marketing, Ruhr-Universität Bochum (2010-2011), Université Nancy II, ICN Business School (France, 2010)
- Assistant Professor of Services Management, TU Dortmund
- Dr. rer. pol., Westfälische-Wilhelms-Universität Münster, Marketing Centrum Münster
- Research Assistant at the Marketing Center Münster, University of Münster
- Dipl.-Kfm., University of Mannheim
- Studies of Business Administration at the University of Mannheim, and UNC North Carolina

Funding

BMBF, BMU, BMVI, BMWI, EU, Volkswagen Foundation, Industry

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Mission Statement

Investments in new services, in marketing actions and organizational improvements are key activities to gain and defend competitive advantage. A systematic assessment of the outcomes of these investments is often neglected. We conceptualize models and apply innovative methods to improve our understanding of how managerial actions create value.

Research

Customer Relationship Management: We identify antecedents of customer lifetime value along the lifecycle from new customer acquisition to win-back strategies. Transaction data and data from customer surveys are used to assess the effectiveness of loyalty programs, personalized online advertising or cross-buying initiatives. We analyze determinants and consequences of customer satisfaction, customer loyalty and customer (mis-)behavior and study the applicability and design of sales incentives, basing on indicators such as the net promoter score.

Service Innovation: We conceptualize and identify success factors of service innovations in organizations and study the requirements of stakeholder participation in the new service development process. In addition, we apply qualitative and quantitative methods to identify antecedents and barriers of customer and employee acceptance of innovative technology-mediated services (e.g., platform concepts such as peer-to-peer sharing, b2c sharing, or multi-sided markets) and innovative technologies based on automation (e.g., automated driving).

Brand Management and Social Media: We measure brand performance and conceptualize strategies intended to growing and sustaining brand equity. Our studies in the contexts of product & service brands, luxury brands and human brands show the effects of marketing mix instruments (e.g., advertising expenditures), inferred brand motives or credibility perceptions (e.g. of brand extensions) on brand equity and consumer online engagement.

Sports Marketing and Sponsorship: Our research examines exchange relationships among multiple actors in the sports business. We assess how sponsorships create attitudinal, behavioral and financial benefits for firms, clubs, and consumers and study managerial and consumer-level success factors of sponsorship activation strategies. We analyze how clubs can foster and capitalize on relationships to their multiple audiences.

Publications

- Gurzki, H./Schlatter, N./ Woisetschläger, D. M. (2019): Crafting Extraordinary Stories: Decoding Luxury Brand Communications, Journal of Advertising, 48(4), 401-414.
- Seegebarth, B./Backhaus, C./Woisetschläger, D. M. (2019): The Role of Emotions in Shaping Purchase Intentions for Innovations Using Emerging Technologies: A Scenario-based Investigation in the Context of Nanotechnology, Psychology & Marketing, 36(9), 844-862.
- Gurzki, H./Woisetschläger, D. M. (2017): Mapping the luxury research landscape: A bibliometric citation analysis, Journal of Business Research, 77, S. 147-166.
- Woisetschläger, D. M./Backhaus, C./Cornwell, T. B. (2017): Inferring Corporate Motives: How Deal Characteristics Shape Sponsorship Perceptions, Journal of Marketing, 81(5), 121-141. – awarded with the AMA Sport & Sponsorship-Linked Marketing Special Interest Group's "Paper of the Year in Sport Marketing" Award.
- Ommen, N./Blut, M./Backhaus, C./Woisetschläger, D. M. (2016): Toward a better understanding of stakeholder participation in the service innovation process: More than one path to success, Journal of Business Research, 69 (7), 2409-2416.
- Woisetschläger, D./Hanning, D./Backhaus, C. (2016): Why Frontline Employees Engage As Idea Collectors – An Assessment of Underlying Motives and Critical Success Factors. Industrial Marketing Management, 52 (1), 109-116.

Institute of Operating Systems and Computer Networks

Prof. Dr.-Ing. Lars Wolf

- Head of the IBR institute

Researcher's Career
- Full Professor for Computer Science, TU Braunschweig
- Associate Professor for Computer Science and Deputy Director of Computing Center, Universität Karlsruhe (TH)
- Assistant Professor, TU Darmstadt
- Research Staff, IBM, Heidelberg
- Dr.-Ing. in Computer Science, TU Chemnitz
- Studies in Computer Science, TU Braunschweig and Universität Erlangen-Nürnberg

Funding
DFG, BMBF, BMWI, EU, DAAD, Lower Saxony, Industry

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Mission Statement

Nowadays, nearly all things and devices are networked and can communicate with each other – from computers, smartphones, small sensor systems, to robots and vehicles. Our mission is to perform basic research on such networked systems and transfer results to real-world application areas.

Research

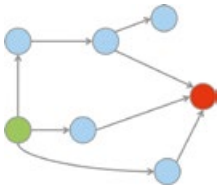
Wireless Sensor Networks: Networked sensing systems using small sensor nodes allow for the monitoring of processes and phenomena in nature as well as in human-created settings. We study and develop wireless sensor networking approaches and methods considering real-time, reliability, and energy requirements. Moreover, we perform real-world experiments and field tests using our own, open-hardware sensor node INGA. Application areas include smart farming, industry monitoring & surveillance, home & building automation, and ambient assisted living.

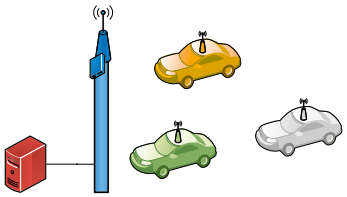
Vehicular Networking and Systems: Communication among vehicles and with infrastructure components including backend systems can reduce accidents, improve traffic safety & efficiency, and support cooperative driving. New functionalities such as autonomous driving and advanced parking are enabled. We analyze and develop new protocols and communication methods as well as backend components such as management components for autonomous parking and charging of electrical vehicles.

Opportunistic and Disruption-Tolerant Networking: Opportunistic and disruption-tolerant networking methods allow the transfer of data not only by routing in space but in space&time – benefiting from the mobility of network nodes. IBR-DTN is our implementation of the bundle protocol for this purpose. It is designed for embedded systems and can be used as framework for DTN applications. For even smaller settings, our µDTN is available and beneficial, e.g., in wireless sensor networks. Besides protocols, routing approaches and support mechanisms are a few of our research directions in this field.

Dependable Networking: Networked embedded systems such as vehicles and space missions operate in challenging, but changing environments. We study dependable networking platforms and protocols between components which are flexible and dynamic, Guarantees have to be given to all components. Safety, availability and security properties in the system must be ensured.

INGA Wireless Sensor Node


Routing in space and time


Vehicular Networking

Publications

- Arne Brüsch, Ngu Nguyen, Dominik Schürmann, Stephan Sigg and Lars Wolf: Security Properties of Gait for Mobile Device Pairing, in IEEE Transactions on Mobile Computing, Vol. 19, No. 3, pp. 697-710, March 2020
- Marie-Theres Suer, Christoph Thein, Hugues Tchouankem and Lars Wolf: Multi-Connectivity as an Enabler for Reliable Low Latency Communications An Overview, in IEEE Communications Surveys & Tutorials, Vol. 22, No. 1, pp. 156-169, 2019
- Dominik Schürmann, Georg von Zengen, Marvin Priedigkeit and Lars Wolf: uDTNSec: A security layer with lightweight certificates for Disruption-Tolerant Networks on microcontrollers, in Annals of Telecommunications, Vol. 73, No. 9, pp. 589-600, October 2018
- Dominik Schürmann, Julian Timpner and Lars Wolf: Cooperative Charging in Residential Areas, in IEEE Transactions on Intelligent Transportation Systems, Vol. 18, No. 4, pp. 834-846, IEEE Comput. Soc, April 2017
- Ulf Kulau, Felix Büsching and Lars Wolf: IdealVolting – Reliable Undervolting on Wireless Sensor Nodes, in ACM Transactions on Sensor Networks (TOSN), New York, NY, USA, ACM, 2016

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Institute of Physical and Theoretical Chemistry

Prof. Dr. Sigurd Bauerecker

Researcher's Career

- Full Professor for Physical Chemistry, TU Braunschweig
- Heisenberg Professor, TU Braunschweig
- Research Periods at the ETH Zurich
- Group Leader, Helmholtz-Zentrum Geesthacht for 10 years
- Dr. rer. nat. at the TU Braunschweig
- Study of Physics, Chemistry, Electrical Engineering, Braunschweig

Funding

DFG, DAAD, Helmholtz, VolkswagenStiftung, Industry

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Mission Statement

Our investigation of gas-phase molecules, aerosol particles and droplets is motivated by multiple factors such as: a better basic understanding of matter between molecule and bulk; their prominent role in the physics and chemistry of the atmospheres of the Earth, other planets, satellites and in space; their impact on weather and climate; the prospects of molecular aerosols and nanoparticles in health care, pharmacy and technical applications.

Research

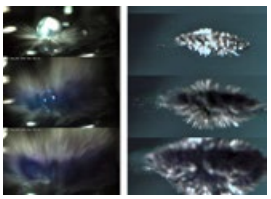
Objects of interest are supercooled gas molecules, molecular clusters (0.1 – 3 nm), molecular nanoparticles (3 – 1000 nm) and microparticles in the aerosol phase (1 – 10 µm), as well as acoustically levitated droplets (0.3 – 6 mm).

Particle properties are investigated as size and size distribution; shape (spherical, cubic, elongated, oblate, prolate, needleshaped, dendritic, …); state of aggregation (liquid, solid); phase (crystalline I, crystalline II, metastable, …); structure (crystalline, amorphous, core-shell, nanocomposite, covered surface, quasi-liquid layer, …); vibrational and scattering spectra, optical constants; intermolecular interactions (hydrogen and van der Waals bonding).

Particle and aerosol dynamics are in the focus of our research regarding size evolution (particle growth, decay, Ostwald ripening); shape evolution (spherical to elongated, dendritic growth), special phase transitions (freezing, melting, sublimation, desublimation, change between crystalline phases); molecular diffusion in nanoparticles; particle agglomeration.

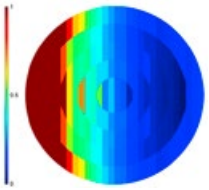
Experimental particle generation is performed by the following techniques: gas aggregation via optical long-path collisional cooling cells with adjustable temperature (4 – 400 K) and pressure (< 0.01 – 3000 mbar); sample-gas inlet techniques such as pulse-injection, (enclosive) flow cooling∞ acoustic trapping and levitation; climate chambers; laser heating, evaporation and desorption. The collisional cooling cells have been constructed, patented and upgraded together with industrial partners. Twin systems of these cells are used in a few collaborations.

Particle and aerosol characterization is realized by FTIR spectroscopy (rapid-scan, low- and high-resolution) in the 400 – 10000 cm^{-1} range; visible (VIS) and infrared (IR) high-speed imaging (analyses of fast processes such as freezing of supercooled droplets); and supported by methods of computational chemistry (ab initio, molecular dynamics, Monte Carlo, Mie calculations, discrete dipole approximation) together with collaboration partners.



Coulombic explosion of a sodium droplet in water with "blue" solvated electrons.

Dendritc freezing of a supercooled water droplet.



Portion of dendritic ice after stage-one freezing.

Publications and Patents

- O.N. Ulenikov, E.S. Bekhtereva, O.V. Gromova, M. Quack, K.B. Berezkin, C. Sydow, and S. Bauerecker: High resolution ro–vibrational analysis of molecules in doublet electronic states: the ν1 fundamental of chlorine dioxide ($^{16}O^{35}Cl^{16}O$) in the X^2B_1 electronic ground state, Chem. Phys. Phys. Chem. 23(8) (2021) 4580–4596 https://doi.org/10.1039/DoCP05515H
- T. Buttersack, V.C. Weiss, and S. Bauerecker: Hypercooling temperature of water is about 100 K higher than calculated before, J. Phys. Chem. Lett. 9 (2018) 471–475 https://doi.org/10.1021/acs.jpclett.7b03068
- O.N. Ulenikov, E.S. Bekhtereva, O.V. Gromova, M. Quack, G.Ch. Mellau, C. Sydow , and S. Bauerecker: Extended analysis of the high resolution FTIR spectrum of $^{32}S^{16}O_2$ in the region of the ν2 band: Line positions, strengths, and pressure broadening widths, J. Quant. Spectrosc. Radiat. Transfer 210 (2018) 141–155 https://doi.org/10.1016/j.jqsrt.2018.02.010
- T. Buttersack, S. Bauerecker: Critical radius of supercooled water droplets: on the transition towards dendritic freezing, J. Phys. Chem. B 120 (2016) 504–512 http://pubs.acs.org/doi/abs/10.1021/acs.jpcb.5b09913
- P.E. Mason, F. Uhlig, V. Vaněk, T. Buttersack, S. Bauerecker, and P. Jungwirth: Coulomb explosion at early stages of the reaction of alkali metals with water, Nature Chemistry 7 (2015) 250–254

Institute of Medicinal and Pharmaceutical Chemistry

Prof. Dr. Knut Baumann

- Chair, Institute of Medicinical and Pharmaceitical Chemistry

Researcher's Career

- Full Professor for Medicinal and Pharmaceutical Chemistry, TU Braunschweig
- Group Leader at the Institute of Pharmacy, University of Würzburg
- Postdoc at the Department of Chemistry, Arizona State University, Tempe, Arizona, USA
- Postdoc at the Institute of Pharmacy, University of Bern, Switzerland
- Dr. rer. nat. at the University of Würzburg
- Licensed pharmacist
- Studies of Pharmacy at the University of Würzburg

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Mission Statement

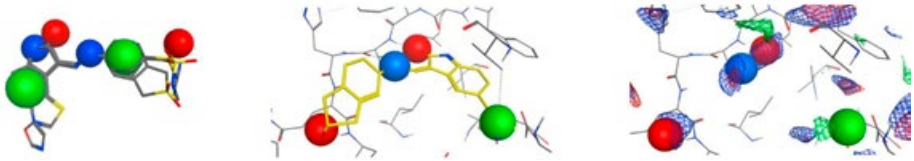
Pre-clinical drug discovery generates a huge amount of data that cannot be evaluated manually. Chemical structure data and biological activity data from various sources as well as analytical data need computational techniques to turn the data into information. Our research focuses on developing chemoinformatic techniques to use the aforementioned data most efficiently.

Research

Encoding chemical structures: Molecules cannot be fed into machine learning tools without encoding them. The chemical structure needs to be transformed into a numerical description of the molecule to develop mathematical models that relate chemical structures to biological activities. The mathematical disciplines of graph theory and geometry, among others, provide techniques to encode molecules. The resulting numerical representation is called molecular descriptor. Molecular descriptors can be used for a number of predictive modeling tasks such as virtual high-throughput screening, visualizing chemical libraries, the analysis of quantitative structure-activity relationships, and for predicting a molecule's target structure.

Development and validation of chemoinformatic models: Most machine learning techniques can be used to develop chemoinformatic models. The employed molecular descriptor is of utmost importance for the successful predictive modeling. If the numerical description of the molecule is unsuitable for the purpose, good results are rather unlikely. Since molecular descriptors are mostly complex and high dimensional descriptions of chemical molecules, data analysis may be prone to chance correlation and overfitting. Rigorous validation and assessment of the resulting models is therefore essential to exclude seemingly good models that would perform badly in the productive phase of the model (i.e. on future molecules).

Evaluation of analytical and bioanalytical data: Bio(-analytical) data often need tailored pre-processing and modelling techniques. Data from vibrational spectroscopy (IR, NIR, Raman spectroscopy) – a workhorse of nondestructive pharmaceutical analysis – often contain spikes, scattering light, or baseline drift. These interfering signals need to be removed for extracting meaningful information from the spectra. Moreover, dimension reduction and the selection of important wavelength regions are important tools to establish predictive multivariate calibration models.



Ligand-based und structure-based pharmacophores. Pharmacophores describe the geometrical arrangement of physical-chemical properties that are necessary for a particular type of biological action. They can be used to virtually screen large compound collections to find novel biologically active compounds.

Publications

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- D. Baumann, K. Baumann, Reliable estimation of prediction errors for QSAR models under model uncertainty using double cross-validation. J. Cheminf. 6 (2014) 47.
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- M. Matz, K. Schumacher, K. Hatlapatka, D. Lorenz, K. Baumann, I. Rustenbeck, Observer-independent quantification of insulin granule exocytosis and pre-exocytotic mobility by TIRF microscopy, Microsc. Microanal. 20 (2014) 206-218.
- U. Schmid, P. Rösch, M. Krause, M. Harz, J. Popp, K. Baumann, Gaussian mixture discriminant analysis for the single-cell differentiation of bacteria using micro-Raman spectroscopy. Chemom. Intell. Lab. Syst. 96 (2009) 159-171.

Institute of Pharmaceutical Biology

Prof. Dr. Ludger Beerhues

Researcher's Career
- Professor for Pharmaceutical Biology, TU Braunschweig
- Assistant/Associate Professor for Pharmaceutical Biology, University of Bonn
- Postdoc, Max Planck Institute for Plant Breeding Research, Cologne
- PhD, University of Münster
- Study of biology, University of Münster

Funding
DFG, BMBF, DAAD, Leibniz Association, Lower Saxony

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Mission Statement

Understanding the biosynthetic pathways of bioactive plant natural products at the metabolite, enzyme, and gene levels, aiming at metabolic engineering of compounds and reconstruction of pathways in microorganisms for drug development.

Research

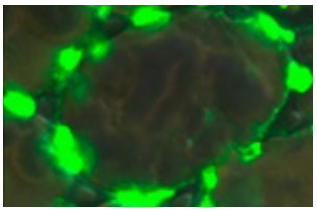
Biotechnology of andidepressant hyperforin: Extracts from the medicinal plant St. John's wort (Hypericum perforatum), which contain hyperforin, are used for the treatment of depression, based on clinical trials. We isolate and functionally characterize the genes that are involved in hyperforin biosynthesis and express them in yeast (Saccharomyces cerevisiae). The aim is to provide alternative production platforms for hyperforin and derivatives (Center of Pharmaceutical Engineering).

Biosynthesis of antitumoral hypericin: St. John's wort contains another interesting compound, hypericin, which is used in photodynamic diagnosis and therapy of cancer. Hypericin is the crimson pigment of the medicinal plant. We study the biosynthesis of hypericin to pave the way for future biotechnological production.

Formation of PPAPs (Polycyclic Polyprenylated Acyl Phloroglucinols): PPAPs have challenging chemical structures and intriguing pharmacological activities, such as antibacterial and anticancer properties. We seek to understand how plants are able to form these amazing compounds and to realize the transfer of the biosynthetic machinery to yeast, aiming at creating tailored cell factories.

Fire blight-induced defence compounds of apple and pear: In response to infection, such as fire blight, scab, and powdery mildew, our important fruit trees form biphenyls and dibenzofurans as defence compounds. These phytoalexins occur only in a small transition zone of the infected stem. We established cell cultures that also produce these compounds. Understanding the biosynthesis and its temporal and spatial regulation may enable an increase in the disease resistance potential of valuable apple and pear cultivars.

Apple replant disease and phytoalexins: After repeated replanting apple suffers from soil sickness, which is due to changes in the microflora of the rhizosphere. The root system of apple plants is strongly affected. We detected formation of phytoalexins in roots that grow in sick soil and study the role of these compounds in apple replant disease.



Cell with immunofluorescent enzyme

Medicinal plant St. John's wort

Fire blight-infected apple shoot

Publications and Patents

- Singh P, Preu L, Beuerle T, Kaufholdt D, Hänsch R, Beerhues L, Gaid M (2020) Promiscuous CoA ligase provides benzoyl-CoA for xanthone biosynthesis in Hypericum. The Plant Journal 104: 1472–1490.
- Nagia M, Gaid M, Biedermann E, Fiesel T, El-Awaad I, Hänsch R, Wittstock U, Beerhues L (2019) Sequential regiospecific gem-diprenylation of tetrahydroxyxanthone by prenyltransferases from Hypericum sp. New Phytologist 222: 318–334.
- Tocci N, Gaid M, Kaftan F, Belkheir AK, Belhadj I, Liu B, Svatoš A, Hänsch R, Pasqua G, Beerhues L (2018) Exodermis and endodermis are the sites of xanthone biosynthesis in Hypericum perforatum roots. New Phytologist 217: 1099-1112.
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- Coyne S, Chizzali C, Khalil MNA, Litomska A, Richter K, Beerhues L, Hertweck C (2013) Biosynthesis of the antimetabolite 6-thioguanine in Erwinia amylovora plays a key role in fire blight pathogenesis. Angewandte Chemie Int. Ed. 52: 10564-10568.

Institute of Pharmacology – Toxicology and Clinical Pharmacy

Prof. Dr. Sönke Behrends

Researcher's Career

- Professor of Pharmacology, Institute of Pharmacology, University of Braunschweig
- Canada Research Chair for Molecular Pharmacology
- Associate professor, University of Toronto
- Group leader and habilitation, University clinic Hamburg Eppendorf
- Postdoctoral Fellow, Institute of Pharmacology, Free University Berlin
- Dr. med. at Institute of Pharmacology, University of Göttingen
- Study of medicine, Universities Göttingen, Würzburg and Hannover

Funding
DFG, EU / BiostructX, Lower Saxony

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Mission Statement

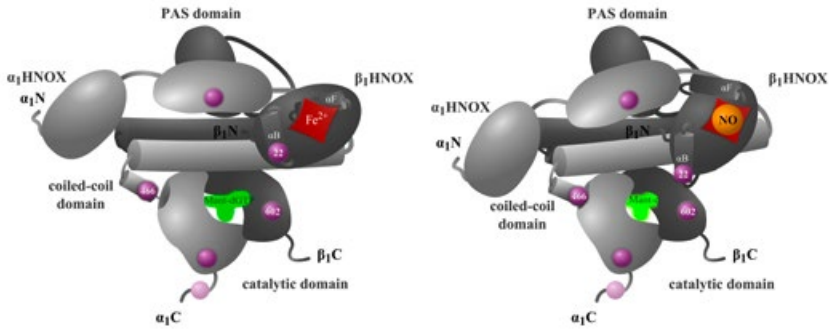
To understand the mechanism of action of novel drugs targeting nitric oxide sensitive guanylate cyclase and the physiological regulation and pharmacogenetic variation of the signal transduction pathway. Techniques range from work with purified protein to visualization in living human cells.

Research

Nitric oxide has long been considered exclusively as a toxic air pollutant. It is now known that this gas is produced by body cells. The gaseous signaling molecule is involved in diverse functions such as cell communication in the brain, regulation of blood pressure and penile erection. The most important receptor of nitric oxide is an enzyme that produces the signaling molecule cyclic GMP. We and others have identified and localized the respective genes and have characterized the resulting enzyme isoforms.

Using a novel approach based on fluorescence resonance energy transfer from endogenous tryptophanes to the fluorescent substrate analogue MANT-GTP, we could show what conformational changes occur in the enzyme as a consequence of nitric oxide binding. In collaboration with groups in London, La Jolla and Bayer in Wuppertal, we could identify a genetic variation in susceptibility to hypoxia-induced pulmonary hypertension in high-altitude residents due to a point mutation in the enzyme. This supported guanylate cyclase as a pharmacological target for reducing pulmonary artery pressure. The recent approval of the drug riociguat to treat pulmonary hypertension has confirmed this idea. Although our data indicate a highly allosteric mechanism of action of riociguat, the exact binding site is still unknown.

In contrast to nitric oxide releasing drugs further development of the allosteric modulator riociguat and the heme displacing drug cinaciguat could lead to the development of isoform specific drugs. Specific subtypes associate with specific targeting proteins within cells or are expressed in an organ-specific manner. One major idea behind our research is to exploit this diversity in nitric oxide receptors for the development of novel specific drugs for single receptor subtypes with novel fields of application and a favorable side effect profile.



basal *NO-stimulated*

Publications

- Busker, M., Neidhardt, I., Behrends, S. (2014). Nitric oxide activation of guanylate cyclase pushes the α1 signaling helix and the β1 heme-binding domain closer to the substrate-binding site. J Biol Chem. 289:476-484.
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Department Structure and Function of Proteins (HZI) and Institute of Biochemistry, Biotechnology and Bioinformatics (TU)

Prof. Dr. Wulf Blankenfeldt

Researcher's Career

- Head of Department Structure and Function of Proteins at the Helmholtz Centre for Infection Research & Full Professor for Structural Biology of Proteins, TU Braunschweig
- Associate Professor of Biochemistry, University of Bayreuth
- Group Leader, Max Planck Institute of Molecular Physiology, Dortmund
- Postdoc at the University of St. Andrews, UK
- Dr. rer. nat. at TU Braunschweig
- Study of Chemistry, TU Braunschweig & National Taiwan Normal University, ROC

Funding

Bill and Melinda Gates Foundation, CARB-X, Chinese Scholarship Council, DFG, European Research Council, Federal Ministry of Education and Research, Ministry of Science and Culture of Lower Saxony, Volkswagen-Foundation

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Mission Statement

Prokaryotic microorganisms inhabit nearly every niche on earth, which is a consequence of their high adaptability and also contributes to their capacity to act as pathogens in infectious disease. We explore this diversity to search for new enzymes and regulators that can be employed as drug targets for novel anti-infectives.

Research

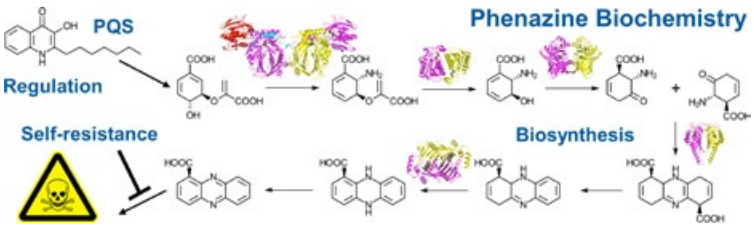
Our main interest lies in understanding small molecule/protein interactions with the aim of exploring new targets for antibiotic discovery and pathoblocker development. As structural biologists, our methodological focus is protein crystallography, but we are also using biophysical techniques and metabolome analysis for synergistic characterization. Current projects include:

Biochemistry of Phenazines: Phenazines are a group of over 150 chorismate-derived bacterial secondary metabolites. They are redox-active, which provides them with a function as broad-specificity antibiotics and virulence factors through the generation of reactive oxygen species. The best-known phenazine producer is the opportunistic pathogen *Pseudomonas aeruginosa*, which generates the blue phenazine derivative pyocyanin. We are studying the conserved genes of phenazine biosynthesis and also investigate how phenazine producers like *P. aeruginosa* protect themselves against their toxicity. Further, we are working towards an understanding of the biosynthesis and propagation of the *Pseudomonas* Quinolone Signal PQS, a unique quorum-sensing signal that may be a promising target for new pharmaceuticals.

Uncharacterized proteins in pathogenic bacteria: Genome sequencing has lead to an explosion of sequence databases in recent years, but a large amount of deposited sequences lack functional annotation such that they cannot be harnessed for biotechnological or medical research. Of these non-annotated genes we address those that have been shown to be involved in infectious disease. Towards this end, we are developing bioinformatic tools to identify proteins whose structures cannot be predicted, and combine structural, analytical and metabolomics approaches to find their molecular function.

Toxic proteins:

Many bacterial toxins are proteins that need to encode several molecular functions to unfold their action, e.g. crossing of membranes and delivery of toxic cargo. We are investigating several of these molecular machines to understand their activity in atomic detail.



Publications

- Chaoprasid P#, Lukat P#, Mühlen S#, Heidler T, Gazdag EM, Dong S, Bi W, Rüter C, Kirchenwitz M, Steffen A, Jänsch L, Stradal TEB, Dersch P*, Blankenfeldt W* (2021). Crystal structure of bacterial cytotoxic necrotizing factor CNFY reveals molecular building blocks for intoxication. EMBO J.:e105202. doi: 10.15252/embj.2020105202. #equal contribution; *corresponding authors
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- Blankenfeldt W*, Parsons JF* (2014). The structural biology of phenazine biosynthesis. Curr Opin Struct Biol 29:26-33; *corresponding authors
- Müller, M.P.#, Peters, H.#, Blümer, J., Blankenfeldt, W.*, Goody, R.S.* & Itzen, A.* (2010) The Legionella effector protein DrrA AMPylates the membrane traffic regulator Rab1b. Science 329:946-949. #equal contribution; *corresponding authors

Institute of Genetics

Prof. Dr. Melanie Brinkmann

Researcher's Career

- Professor for Virus Genetics at the TU Braunschweig, since 2018
- W1 Professor in the Institute of Virology at Hannover Medical School (MHH), 2012–2018
- Group leader at the Helmholtz Centre for Infection Research Braunschweig, since 2010
- Postdoc at the Whitehead Institute for Biomedical Research, Cambridge, USA, 2006–2010
- Postdoc in the Institute of Virology at MHH, 2004–2005
- Dr. rer. nat. at the University of Hannover/ MHH, in 2004
- Undergraduate studies in the Institute of Virology at MHH, 2000–2004
- Diploma in Biology, Humboldt University Berlin, in 1999
- Studies of Biology, Georg-August University Göttingen and Humboldt University Berlin, 1994–1999

Memberships on boards and editorial assignments

- Advisory board member Heinrich-Pette-Institute, since 2020
- Member of the Think Tank of the Helmholtz Association, since 2020
- Elected advisory board member of the German Society of Virology, since 2019
- Member of the BRICS, TU Braunschweig, since 2018

Funding

DFG, EU, State of Lower Saxony, Helmholtz Association

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Mission Statement

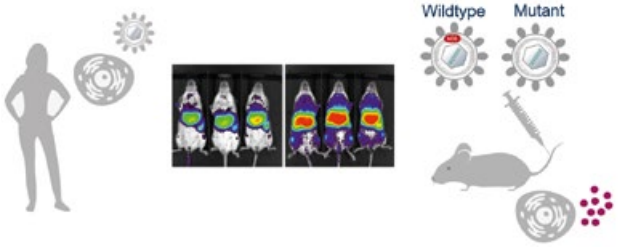
State-of-the-art virological research using a multidisciplinary approach to achieve a profound understanding of the complex relationship between viruses and their hosts. By revealing molecular mechanisms of viral immune modulation, novel insights into the innate immune response are obtained, paving the way to identifying novel intervention strategies.

Research

The herpesvirus Human Cytomegalovirus (HCMV) can cause significant morbidity in transplant patients and newborns. No licensed vaccine exists, and antiviral treatment is accompanied by the occurrence of drug-resistant mutants. Herpesviruses have large and complex genomes and have evolved a plethora of mechanisms to modulate their host. In order to develop intervention strategies, we need to understand how these viruses modulate the host's immune response, thereby avoiding their elimination by the host's immune system and securing lifelong infection.

Detection and control of viral infection: The innate immune system is equipped with receptors called pattern recognition receptors (PRR) that detect intruding pathogens and induce a potent antiviral response, leading to the expression of interferon-stimulated genes. Our work aims to understand the impact of this defense mechanism on the progression of viral infection and establishment of chronic infection. For many of them, mechanistic insights into their function are still lacking. We aim to understand which role these proteins play during viral infection with a focus on herpesviruses and SARS-Coronavirus 2, and whether they are counteracted by viral antagonists.

Viral modulation of innate immunity: We have identified several viral proteins that counteract the PRR-mediated innate immune response to infection, and have shown that these viral antagonists are crucial for the virus to secure establishment of lifelong chronic infection. While the M35 protein of murine cytomegalovirus (MCMV) targets cellular transcription, the m152 protein binds to the cellular adapter protein STING in the endoplasmic reticulum and delays its signaling activity, leading to downmodulation of the type I IFN response. Studying the detailed molecular mechanism of how these viral proteins counteract the host allows important novel insights into innate immunity and reveals novel targets for therapeutic interventions.



The complex interplay between viruses and their hosts

Publications

- Günther T, Czech-Sioli M, Indenbirken D, Robitaille A, Tenhaken P, Exner M, Ottinger M, Fischer N, Grundhoff A, Brinkmann MM (2020). SARS-CoV-2 outbreak investigation in a German meat processing plant. EMBO Mol Med. 12(12): e13296. doi: 10.15252/emmm.202013296
- Reimer E, Stempel M, Chan B, Bley H, Brinkmann MM (2020). Protein tyrosine phosphatase 1B (PTP1B) is involved in efficient type I interferon secretion upon viral infection. J Cell Science doi: 10.1242/ jcs.246421.
- Stempel, M., Chan, B., Juranić Lisnić, V., Krmpotić, A., Hartung, J., Paludan, S.R., Füllbrunn, N., Lemmermann, N.A.W., Brinkmann M.M. (2019) The herpesviral antagonist m152 reveals differential activation of STING-dependent IRF and NF-κB signaling and STING's dual role during MCMV infection. The EMBO Journal pii: e100983
- Bussey, K.A., Lau, U., Schumann, S., Gallo, A., Osbelt, L., Stempel, M., Arnold, C., Wissing, J., Gad, H.H., Hartmann, R., Brune, W., Jänsch, L., Whitehouse, A., Brinkmann M.M. (2018) The interferon-stimulated gene product oligoadenylate synthetase-like protein enhances replication of Kaposi's sarcoma-associated herpesvirus (KSHV) and interacts with the KSHV ORF20 protein. PLoS Pathogens 14(3): e1006937
- Chan B., Gonçalves Magalhães V., Lemmermann N.A.W., Juranic Lisnic V., Stempel M., Bussey K.A., Reimer E., Podlech J., Lienenklaus S., Reddehase M.J., Jonjic S., Brinkmann M.M. (2017) The murine cytomegalovirus M35 protein antagonizes type I IFN induction downstream of pattern recognition receptors by targeting NF- B mediated transcription. PLoS Pathogens 13(5): e1006382

Institute of Inorganic and Analytical Chemistry

Prof. Dr. Martin Bröring

Researcher's Career
- Full Professor (W3) for Inorganic Chemistry, TU Braunschweig
- Associate Professor (C3) for Bioinorganic Chemistry, Universität Marburg
- Habilitation, Emmy-Noether Awardee and Group Leader, Universität Würzburg
- Postdoctoral Researcher, Stanford University
- Dr. rer. nat. in Chemistry, Universität Köln
- Study of Chemistry in Würzburg and Köln

Funding
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Mission Statement

Biological energy collection and conversion is largely based on metal porphyrins, the "pigments of life", and modern research can learn from these paradigms. We develop biomimetic approaches towards problems in energy research and life science by synthesis and assembly of tailor-made porphyrin-like metal chelates.

Research

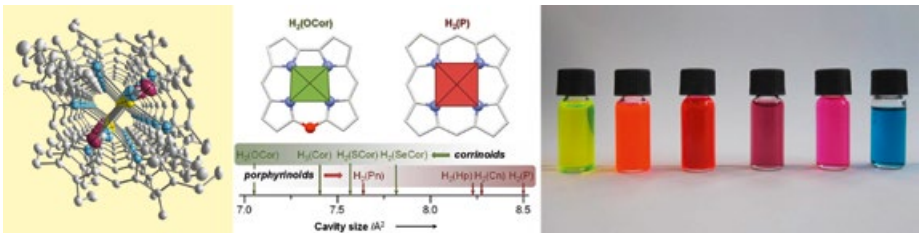
Novel Porphyrinoids: We prepare metal porphyrin variants with fine-tuned core sizes (corrole, heterocorrole), broken conjugation (isoporphyrin, isocorrole) or linear ligand structures (bidipyrrin, tripyrrin) and focus on the isolation and detailed characterization of these novel species. Unexpected and intriguing electronic structures result from such variations. Applications are found in organometallic synthesis (*Viking Helmet* corroles, Corrolocenes), in bioinorganic modelling (Cpd. I, Cyt *c*', light collection), and catalysis (C-C coupling, atom transfer).

DYEmers: Boron chelates of linear oligopyrroles (BODIPYs) are easily engineered with respect to photophysical properties by di- and oligomerization strategies. Such strongly luminescent oligomers we call DYEmers hold great potential as sensor materials and probes as well as in energy research, and applications as biosensors (CO release), battery components (redox flow) and photocatalysts (H_2 generation) are investigated in cooperation.

bioHybrids: Exchange of non-covalently bound cofactors in heme proteins against synthetic metal complexes is currently in the focus of many bioinorganic research activities. We are aiming towards the preparation and investigation of biohybrid compounds and bioconjugated catalysts using metal (iso-/hetero-)corrole complexes with biomimetic side chains.

Complex(es in) Materials: Supramolecular assemblies of our metal chelates can be obtained by ligand substitution (coordination polymers) or by stacking interactions (CT materials). We have developed several preparative strategies for ring-contracted and linear oligopyrrole building blocks and study such assemblies in cooperation with respect to optical or conductivity properties using solid state methodology.

MAGicLAB: The group owns a facility for the investigation of paramagnetic material (Mössbauer- and EPR spectroscopy, SQUID magnetometry). Many international cooperations span topics from solid state physics to molecular biology.



Publications

- R. Wicht, S. Bahnmüller, K. Brandhorst, P. Schweyen, M. Bröring (2016) Cationic Nickel porphyrinoids with unexpected reactivity. Chem. Sci., 7:583-588.
- A. Scheja, D. Baabe, D. Menzel, C. Pietzonka, P. Schweyen, M. Bröring (2015) Spin Crossover and Valence Tautomerism in Neutral Homoleptic Iron Complexes of Bis(pyridylimino)isoindolines. Chem. Eur J., 21:14196-14204.
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- P. Schweyen, K. Brandhorst, R. Wicht, B. Wolfram, M. Bröring (2015) The Corrole Radical. Angew. Chem. 127:8331-8334.
- T. Bruhn, G. Pescitelli, S. Jurinovich, A. Schaumlöffel, F. Witterauf, J. Ahrens, M. Bröring, G. Bringmann (2014) Axially Chiral BODIPY DYEmers: An Apparent Exception to the Exciton Chirality Rule. Angew. Chem. 126:14821-14824.

Institute of Pharmaceutical Technology and Biopharmaceutics

Prof. Dr. Heike Bunjes

Researcher's Career

- Professor for Pharmaceutical Formulation Technology, Institute of Pharmaceutical Technology and Biopharmaceutics, TU Braunschweig
- Professor for Pharmaceutical Technology, Institute of Pharmaceutical Technology, TU Braunschweig
- Junior professor for Pharmaceutical Technology, Institute of Pharmacy, Friedrich-Schiller-Universität Jena
- Dr. rer. nat., Institute of Pharmacy, Friedrich-Schiller-Universität Jena
- Studies in Pharmacy, TU Braunschweig

Funding

DFG, Lower Saxony, Phospholipid Research Center, Industry

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Mission Statement

Our goal is to develop delivery systems for active pharmaceutical ingredients with challenging physicochemical properties such as poor solubility or delicate chemical structure. An important basis is the fundamental understanding of the interactions between formulation composition and preparation, resulting structural properties and pharmaceutical performance.

Research

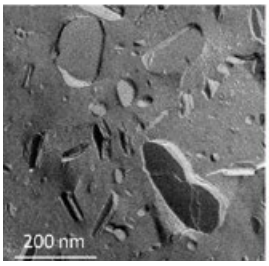
Nanoparticulate lipid carriers: Our group has long-term experience in the development, preparation and physicochemical characterization of different kinds of colloidal/nanostructured lipid-based drug delivery systems. These include solid lipid nanoparticles, lipid nanoemulsions, liposomes as well as dispersions of lyotropic and thermotropic liquid crystalline phases. Such dispersions can be used as carriers for poorly soluble drugs, for example to enable their parenteral administration.

Drug nanosuspensions: The applicability of poorly soluble drugs can also be improved by processing them into drug nanosuspensions. We work on issues of drug nanoparticle stabilization and their processing into solid dosage forms.

Protein formulations: Proteins like, for example, monoclonal antibodies represent an important class of active pharmaceutical ingredients. Their complex three-dimensional structure results, however, in challenges with regard to formulation development. Our group works on strategies for the development of stable protein formulations, in particular with regard to controlled release applications.

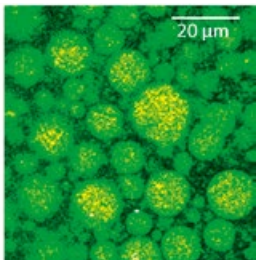
Carrier selection: When developing formulations for new drug candidates the availability of the drug substance is often limited. We establish miniaturized experimental approaches for the efficient identification of suitable carrier systems for poorly soluble drug substances and study the basics of drug-carrier interactions in order to develop a rational basis for carrier selection.

Drug release: Understanding and controlling the drug release from delivery systems is of paramount pharmaceutical importance. However, adequate methods for studying the release behavior from modern drug administration systems are not always available. We are concerned with establishing methods for investigating drug release from parenteral administration systems for poorly soluble and biomacromolecular drug substances under close to physiological conditions.



Solid lipid nanoparticles

Colloidal emulsions as drug carriers



Protein-loaded hydrogel microparticles

Publications

- Czyz S., Wewers M., Finke J.H., Kwade A., van Eerdenbrugh B., Juhnke M., Bunjes H., Spray drying of API nanosuspensions: Importance of drying temperature, type and content of matrix former and particle size for successful formulation and process development, Eur. J. Pharm. Biopharm. 152 (2020) 63–71.
- Gehrmann S., Bunjes H., Influence of membrane material on the production of colloidal emulsions by premix membrane emulsification, Eur. J. Pharm. Biopharm. 126 (2018) 140–148.
- Roese E., Bunjes H., Drug release studies from lipid nanoparticles in physiological media by a new DSC method, J. Control. Rel. 256 (2017) 92–100.
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- Wöhl-Bruhn S., Badar M., Bertz A., Tiersch B., Koetz J., Menzel H., Mueller P.P., Bunjes, H., Comparison of *in vitro* and *in vivo* protein release from hydrogel systems, J. Control. Rel. 162 (2012) 127–133.

Institute of Biochemistry, Biotechnology and Bioinformatics (IB3)

Prof. Dr. Stefan Dübel

- Head, Dept. Biotechnology

Researcher's Career

- Full Professor, Biotechnology, TU Braunschweig, Managing Director of IB3 and Director, Centre of Molecular Engineering, iTUBS
- Co-founder of four biotech spin-off companies
- Group Leader, Institute for Molecular Genetics, University of Heidelberg
- Scholar, senior scientist and Group Leader, German Cancer Research Centre, Heidelberg (DKFZ)
- Ph.D. at Center for Molecular Biology Heidelberg (ZMBH)
- Studies of Biology, Mainz and Heidelberg

Funding

EU, BMBF, BMWi, DFG, AIF, Waldklimafonds, PISC, Industry

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Mission Statement

A recombinant antibody generated by phage display is currently the world's bestselling biological drug. Since we developed the enabling technology, we continue to generate and refine human antibodies both by adding novel functions allowing new therapeutic paradigms and developing high-throughput in vitro antibody generation to substitute animal experiments.

Research

Phage display and human antibody discovery: We partner with academia and pharma in the generation of new drugs against cancer, autoimmune diseases and infections using our world leading antibody phage display systems, including the first truly comprehensive naïve functional human antibody gene repertoire.

Designer antibodies: The control of the biochemical milieu during the in vitro selection step can be employed to predetermine antibody properties at the very moment of selection, e.g. to fine tune specificity, to avoid crossreactivity or to generate compatible sandwich pairs.

Antibodies against pathogens: We generated neutralizing antibodies to numerous bacterial and viral pathogens, including SARS-CoV2, as well as conformation specific antibodies to alzheimer peptide.

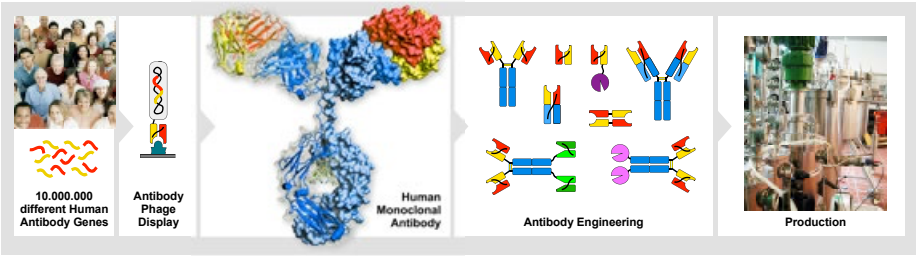
Discovery of novel disease biomarkers: Using phage display of whole genomes together with Hyperphage, we identified immunogenic proteins not found so far using cultivated pathogens, yielding new candidates for diagnostic markers or vaccines.

High-throughput *in vitro* antibody generation to avoid animal experiments: In international consortia, we generated large sets of research antibodies in a high throughput semi-automated pipeline, bypassing the capability of animal based methods both in speed and quality.

Improving antibodies: Multiple biochemical properties, like stability, affinity, valency or size, as well as additional functions of immunoglobulins can be designed, engineered or improved by in vivo evolution or by fusion with other domains. The new proteins can be made in various production and purification systems for recombinant antibodies.

Protein knock down *in vivo* by intrabodies: Protein knock down can be achieved in vivo by expressing intracellular antibodies, as demonstrated in trangenic mice.

Allosteric switches for antibodies: by adding a generic allosteric regulation element as a linker between the two antigen binding domains of an immunoglobulin, regulation of antigen binding affinity can be achieved.



Publications

- Dübel, S. et al. (2019). Rekombinante Antikörper. Lehrbuch, Springer Verlag, Heidelberg, ISBN 978-3-662-50275-45
- Zehner, M.et al. (2015) Endosomal Sec61 mediates antigen translocation in the cytosol for cross-presentation. Immunity 42:850-863
- Dübel, S. & Reichert, J.M. (eds.) (2014) Handbook of Therapeutic Antibodies, 2nd ed. 4 Vol., Wiley-VCH, Weinheim, ISBN 978-3-527-32937-3
- Marschall, A.L.J.et al. (2014) Functional knock down of VCAM1 in mice mediated by ER intrabodies. mAbs 6, 1394-1401
- Sehnert, B. et al. (2013) An NF-κB inhibitor targeted to activated endothelium demonstrates a critical role of endothelial NF-κB in immune-mediated diseases. Proc. Natl. Acad. Sci., 110, 16556-16561

Institute for Physical and Theoretical Chemistry

Prof. Dr. Simon Ebbinghaus

- 2007 Doctorate Degree (Dr. rer. nat.), Ruhr-University Bochum
- 2004 Diploma in Chemistry and Biochemistry, Ruhr-University Bochum
- 2001–2002 Undergraduate studies, (3rd year Chemistry), St. Hugh's College, University of Oxford

Researcher's Career

- Since 2018 Full Professor (W3), Institute of Physical and Theoretical Chemistry, TU Braunschweig
- 2017–2018 Professor (W2), Ruhr-University Bochum
- 2011–2017 Juniorprofessor (W1), Ruhr-University Bochum
- 2012–2013 Interim Professor, Chair of Physical Chemistry II (W3), University of Freiburg
- 2008–2010 Postdoctoral Researcher, University of Illinois, Urbana-Champaign, USA

Funding

DFG-SPP, DFG-Graduate-School, GIF, HFSP

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Mission Statement

Most biopolymers like proteins, DNA, and RNA molecules function inside cells, but are probed under test tube conditions. We are interested in studying biomolecular structure, function and aggregation directly in the cellular environment using state-of-the-art techniques to yield new insights on their function in health and disease.

Research

Physical nature of macromolecular crowding effects

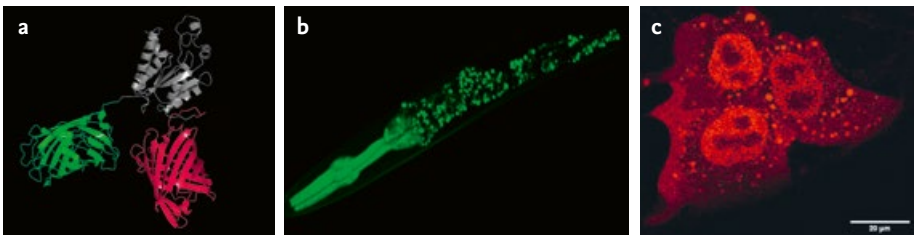
One factor that alters folding in cells is macromolecular crowding. Although it was assumed that crowding effects are mainly mediated by entropic excluded volume effects, our group could show that enthalpic stabilization and entropic destabilization effects determine the protein folding stability. Including osmolytes and electrolytes, the lab developed a novel model to describe cosolute effects based on their thermodynamic fingerprints.

Biomolecular reactions in health and disease conditions

Our group further developed biosensors to quantify crowding effects directly in living cells. These sensors report on the different contributions of crowding effects such as excluded volume, non-specific interaction, water content or chaperone activity. Their net balance can be perturbed for example by osmotic stress. Further, the cellular environment imposes stabilizing or destabilizing effects to nucleic acids while the folding stability is dependent on subcellular localization. Such variations could be utilized by the cells to locally adjust the energy landscape for RNA folding.

Protein complex assembly, aggregation and liquid-liquid phase separation

Similar effects can be observed for proteins, where most destabilizing conditions lead to protein aggregation or phase separation. Our lab developed a new technology to measure conformational stability and aggregation kinetics of Huntingtin exon-1, human islet polypeptide hIAPP and superoxide dismutase 1 directly on the cellular level by using fast laser-induced temperature jumps in combination with microscopy. This allows analyzing cellular factors that either promote (e.g. osmotic stress) or prevent (e.g. chaperone interactions or protective osmolytes) protein aggregation. Using the in-cell aggregation assay, our group explores new strategies to interfere with protein aggregation developing new therapeutic intervention against neurodegenerative diseases.



The stability and function of different proteins (here: APS kinase (a)) is investigated in cellular and multicellular organisms (b,c).

Publications

- D. Gnutt, S. Timr, J. Ahlers, B. König, E. Manderfeld, M. Heyden, F. Sterpone, S. Ebbinghaus. (2019) Stability Effect of Quinary Interactions Reversed by Single Point Mutations, J.Am.Chem.Soc., 141(11), 4660-4669, 2019.
- Ribeiro, S. S.; Samanta, N.; Ebbinghaus, S.; Marcos, J. C. (2019) The Synergic Effect of Water and Biomolecules in Intracellular Phase Separation. Nat Rev Chem, 3 (9), 552–561. https://doi.org/10.1038/s41570-019-0120-4.
- Vöpel, T.; Bravo-Rodriguez, K.; Mittal, S.; Vachharajani, S.; Gnutt, D.; Sharma, A.; Steinhof, A.; Fatoba, O.; Ellrichmann, G.; Nshanian, M.; Heid, C.; Loo, J. A.; Klärner, F.-G.; Schrader, T.; Bitan, G.; Wanker, E. E.; Ebbinghaus, S.; Sanchez-Garcia, E. (2017) Inhibition of Huntingtin Exon-1 Aggregation by the Molecular Tweezer CLR01. J. Am. Chem. Soc., 139 (16), 5640–5643. https://doi.org/10.1021/jacs.6b11039.
- Gao, M.; Gnutt, D.; Orban, A.; Appel, B.; Righetti, F.; Winter, R.; Narberhaus, F.; Müller, S.; Ebbinghaus, S. (2016) RNA Hairpin Folding in the Crowded Cell. Angew Chem Int Ed Engl 2016, 55 (9), 3224–3228. https://doi.org/10.1002/anie.201510847.
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Institute of Psychology – Methodology and Biopsychology (IPMB)

Prof. Dr. Frank Eggert

Researcher's Career

- Professor of Psychological Methodology and Biopsychology, TU Braunschweig
- Adjunct Professor of General Psychology, University of Kiel
- Senior Lecturer, University of Kiel
- Dr. phil. habil. and Venia Legendi in Psychology, University of Kiel
- Professioral Assistant, University of Kiel
- Dr. phil., University of Kiel
- Research Assistant, University of Kiel
- Dipl.-Psych., University of Kiel
- Study of Psychology, University of Kiel

Funding
BMWi, BMU, Volkswagen Foundation, Industry

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Mission Statement

I try to understand how behaviour is selected by its consequences for the organism via its effect on the organism's environment. I am interested in behavioural adaptations at all levels (overt, verbal, covert) resulting from natural selection as well as operant conditioning or social discourses and the role these adaptations play in individual, social and cultural behaviour.

Research

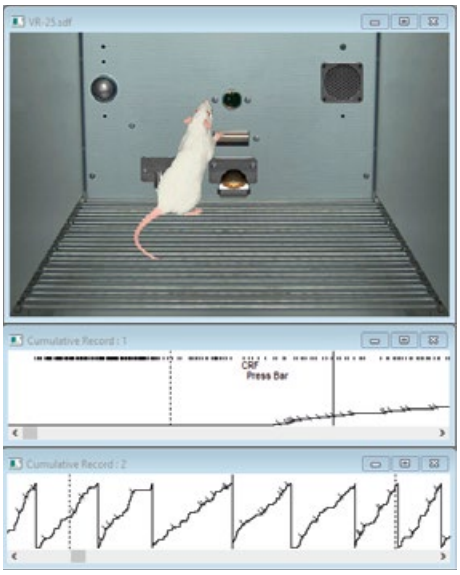
Human-Machine-Interaction: We developed a number of innovative driver assistance systems that are based on principles of behavioural control that have not been utilized in this field before. We used theoretically based design to develop a user interface for influencing resource related behaviour by means of different strategies to present information to the user.

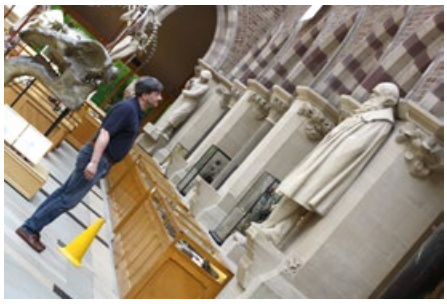
Resource conserving behaviour: We investigate a number of different factors that are involved in the control of resource relevant behaviour in humans. Further on, we try to develop a behavioural definition of sustainable behaviour in terms of a more general theory of behaviour.

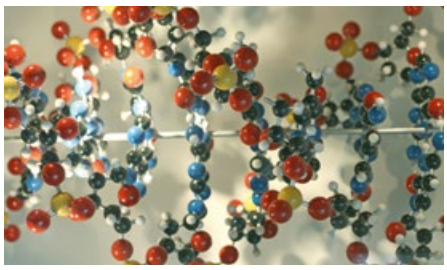
Psychology as the science of behaviour: We are interested in the re-interpretation of common psychological constructs (and procedures) in terms of behaviour, trying to clarify the categorical foundations of Psychology.

Research methods in Psychology: We are interested in examining the role of statistics and formal methods in the research process and why they are applied inappropriately so often.

General theory of behaviour: We are interested in the theoretical integration of Behavioural Ecology and Psychology and the development of a general theory of behaviour.







Publications and Patents

- Holzhauser, N. & Eggert, F. (2019). The role of measurement in theorising about the world. Social Science Information, 58, 301-326.
- Buntins, M., Buntins, K. & Eggert, F. (2017). Clarifying the concept of validity: From measurement to everyday language. Theory & Psychology, 27, 703-710.
- Lange, F. & Eggert, F. (2015). Selective cooperation in the supermarket: Field experimental evidence for indirect reciprocity. Human Nature, 26, 392-400.
- Buntins, M., Buntins, K. & Eggert, F. (2015). Psychological tests from a (fuzzy-)logical point of view. Quality and Quantity: International Journal of Methodology, 50, 2395-2416.
- Lange, F., Brückner, C., Kröger, B., Beller, J. & Eggert, F. (2014). Wasting ways: Perceived distance to the recycling facilities predicts pro-environmental behavior. Resources, Conservation and Recycling, 92, 246-254.
- Schwarze, A., Buntins, M., Schicke-Uffmann, J., Goltz, U. & Eggert, F. (2013). Modelling driving behaviour using hybrid automata. IET-Intelligent Transport Systems, 7, 251-256.

Institute for Microbiology

Prof. Dr. Susanne Engelmann

Researcher's Career

- Professor for Microbial Proteomics at the TU Braunschweig
- Group leader of the Microbial Proteomics Group at the HZI in Braunschweig
- Group leader of the Pathogenomics Group at the University in Greifswald, Institute for Microbiology
- PostDoc at the University in Greifswald, Institute for Microbiology
- Dr. rer. nat. at the University in Greifswald, Institute for Microbiology
- Study of Biology at the University in Greifswald

Funding
DFG

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Mission Statement

We are using functional genomics approaches to get deeper insights into host pathogen interactions which is an essential prerequisite for the development of novel diagnostic tools and antiinfective strategies to successfully combat bacterial infections also in the future.

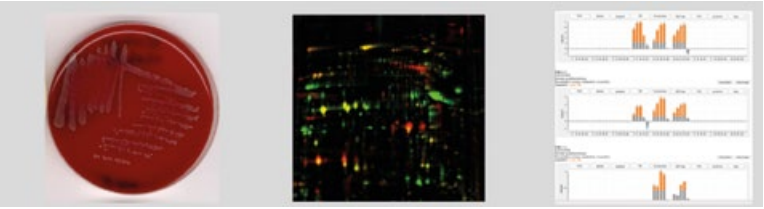
Research

Staphylococcus aureus and *Pseudomonas aeruginosa* are among the leading nosocomial pathogens frequently involved in respiratory-associated pneumonia and sepsis. The mortality rate of infected patients in the hospitals is alarming and strongly demands novel and more effective antimicrobials. One hallmark of our research is thus to provide a more comprehensive understanding of host pathogen interactions during colonization and infection using *S. aureus* and *P. aeruginosa* as model organisms.

Adaptation of pathogenic bacteria to infection and colonization related conditions: Adaptation of bacteria to the host environment during colonization and infection is a very complex process and involves physiological adaptation and immune evasion strategies. We are using functional genomics technologies, particularly mass spectrometry (MS) based proteomics to gain new information on the dynamics of the protein inventory and protein modification events, the role of crucial regulons in metabolism and proteins displaying essential functions under these conditions.

Identification of novel targets for antiinfectiva and new vaccine candidates: By identifying proteins which are essential for bacterial colonization and infection we are not only able to define vaccine candidates to monitor and prevent spreading of the respective pathogen but also drug targets leading to novel treatment options for infections with multiresistant isolates.

Functional characterization of bacterial proteins: MS-based protein identification revealed that about 40 % of the proteins expressed in bacteria lack functional annotation. We are particularly interested in proteins that are secreted and thus highly relevant for host pathogen interaction. Mutants, recombinant proteins and corresponding polyclonal antibodies are being generated and used for functional characterization (identification of interaction partners, binding to immune cells and non-professional phagocytes, interaction with components of the immune system and virulence in animal models).



Publications

- Stentzel, S., Teufelberger, A., Nordengrün, M., Kolata, J., Schmidt, F., van Crombuggen, K., Michalik, S., Kumpfmüller, J., Tischer, S., Schweder, T., Hecker, M., Engelmann, S., Völker, U., Krysko, O., Bachert, C., Bröker, B. M. (2017) Staphylococcal serine protease-like proteins are pacemakers of allergic airway reactions to Staphylococcus aureus. J. Allerg. Clin. Immunol. 139:492-500.
- Kloppot, P., Selle, M., Kohler, C., Stentzel, S., Fuchs, S., Liebscher, V., Müller, E., Kale, D., Ohlsen, K., Bröker, B. M., Zipfel, P., Kahl, B., Ehricht, R., Hecker, M., Engelmann, S. (2015) Microarray based identification of human antibodies against *S. aureus* antigens. Proteomics Clin. Appl. 9:1003-1011.
- Müller, M., Reiß, S., Schlüter, R., Mäder, U., Beyer, A., Reiß, W., Marles-Wright, J., Lewis, R. L., Pförtner, H., Völker, U., Riedel, K., Hecker, M., Engelmann, S., Pané-Farré, J. (2014) The DUF322 protein Asp23 of *S. aureus* is membrane localized and functionally linked to cell wall stress. Mol. Microbiol. 93:1259-1268.
- Fuchs, S., Zühlke, D., Pané-Farré, J., Kusch, H., Wolf, C., Reiß, S., Binh, L.T.N., Albrecht, D., Riedel, K., Hecker, M., Engelmann, S. (2013) Aureolib – a proteome signature library: Towards an understanding of *S. aureus* pathophysiology. PlosOne. 8:e70669.
- Pagels, M., Fuchs, S., Pané-Farré, J., Kohler, C., Menschner, L., Hecker, M., McNamarra, P.J., Bauer, M.C., von Wachenfeldt, C., Liebeke, M., Lalk, M., Sander, G., von Eiff, C., Proctor, R.A., Engelmann, S. (2010) Redox sensing by a Rex-family repressor is involved in the regulation of anaerobic gene expression in *S. aureus*. Mol. Microbiol. 76:1142-1161.

Institute of Genetics

Prof. Dr. André Fleißner

Researcher's Career

- Professor of Genetics, TU Braunschweig
- Assistant Professor of Genetics, TU Braunschweig
- Postdoc at the University of California, Berkeley
- Dr. rer. nat. at the University Münster, Institute of Botany
- Studies of Biology at the Freie Universität Berlin and the University Münster

Funding

DFG, EU, Lower Saxony, Volkswagen Foundation

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Mission Statement

We are employing various fungal model organisms to elucidate the basic molecular mechanisms governing growth, development and differentiation of individual cells and cell populations. In addition, our expertise includes fungal pathogenesis and biotechnological applications.

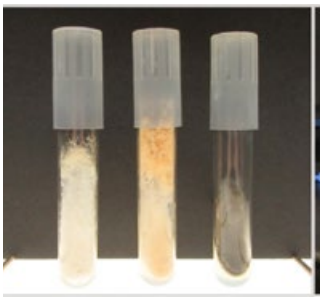
Research

Cell-cell communication and fusion: Using the red bread mold *Neurospora crassa*, we are investigating how cells communicate and fuse into supracellular structures. Currently, we are focussing on a novel signaling mechanism, in which cells alternate between signal sending and receiving, and the contribution of the plasma membrane to the formation and activation of signaling protein complexes.

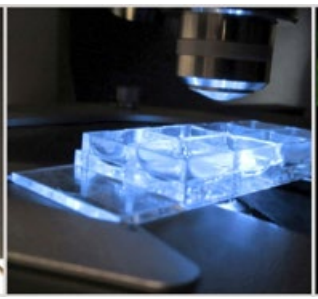
Membrane repair mechanisms: We are analyzing the molecular mechanisms mediating membrane repair in *Neurospora crassa*, the human pathogenic yeast *Candida albicans*, and the plant pathogen *Botrytis cinerea*. This research furthers our understanding of cellular stress responses, including the reaction of fungal cells to antimycotic drugs.

Interspecies interactions and horizontal gene transfer: We obtained evidence that fungi speak a common molecular language, enabling interactions across species borders. Recently, we started to test the novel hypothesis that such interspecies interactions offer an avenue for horizontal gene transfer, which significantly contributes to the evolution of fungi.

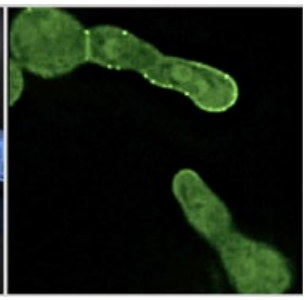
Fungi as biotechnological production hosts: Fungi have many features desirable in biotechnological applications, including fast growth and high secretory capacities. We aim to optimize their use as production hosts for heterologous proteins, including pharmaceutical relevant products, such as human antibody fragments. A current goal is to identify the main molecular restrictions, which limit microbial productivity.



Different fungal strains



Fluorescence microscopy



Signaling complexes in interacting cells of *N. crassa*

Publications

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- Schumann, M.R., Brandt, U., Adis, C., Hartung, L., and Fleißner, A. (2019) Plasma membran integrity during cell-cell fusion and in response to pore-forming drugs is promoted by the penta-EF-hand protein PEF1 in *Neurospora crassa.* Genetics 213(1):195-211.
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Institute of Microbiology

Prof. Dr. Dirk Heinz

Scientific Director
Helmholtz Centre for Infection Research (HZI)

Researcher's Career

- Full professorship for Molecular Structural Biology at TU Braunschweig
- Scientific Director, Helmholtz Centre for Infection Research, Braunschweig (HZI)
- Speaker of Helmholtz Programme "Infection Research"
- Head Department for Molecular Structural Biology, HZI, Braunschweig
- Head of Division of Structural Biology, German Research Center for Biotechnology (GBF)*, Braunschweig (now HZI)
- Head of Department of Structural Biology, GBF, Braunschweig
- Habilitation in Biochemistry, University of Freiburg
- Junior research group leader in the Department of Structural Biology, GBF
- Research Assistant, University of Freiburg
- Postdoctoral Fellow, University of Oregon, Eugene, U.S.A.

Funding
EU, BMBF, Lower Saxony/State, Helmholtz Association, DFG, DZIF, Industry

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Mission Statement

The structure and function of biomacromolecules, such as proteins and nucleic acids, are the basis of all biological processes. Infections can be better understood by investigating the structures of bacterial virulence factors and their interactions with the host. Elucidating the details of these processes will provide us with new ideas to fight infections.

Research

- Structural analysis of virulence factors of pathogenic micro-organisms and their interactions with host cell receptors
- Structural analysis of enzymes of the co-factor synthesis
- Structural analysis of bacterial enzymes of natural compound synthesis

Currently, Prof. Heinz (as Scientific Director of the Helmholtz Centre for Infection Research) is not operating an active laboratory, neither on the premises of the TU nor the HZI.

Publications

- Hebecker S., Krausze J., Hasenkampf T., Schneider J., Groenewold M., Reichelt J., Jahn D., Heinz D.W. & Moser J. (2015) Structures of two bacterial resistance factors mediating tRNA-dependent aminoacylation of phosphatidylglycerol with lysine or alanine. Proc Natl Acad Sci USA. 25, 10691-6.
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- Quade N., Huo L., Rachid S., Heinz D.W. & Müller R. (2011) Unusual carbon fixation gives rise to diverse polyketide extender units. Nat Chem Biol 8, 117-124.
- Niemann H.H., Jäger V., Butler P.J., van den Heuvel J., Schmidt S., Ferraris D., Gherardi E. & Heinz D.W. (2007) Structure of the human receptor tyrosine kinase met in complex with the Listeria invasion protein InlB. Cell 27, 235-246.

Department of Biochemistry and Bioinformatics

Prof. Dr. Karsten Hiller

- Director of the Department of Biochemistry and Bioinformatics
- Deputy Director of the Systems Biology Centre BRICS

Researcher's Career

- Full Professor of Biochemistry and Bioinformatics at the TU Braunschweig
- Associate Professor of Cellular Metabolism, University of Luxembourg
- Junior Group Leader, Luxembourg Centre for Systems Biomedicine (LCSB)
- Postdoc at Massachusetts Institute of Technology (MIT), USA
- Postdoc at TU Braunschweig
- Dr. rer. nat. at TU Braunschweig, Institute of Microbiology
- Study of Biology and Computer Sciences, Braunschweig

Funding
DFG, State of Lower Saxony, industry

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Mission Statement

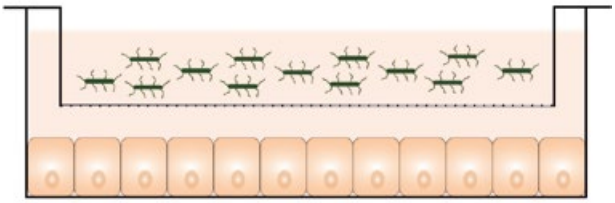
To reveal how metabolism is involved in the mammalian immune response by using mass-spectrometry based metabolomics and stable-isotope labeling in combination with computational methods.

Research

Metabolic profiling of immune cells: We are interested to understand how metabolism is involved in disease progression and how metabolic intervention can be of advantage for disease outcome. The immune system is an excellent example for a very well-balanced homeostasis – if hyperactive, it can cause autoimmune diseases or other complications such as anaphylactic or septic shock. In contrast, if hypoactive, it can cause malignancies such as infections or cancer. With our discovery that activated macrophages produce high amounts of the anti-microbial and anti-inflammatory metabolite itaconic acid, we set ground for many follow-up studies in the field, intriguingly demonstrating how metabolism can interfere with innate immune homeostasis.

Metabolic host pathogen interaction: Besides immunological signaling processes, an infection also induces a metabolic cross-talk between host cells and the pathogen. We set out to understand the metabolic language of this cross-talk and established in vitro co-culture systems to profile cellular metabolism of host and pathogen cells simultaneously during an infection. With this strategy, we intend to reveal new intervention points that will allow for a beneficial modulation of the infection process.

Bioinformatics and Metabolomics analytical methods: Our main goal is to tailor new computational and analytical tools that help us to obtain a better understanding of metabolic and cellular mechanisms relevant for our scientific questions. In the past, we have already developed specific stable-isotope and mass spectrometry based technologies including algorithms and software: MetaboliteDetector, Non-targeted Tracer Fate Detection (NTFD), Mass Isotopolome Analyzer (MIA), MIA Mode of Action Identification (MIAMI), Fragment Formula Calculator (FFC) and others.



Publications

- He, W., Heinz, A., Jahn, D. & Hiller, K. Complexity of macrophage metabolism in infection. Current Opinion in Biotechnology 68, 231–239 (2021).
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Department of Psychology – Institute of Developmental-, Personality-, & Forensic Psychology

Prof. Dr. Daniela Hosser

Researcher's Career

- Full Professor for Psychology, TU Braunschweig
- Associate Professor for Psychology, TU Braunschweig
- Scientific Vice Director at the Criminological Research Institute of Lower Saxony, Hannover
- Senior Researcher at the Criminological Research Institute of Lower Saxony, Hannover
- Dr. rer. nat. TU Braunschweig, Institute of Psychology
- Research Assistant at the Criminological Research Institute of Lower Saxony, Hannover
- Study of Psychology, degree Dipl.-Psych. TU Braunschweig

Funding

DFG, BMBF, Ministries of Justice

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Mission Statement

The main aim of our research is to understand the origins, conditions, and functions of empathy, moral emotions, and emotion regulation and their role in the development of moral or antisocial behavior. Especially, we engage in the examination of delinquent trajectories and the evaluation of offender treatment and criminal prevention.

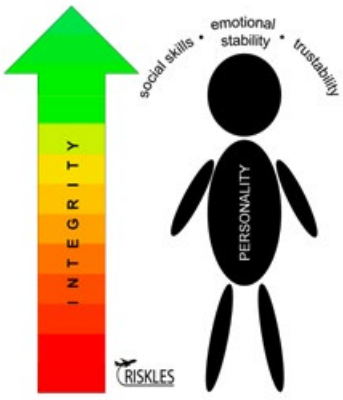
Research

Developmental Trajectories of Delinquent Behavior: We investigate trajectories of delinquency in serious offenders across adolescence and adulthood and how these trajectories differ for varying offender groups. Identifying specific risk and protective factors for different developmental conditions may help to further improve the effects of offender treatment. Our special focus is on the interplay of emotions, personality, and crime.

Self- and emotion regulation:
When changing dysfunctional behavioral habits and pursuing new goals, temperament and affect as well as emotion regulation and defense mechanisms play an important role as promoting or inhibiting factors. Their interplay is examined, especially in stressful situations or after a critical life event.

Moral Emotions, Moral Behavior, and Well-Being: Using multimethod designs, longitudinal and cross-sectional data of varying samples and age groups, we study the relationship between moral emotions, moral or antisocial behavior, and well-being. In a broader ongoing study we analyze the impact of guilt and shame in offender treatment and rehabilitation. Furthermore, we look at the meaning of guilt and shame on well-being and social functioning in individuals in old age and near the end of life.

Integrity Testing for Pre-Employment Screening: We develop standardized personality tests to assess integrity via online-testing as part of the pre-employment screening for security personnel in various settings.



Publications

- Krokoszinski, L. & Hosser, D. (2016). Emotion regulation during deception: An EEG study of imprisoned fraudsters. Journal of Criminal Psychology, 6, (2), 76-88.
- Beller, J., Kröger, C., & Hosser, D. (2019). Disentangling Honor-Based Violence and Religion: The Differential Influence of Individual and Social Religious Practices and Fundamentalism on Support for Honor Killings in a Cross-National Sample of Muslims. Journal of Interpersonal Violence. https://doi.org/10.1177/0886260519869071
- Taefi, A., & Hosser, D. (2019). Trajectories of delinquency among young adult prisoners. European Journal of Criminology, https://doi.org/10.1177/1477370819877769
- Krokoszinski, L., Westenberger, A. & Hosser, D. (2018). Emotional responsiveness in convicted fraudsters: a study on baseline activation of the anterior insula and its influence on moral decision-making Journal of Forensic Psychiatry and Psychology, 29, 527-543. https://doi.org/10.1080/14789949.2018.1425470
- Krokoszinski, L., Westenberger, A., & Hosser, D. (2018). Social competencies and the sociomoral reflectiveness of imprisoned fraudsters. Journal of Forensic Practice, 20(4), 279-288.

Institute of Physical and Theoretical Chemistry

Prof. Dr. Christoph Jacob

Researcher's Career

- Professor for Theoretical Chemistry, TU Braunschweig
- Independent Group Leader, Karlsruhe Institute of Technology
- Postdoc at ETH Zurich
- Ph.D. at Vrije Universiteit Amsterdam
- Research Fellow, Auckland University
- Studies of Chemistry and Mathematics at University of Karlsruhe and Philipps University Marburg

Funding

DFG, Industry

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Mission Statement

We develop quantum-chemical methods for the description of complex chemical systems – ranging from biomolecules to materials. We apply these methods to study spectroscopic properties and to design functional chemical systems – for energy conversion, for catalysis, and for drug discovery.

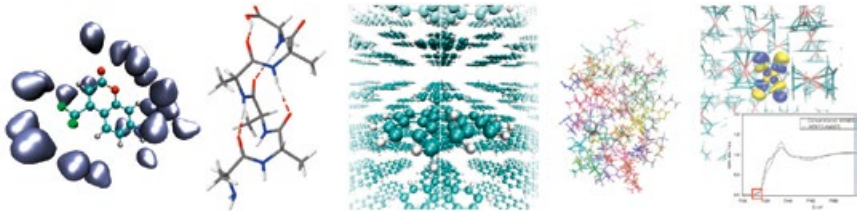
Research

In our research efforts, the application of computational chemistry to complex chemical systems and to challenging problems of theoretical spectroscopy goes hand in hand with quantum-chemical method and software development.

Subsystem Quantum Chemistry: To describe large chemical systems with quantum-chemical methods, we develop subsystem methods, in which such large systems are partitioned into smaller building blocks. These are then treated individually, embedded into the environment of all other subsystems. This also provides a starting point for quantum-chemical embedding methods, in which subsystems of interest are treated with more accurate methods or in which local spectroscopic properties of selected subsystems are targeted. These methods are applied to a wide range of problems, including computational materials design, (bio-)catalysis, and the discovery of novel anti-infectives.

Theoretical Spectroscopy: We develop and apply quantum-chemical methods for predicting spectroscopic properties of complex molecular systems, ranging from transition-metal catalysts to biological molecules as well as complex materials and from X-ray spectroscopy through optical (UV/Vis) and vibrational spectroscopy to nuclear-magnetic and electron-spin resonance (NMR and ESR) spectroscopy. Our method development in this area is driven by challenging experimental problems and novel spectroscopic experiments.

Density-Functional Theory: To develop more reliable quantum-chemical methods, we address fundamental issues in density-functional theory. This includes subsystem approaches to treat intermolecular charge transfer as well as the development of novel quantum-chemical approaches for open-shell molecules, in particular transition metal complexes.



Publications

- T. G. Bergmann, M. Ole Welzel, Ch. R. Jacob, "Towards Theoretical Spectroscopy with Error Bars: Systematic Quantification of the Structural Sensitivity of Calculated Spectra", Chem. Sci. 11 (2020), 1862-1877
- J. Rudolph, Ch. R. Jacob, "Revisiting the Dependence of Cu K-Edge X-ray Absorption Spectra on Oxidation State and Coordination Environment", Inorg. Chem. 57 (2018), 10591-10607.
- P. T. Panek, Ch. R. Jacob, "Anharmonic Theoretical Vibrational Spectroscopy of Polypeptides", J. Phys. Chem. Lett. 7 (2016), 3084-3090.
- A. Boubnov, H. W. P. Carvalho, D. E. Doronkin, T. Günter, E. Gallo, A. J. Atkins, Ch. R. Jacob, J.-D. Grunwaldt, "Selective Catalytic Reduction of NO Over Fe-ZSM-5: Mechanistic Insights by Operando HERFD-XANES and Valence-to-Core X-ray Emission Spectroscopy", J. Am. Chem. Soc. 136 (2014) 13006-13015.
- Ch. R. Jacob, J. Neugebauer, "Subsystem Density-Functional Theory", WIREs Comput. Mol. Sci. 4 (2014) 325-362.

Institute of Microbiology

Prof. Dr. Dieter Jahn

- Director of the Systems Biology Centre BRICS
- Former Vice President for Research and International Affairs, TU Braunschweig
- Coordinator of the infection biology consortium CDInfect (*Clostridium difficile*)
- Co-Coordinator of the DFG Transregional Collaborative Research Centre SFB-TRR 51"Roseobacter"
- Co-Coordinator of the DFG GRK 2223/1 "Protein Complex Assembly – PROCOMPAS"

Researcher's Career

- Full Professor for Microbiology at the TU Braunschweig
- Associate Professor for Biochemistry, Freiburg University
- Junior Group Leader at Max-Planck Institute for Terrestrial Microbiology, Marburg
- Postdoc at Yale University, USA
- Dr. rer. nat. at the Philipps-Universität Marburg, Institute for Physiological Chemistry
- Study of Biology, Chemistry, Political Sciences, Marburg

Funding
DFG, BMBF, EU, State Lower Saxony, Industry

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Mission Statement

State-of-the-art microbiological research using a broad spectrum of methods in combination with various bacterial model systems is employed to achieve worldwide recognized scientific progress in the fields of bacterial physiology, biochemistry, infection biology, ecology, biotechnology and systems biology.

Research

Enzymology and structural biology of enzymes for the biosynthesis of heme and chlorophyll: For more than 25 years our laboratory has been investigating step by step the structure and function of enzymes for the biosynthesis of the tetrapyrroles heme and chlorophyll. Currently, we are focusing on enzymes of alternative heme and chlorophyll biosynthesis.

Systems infection biology of the pathogens *Clostridium difficile* and *Pseudomonas aeruginosa*: We use biochemistry, physiology and modern Omics technologies in combination with bioinformatics based modelling to elucidate the regulatory networks, involved regulators and the structure of enzyme complexes for anaerobic denitrification in *P. aeruginosa* and of iron uptake/oxygen stress in *C. difficile.*

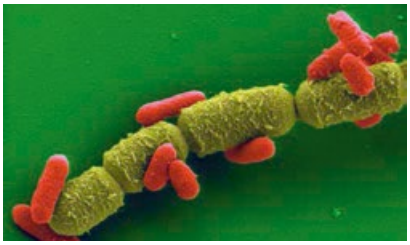
Molecular biology of marine bacteria: Anaerobic metabolism and iron acquisition with their underlying regulatory networks are investigated with systems biology methods for the marine model bacterium *Dinoroseobacter shibae* in the framework of the SFB-TRR 51.

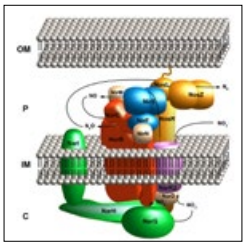
Systems biotechnology of *Bacillus megaterium*: A plasmid-based system for the gram per liter intra- and extracellular production of recombinant proteins. It is commercially available (MoBiTec GmbH, Göttingen).

Physiology and regulation of the anaerobic metabolism of *Bacillus subtilis*: We elucidated the anaerobic nitrate respiratory and fermentative metabolism of *B. subtilis* and determined the biochemistry of the involved regulatory proteins Fnr and AlsR.

Industrial microbiology: In cooperation with various companies (Behr AG, Volkswagen AG) we investigated the contamination of industrial surfaces and prevention strategies.

Bioinformatics: Databases and tools for transcriptional network prediction in bacteria are provided.





Publications

- Kubannek, F., Thiel, S., Bunk, B., Huber, K., Overmann, J., Krewer, U., Biedendieck, R. & Jahn, D. (2020) Performance modelling of the bioelectrochemical glycerol oxidation by a co-culture of *Geobacter sulfurreducens* and *Raoultella electrica*. ChemElectroChem. no. 8.0 (2020): 1877.0-1888.
- Berges, M. , Michel, A.-M., Lassek, C., , Nuss, A. M., Beckstette, M., Dersch, P., Riedel, K., Sievers, S., Becher, D., Otto, A. , Maaß, S., Rohde, M., Eckweiler, D., Borrero-de Acuna, J. M., Jahn, M. J., Neumann-Schaal, M. & Jahn, D. (2018) Iron regulation in *Clostridioides difficile*. Front. Microbiol., 9:3183.
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- Möbius, K., Arias-Cartin, R., Breckau, D., Haennig, A.-L., Riedmann, K., Biedendieck, R., Schroeder, S., Becher, D., Magalon, A., Moser, J., Jahn, M. & Jahn, D. (2010) Heme biosynthesis is coupled to electron transport chains for energy generation. Proc. Natl. Acad. Sci. USA 107:10436-10441.

Department of Psychology – Institute of Industrial/Organizational and Social Psychology

Prof. Dr. Simone Kauffeld

- Former vice president for teaching and diversity, TU Braunschweig
- Editor of the Journals "Personal Quarterly" and "Group. Interaction. Organization"
- Associate of the 4A-SIDE GmbH (HR consultancy)
- Former coordinator of the graduate school Grad.life, TU Braunschweig

Researcher's Career

- Full Professor for Industrial/ Organizational and Social Psychology, Institute of Psychology, TU Braunschweig
- Professor for Work and Organizational Psychology, University of Applied Sciences Northwestern Switzerland
- Visiting Scholar at Brooklyn College, City University of New York, USA
- Research group leader in competence development projects at the University of Kassel
- Ph.D. in Psychology (title of habilitation: "measuring, rating, and developing competences") from the University of Kassel
- Study of Psychology and Economics, Philipps-University Marburg and University of Koblenz-Landau

Funding
DFG, BMBF, BMWi, EFRE,
State Lower Saxony, Industry

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Mission Statement

We aim to contribute to a humane and efficient design and development of work and organizations. In our research, we build on Social and I-O psychological knowledge and use various methodological approaches (tool development, interaction analysis and temporal dynamics, multilevel modeling and social network analysis).

Research

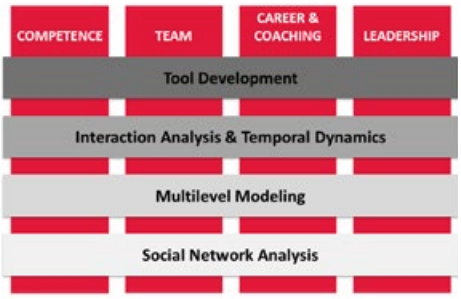
Industrial and Organizational Psychology is the scientific study of the workplace. Methods of psychology are applied to questions concerning humans operating within the context of business and organizations. Our research builds on well-established psychological theories and models. However, we believe that research in organizational psychology is only as good as its practical value. Therefore, we work closely together with organizations and develop tools and concepts of practical revelance. The image below depicts the areas and methods that we focus on in our research.

Competence: In times of globalization and rapid development of information technologies, organizational success is more and more based on non-material competencies. Thus, occupational competence is a key element for future success of individual employees and companies as a whole. In our research, we focus on ways to measure, develop, and manage occupational competencies.

Team: Contemporary organizations are facing an increasing need for flexibility that calls for teamwork. However, functioning teamwork is not a matter of course, especially in times of increased digitization. We focus on intra-group processes to understand what makes teamwork successful. For instance, we examine communication patterns in both virtual teams and teams that work face-to-face.

Career and coaching: We use a blend of interaction and social network analysis to understand which processes contribute to successful and healthy careers. In doing so, we analyze early career stages and early career choices (e.g., choice of field of study) as well as long term career development (e.g., in academia). Moreover, we develop coaching tools such as the VaMoS (short for values, motives, and skills) questionnaire to support successful coaching interactions and we aim to gain insight into factors that influence interactions and relationships between coach and client.

Leadership: Following recent calls, we study leadership as a relational process and follow an organizational discourse approach. For example, we study leader-follower-interactions during annual appraisal interviews.



Publications

- Spurk, D., Kauffeld, S., Meinecke, A. L., & Ebner, K. (2016). Why do adaptable people feel less insecure? Indirect effects of career adaptability on job and career insecurity via two types of perceived marketability. Journal of Career Assessment, 24, 289-306.
- Lehmann-Willenbrock, N., Meinecke, A. L., Kauffeld, S., & Rowold, J. (2015). How transformational leadership works during team interactions: A behavioral process analysis. The Leadership Quarterly, 26, 1017-1033.
- Klonek, F.E., Lehmann-Willenbrock, N., & Kauffeld, S. (2014). The dynamics of resistance to change: A sequential analysis of change agents in action. Journal of Change Management, 44, 334-360.
- Gessnitzer, S., Schulte, E.-M., & Kauffeld, S. (2014). VaMoS: Measuring the "within person fit" of affective Values, cognitive Motives, and Skills. Journal of Career Assessment, 23, 559-581.
- Sauer, N. C., & Kauffeld, S. (2013). Meetings as networks: Applying social network analysis to team interaction. Communication Methods & Measures, 7, 26-47.
- Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter: Effects of team meetings on team and organizational success. Small Group Research, 43, 130–158.

Zoological Institute, Cellular Neurobiology

Prof. Dr. Martin Korte

- Head of the Zoological Institute, TU Braunschweig
- Elected member to the Berlin-Brandenburgische Akademie der Wissenschaften (BBAW)
- Former Head of the graduate school Grad. TUBS, TU Braunschweig
- Former Vice President for Strategic development, TU Braunschweig
- Member of the "Strategiekommission der TU Braunschweig"

Researcher's Career

- Professor for Cellular Neurobiology
- Research Group leader for the "Neuroinfection and Neurodegeneration" group at the HZI, Braunschweig
- Research Group leader at the MPI for Neurobiology, Martinsried
- Postdoc at MPI of Neurobiology Martinsried
- Dr. rer. nat. at the MPI of Psychiatrie, Munich
- Research Assistent at the NIH, Bethesda, Maryland, USA

Funding
DFG, BMBF, DAAD

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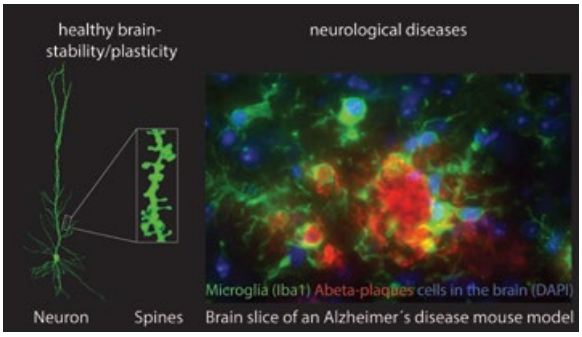
Mission Statement

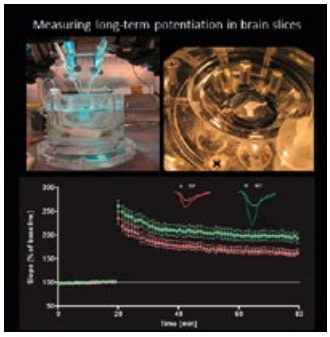
The study of cellular mechanisms linking functional to structural modifications occurring during learning, memory and forgetting processes will contribute to a better understanding of how the brain keeps its stability and maintains its plasticity in normal brain function. This knowledge can then be applied to the diseased brain.

Research

Synaptic plasticity: We are interested in how exactly neurons are able to store information by modulating both the strength of their synapses as well as their number and size – a process termed neuronal plasticity. In experiments ranging from structural and/or functional manifestation of memory expressed as a long-term potentiation, studying learning behavior in living mice to the detailed investigation of signaling cascades in cultured neurons, our laboratory aims to reveal central pathways which allow nerve cells to rapidly change the structure of some synapses, while on the other hand others might be stabilized even for a life-time. In this respect we investigate two molecules intensively: Brain Derived Neurotrophic Factor (BDNF) – promotes plasticity and Nogo-A, which restricts it. Furthermore, we are focusing on the cytoskeleton of neurons, and especially the highly concerted regulation of actin dynamics (e.g. Profilin, Cofilin) during learning processes.

Modeling human diseases: Neurodegenerative diseases such as Alzheimer's disease and disorders like the Fragile X Syndrome represent medical challenges for health care systems. We are studying mouse models that mimic and recapitulate important aspects of these diseases. In this respect, chronic inflammation of the central nervous system caused by various factors such as peripheral infections (with pathogenes as variable as influenza viruses or toxoplasma gondii) or other risk factors such as obesity, stress or simply the aging process itself are gaining more and more attention. Understanding the crosstalk between the immune system and the brain might actually show that preventing imbalances in brain plasticity, sometimes starting already early in life, might in fact be easier than finding a cure against neurodegenerative diseases (such as dementia) once they have fully developed. Our goal is to contribute to a better understanding of neurological diseases, eventually providing insights for potential therapies or prevention.





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Zoological Institute – Cellular and Molecular Neurobiology

Prof. Dr. Reinhard W. Köster

- Chair, Cell Biology, TU Braunschweig
- President of German Genetics Society (GfG)
- Senator, TU Braunschweig
- Former Dean of Life Sciences Faculty, TU Braunschweig
- Former Member of Research Governance Committee, TU Braunschweig

Researcher's Career

- Full Professor for Cellular and Molecular Neurobiology, TU Braunschweig
- Associate Professor for Cell Biology and Cellular Physiology, TU Braunschweig
- Junior Group Leader of BMBF BioFuture Group Zebrafish Neuroimaging, Helmholtz Centre Munich
- Postdoc at California Institute of Technology, USA
- Dr. rer. nat. at Max-Planck-Institute for Biophysical Chemistry Göttingen / University Würzburg
- Studies of Chemistry, University Würzburg

Funding
DFG, EU, State Lower Saxony, VW-Foundation, DAAD

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Mission Statement

We combine sophisticated genetics with bioimaging in transparent zebrafish to dissect cell biological and molecular mechanisms of neuronal migration, differentiation and function. Genetic modeling of neurodegenerative diseases (SCA1, SCA13, AD) serves to study disease mechanisms, regeneration and pharmacological drug screening.

Research

Our reserach focuses on the zebrafish cerebellum as one of the evolutionary highest conserved brain compartments among vertebrates. This brain region is dedicated to control body posture, balance, locomotion and motor learning among others.

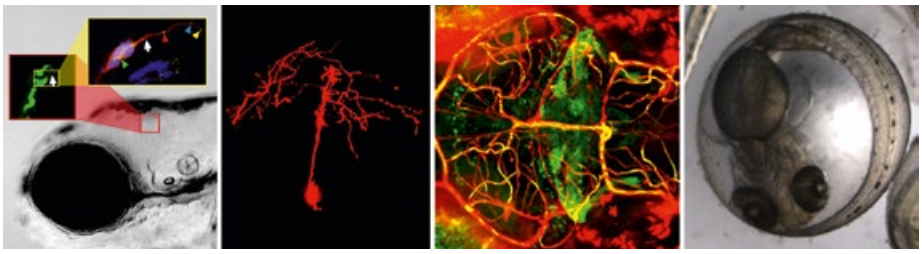
Neuronal Migration: Using *in vivo* microscopy we address molecular mechanisms of directional and cohesive neuronal migration, which serves to place neurons in their correct place of function. Currently we are investigating the regulation of neuronal motility by membrane depolarization and transmission of adhesive forces to the cytoskeleton.

Neuronal Differentiation and Function: With light-controlled channel proteins (optogenetics) we alter neuronal activity in the cerebellum during stereotypic behavior of zebrafish larvae to understand the circuitry and functional organization of the cerebellar cortex.

Genetic modeling of human neurodegenerative diseases: In our zebrafish neurodegenerative disease models (SCA1, SCA13, AD) disease progression and cell biological mechanisms of degeneration can be followed directly *in vivo* to unravel the underlying pathogenic mechanisms of cytotoxicity. Moreover such models are being used for screening and validation of disease-interfering compounds. Currently we are analyzing pathogenic malfunctions of autophagy, and protein aggregation.

Neuronal Regeneration: A cerebellar Purkinje cell specific inducible ablation technique (PC-ATTAC) enables us to follow Purkinje cell regeneration within the differentiated zebrafish brain by bioimaging in order to address signal transduction events and cellular dynamics during neuronal regeneration.

Technique Development: We develop methods for conditional and combinatorial genetics in zebrafish to monitor cellular and subcellular dynamics and to manipulate cell biological mechanisms with cell type specific and temporal control. Methods developed by us in zebrafish are: combinatorial Gal4 genetics and enhancer trap screening, bidirectional and multi-cistron expression systems, inducible cell type specific cell ablation, transsynaptic neuronal connectivity mapping, and various compound screening assays.



Publications

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Institute of Medicinal and Pharmaceutical Chemistry (IMPC)

Prof. Dr. Conrad Kunick

Researcher's Career

- Professor for Medicinal and Pharmaceutical Chemistry, IMPC, TU Braunschweig
- Visiting Professor, Universität Münster
- Visiting Professor, Purdue University (West Lafayette, IN, USA)
- Habilitation (Pharmaceutical and Medicinal Chemistry), Universität Hamburg
- Research Assistant, Universität Hamburg
- Postdoc, Universität Bonn
- Dr. rer. nat., Pharmaceutical Chemistry, Universität Hamburg
- Study of Pharmacy, Universität Hamburg

Funding

DFG, EU, BMBF, COST, MWK.

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Mission Statement

Our mission is to design and develop compounds that can be used as tools in biological and biochemical test systems. These compounds are then made available to the global scientific community for basic research and drug development.

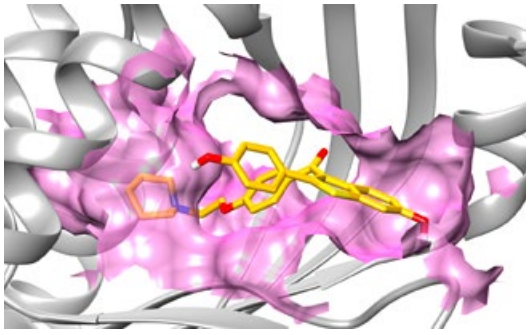
Research

Enzyme inhibition is the general mode of action of the biochemical tools developed in our group. The targeted enzymes comprise protein kinases and synthetases.

Protein kinases interfere with numerous biochemical regulatory mechanisms. The hyperfunction of certain protein kinases plays a role in the pathogenesis of manifold diseases, and inhibitors of these enzymes can therefore be used on a rational basis as drugs. In this context, we have already developed inhibitors for the protein kinases CDK1, CDK5, GSK-3, PfGSK-3, ALK, RET, PLK-1, VEGF-R2, EGFR, DYRK1A, CLK1, and HIPK2. Some of these inhibitors were the first available for targeted inhibition of the respective protein kinases.

Synthetases are used in biological systems for the synthesis of small molecules. Inhibition of microbial synthetases can disrupt the metabolism of the pathogenic germs, and synthetase inhibitors can therefore be used as drugs for the therapy of infectious diseases.
We start development projects with the molecular structure of the enzyme to be addressed as a biological target. Computational methods (docking, scoring, visualization) are used to design small molecules that fit into binding pockets of the target structures. Synthesis, purification, and characterization of the so-designed molecules are performed in our lab. In cooperation with partners around the world, the compounds are then tested for biological activity and structure-activity relationships. Particularly suitable compounds are made commercially available.

The commercially most successful compounds from our lab are the paullones. Several members of this compound class invented and developed in our group are commercialized by more than 30 companies worldwide.



Publications

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Institute of Plant Biology

Prof. Dr. Theo Lange

Researcher's Career

- Professor of Plant Biology at the TU Braunschweig
- Gutenberg chair of the region Alsace, France (University of Strasbourg)
- Research group leader, University of Göttingen, Institute of Plant Physiology
- Post-doc, Institute of Physical and Chemical Research, Tokyo, Japan
- Post-doc, Long Ashton Research Station, U.K.
- Dr. rer. nat. University of Göttingen
- Studies of botany, microbiology, and chemistry, degree Dipl. Biol. Universities of Münster and Göttingen

Funding

DFG, Region Alsace, Industry,

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Mission Statement

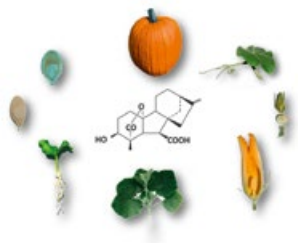
Fit plants are necessary to increase food and feed production for a growing global population. Alteration of plant hormone signalling improves agricultural productivity of important crops, as has been demonstrated by the "Green revolution".

Research

Gibberellin Synthesis and Signalling. Gibberellins (GAs) are important signalling molecules produced to regulate and integrate growth and development during the entire life cycle of plants. By modulation of the GA network, plants are designed to be fit for a future which offers strategic values to agriculture and horticulture. We have made significant contributions to identify key regulators of this network and their trafficking, using state-of-the-art technologies, including mass-spectrometry.

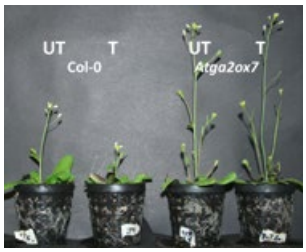
Touch genes. In response to thigmo (touch) stresses, plants undergo various morphological and physiological changes including dwarf growth, thicker stems and delay in flowering. GAs are phytohormones that control plant growth and development. Recently, we identified a "touch" gene that regulates thigmomorphogenesis in *Arabidopsis* via GA catabolism. Plants without this gene do not react to touching. We are now going to unravel elements of the touch signalling pathways.

Response to multiple stresses. Plants are subjected to multiple abiotic and biotic environmental stresses from which, contrarily to animals, they cannot escape. To survive, they developed sophisticated defense strategies during evolution. Some of those involve convergence of signalling pathways for abiotic and biotic stress resistance. As plant growth hormones, GAs are targets for growth regulation to compensate stress and are central players to integrate different types of stresses. This interlink between different stress responses might be used for "priming" stress strategies, i.e. increasing plant resistance to one type of stress by previous exposure to another type of stress. Our research goals are to analyze interactions of touch and other abiotic and biotic stress signalling pathways to unravel the function of GA-signalling for acquiring abiotic and biotic stress resistance. For instance, we will investigate the potential of touch for improving stress resistance in plants in an environmentally friendly way.



Hormones regulate the full life cycle of plants.

Pre-cold treated plants (on the right) are more frost tolerant compared to plants that are not pre-treated (on the left).



Plants react to touch (from left to right: 1st plant, untouched (UT), 2nd touched (T), 3rd and 4th plants lost the touch gene and do not react to touch).

Publications

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- Lange T, Pimenta Lange MJ (2020) The Multifunctional Dioxygenases of Gibberellin Synthesis. Plant Cell Physiol., doi:10.1093/pcp/pcaa051
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Institute of Organic Chemistry

Prof. Dr. Thomas Lindel

Researcher's Career
- Full Professor of Organic Chemistry, TU Braunschweig
- Associate Professor of Organic Chemistry, LMU München
- Research Group Leader, Institute of Pharmaceutical Chemistry, University of Heidelberg
- Postdoctoral Scientist, Scripps Institution of Oceanography, University of California, San Diego
- Doctorate at the Institute of Organic Chemistry, University of Münster
- Study of Chemistry, University of Münster

Funding
DFG, Fonds der Chemischen Industrie, ZIM

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Mission Statement

Natural products have proven to be highly valuable tools of life. However, in many cases only the structures are described, perhaps accompanied by preliminary biological data. Chemical synthesis has to pave the way to sufficient amounts of material and to structural modification. Otherwise, the potential of many natural products will remain in the dark.

Research

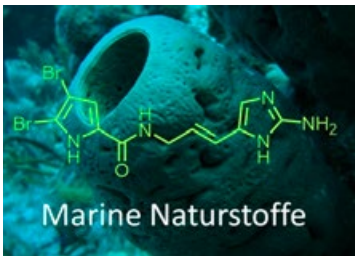
Alkaloids and peptides: Found only in marine sponges, about 200 pyrrole-imidazole alkaloids constitute a unique group of natural products with breathtaking structural diversity on the skeleton level. We develop methods to interconvert pyrrole-imidazole alkaloids and to make them from scratch. In the peptide field, we synthesized the highly cytotoxic hemiasterlin and crystallized it.

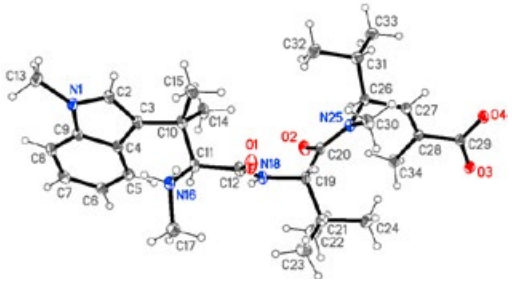
Indole chemistry: Key steps to the raputindoles from the Peruvian tree *Raputia simulans* included the gold-catalyzed cyclization of an alkyne precursor and enantioselective desymmetrizing benzoylation. Other projects address the synthesis of microbial indole alkaloids with activity against multi-drug resistant pathogens, such as cyanogramide from *Actinoalloteichus cyanogriseus*.

Terpenoid synthesis: Among the terpenoids we synthesized recently, the fungal terreumols were obtained in quantities above 100 mg. We also succeeded in synthesizing cubitene, a natural product from termites, which represents the core of the cytotoxic calyculones from the coral *Eunicea calyculata*. Calyculone A or one of its congeners are next on the list. Every step is a new challenge.

New reactions with heterocycles: We discovered a novel chemoselective photoarylation of carboxy side chains of peptides in the presence of water by employing 2-azidobenzimidazoles. Now, we have to understand the physical photochemistry behind it.

Chemistry software: In pandemic times, the development of chemistry software became interesting again as a hobby project. It is the ultimate goal to be able to propose chemical mechanisms leading from A to B, guided by energy calculations conducted in parallel. In addition, structure elucidation of unknown compounds is addressed.





Publications

- Synthesis of (–)-dihydroraputindole D by enantioselective benzoylation of a 1,3-diol intermediate, M. Fresia, M. Kock, T. Lindel, Chem. Eur. J. 2020, 26, 12733–12737.
- Tackling the spiro tetracyclic skeleton of cyanogramide: incorporation of a hydantoin moiety, M. Monecke, T. Lindel, Org. Lett. 2018, 20, 7969-7972
- Synthesis of raputimonoindoles A-C and congeners, M. Kock, M. Fresia, P. G. Jones, T. Lindel, Eur. J. Org. Chem. 2019, 4061-4065.
- Macrocyclic core of salarin C: synthesis and oxidation, J.-N. Schäckermann, T. Lindel, Org. Lett. 2018, 20, 6948-6951.
- Diastereoselective total synthesis of raputindole A, M. Kock, T. Lindel, Org. Lett. 2018, 20, 5444-5447.
- Total synthesis of the marine natural product hemiasterlin via organocatalyzed α-hydrazination, J. H. Lang, P. G. Jones, T. Lindel, Chem. Eur. J. 2017, 23, 12714-12717.

Applied Microbiology

Prof. Dr. Yvonne Mast

Researcher's Career

- Head of Department Bioresources for Bioeconomy and Health Research at Leibniz Institute DSMZ
- Professor at TU Braunschweig
- Habilitation, venia legendi for Microbiology, University of Tübingen
- Junior Group Leader at the Interfaculty Institute of Microbiology and Infection Medicine (IMIT), Department Microbiology/Biotechnology, University of Tübingen
- Postdoc, IMIT, University of Tübingen
- Dr. rer. nat. at the IMIT, University of Tübingen
- Study of Biology, University of Tübingen

Funding

BMBF, DZIF, Baden-Württemberg Stiftung

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Mission Statement

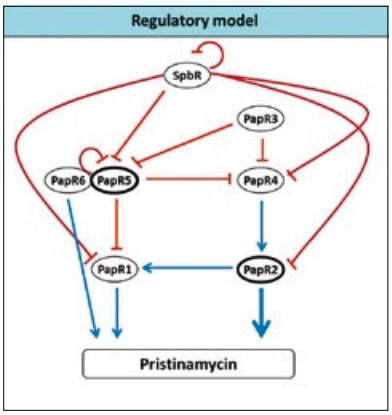
Actinomycetes are the most important source of novel natural compounds and origin of up to two thirds of all antibiotics in use today. Our mission is to understand molecular principles of antibiotic production with a special focus on regulation with the aim of exploiting these organisms for the discovery of novel natural compounds.

Research

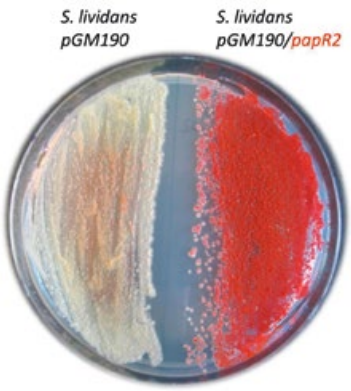
Regulation of antibiotic biosynthesis in actinomycetes: The onset and level of antibiotic production in actinomycetes is subject to complex control networks involving multi-level regulation. We analyse regulatory signaling cascades in antibiotic-producing streptomycetes. Understanding and applying regulatory principles in antibiotic producers enables us to targetedly optimize antibiotic production yields but also allows us to activate silent gene cluster expressions as a basis for the discovery of novel natural compounds.

Screening approaches for the identification of novel natural compounds: Next-generation sequencing techniques and genome sequence analysis revealed that actinomycetes encode ~10 times the number of secondary metabolites than anticipated from prior fermentation studies. We isolate novel actinomycetes from special habitats but also make use of the large collection of Actinobacteria at the DSMZ and analyze these strains for their antibiotic properties. We apply genome mining approaches on prioritized genome-sequenced strains for the identification of potential antibiotic gene clusters and analyze strains for the production of novel natural compounds.

Genetic engineering of natural compound biosynthesis: One alternative to combat drug-resistances is to optimize established drugs by compound derivatization. We apply genetic engineering of antibiotic biosynthesis to derivatize substances with the aim to optimize antibiotic properties. Furthermore, we use synthetic biology to enable fermentative production of industrial relevant compounds, such as the non-proteinogenic amino acid phenylglycine.



*Regulatory signaling cascade of pristinamycin production in **Streptomyces pristinaespiralis**.*



*Activation of antibiotic (undecylprodigiosin) production upon expression of a transcriptional activator gene (papR2) in **Streptomyces lividans**.*

Publications

- Krause, J., Handayani, I., Blin, K., Kulik, A., Mast, Y. (2020) Disclosing the Potential of the SARP-Type Regulator PapR2 for the Activation of Antibiotic Gene Clusters in Streptomycetes. Front Microbiol. 11:225.
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Computational Biology of Infection Research

Prof. Dr. Alice Carolyn McHardy

Researcher's Career

- Head of Department for Computational Biology of Infection Research at Helmholtz Centre for Infection Biology and full professor for Bioinformatics at TU Braunschweig
- Chair of Algorithmic Bioinformatics at Heinrich-Heine University Düsseldorf
- Head of independent Max-Planck Research Group for Computational Genomics & Epidemiology at the Max-Planck Institute for Informatics
- Postdoc, then permanent Research Staff in Bioinformatics & Pattern Discovery Group, IBM T.J. Watson Research Center, USA
- Dr. rer. nat. in Bioinformatics at Technical Faculty of Bielefeld University
- Study of Biochemistry at the University of Bielefeld

Funding

Helmholtz society, BMBF, DFG, Bill & Melinda Gates Foundation, Volkswagen-stiftung, Land Niedersachsen

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Mission Statement

The department studies the human microbiome, viral and bacterial pathogens, and human cell lineages within individual patients, computational analyses of large biological and epidemiological data sets, and develops computational methods for this purpose.

Research

Our attention is focused on questions relating to human health and disease, such as the study of gene-phenotype connections within the human microbiome using metaomics technologies. Secondly, we study the interactions and co-evolution between viral pathogens and their hosts, with a particular focus on influenza viruses. Methodologically, our lab develops software and algorithms by combining methods from various fields of computer science and biology, such as machine learning, phylogenetic theory and population genetics.

Metaomics: Metaomics is a young research area which deals with the sequencing and study of whole communities of microorganisms, as opposed to the sequencing of genomes of individual organisms that have been obtained in pure culture. According to estimates, less than 1% of all microorganisms can be cultured using standard techniques; the current knowledge of prokaryote biology and the collection of sequenced genomes are strongly biased towards a few, well-characterized phyla, while very little is known about the vast majority of the prokaryotic world. Metaomics has the potential to level this inequality and has already delivered an enormous gain in biological knowledge. The lab has developed methods that allow prediction of microbial phenotypes directly from the genomic information of individual microbes and suggestion of protein families that are key to their realization (DiTaxa, MicroPheno). The lab coorganizes the Critical Assessment of Metagenome Interpretation challenge (CAMI; https://data.cami-challenge.org.), hosts the bioinformatics unit of the German centre for infection research (www.dzif.de), develops software and algorithms and collaborates locally, nationally and internationally with biologists and medical experts from universities and research institutes.

Viral pathogens: We have developed a method to reconstruct the geographic spread and the putative origin of a pandemic for rapidly evolving human pathogens, like influenza or Corona viruses, based on the sample origins and world-wide passenger flows in air-travel. Currently we are working on further adapting this method by for example modelling the role of the strongly reduced air travel in a pandemic on viral spread. Further, we are working on designer antigens, both for a universal influenza vaccine and the new SARS-CoV-2 virus. We furthermore developed techniques to predict which future viral strains may become predominant in the next influenza seasons and suggest suitable candidates for the seasonal influenza vaccine.

Publications

- S. Reimering, S. Muñoz, A. C. McHardy (2020) Phylogeographic reconstruction using air transportation data and its application to the 2009 H1N1 influenza A pandemic. PLoS Comput Biol. 16: e1007101
- A. Fritz, P. Hofmann, S. Majda, E. Dahms, J. Droge, J. Fiedler, T. R. Lesker, P. Belmann, M. Z. DeMaere, A. E. Darling, A. Sczyrba, A. Bremges, A. C. McHardy (2019) CAMISIM: simulating metagenomes and microbial communities. Microbiome. 7:17
- F. Meyer, A. Bremges, P. Belmann, S. Janssen, A. C. McHardy*, D. Koslicki* (*shared last authors) (2019) Assessing taxonomic metagenome profilers with OPAL. Genome Biol. 20:51
- E. Asgari, P. C. Munch, T. R. Lesker, A. C. McHardy*, M. R. K. Mofrad* (*shared last authors) (2018)
- DiTaxa: Nucleotide-pair encoding of 16S rRNA for host phenotype and biomarker detection Bioinformatics. 35: 2498
- A. Sczyrba*, P. Hofmann*, P. Belmann*, [...], A. C. McHardy (*shared first authors) (2017) Critical Assessment of Metagenome Interpretation – a benchmark of metagenomics software. Nat Methods. 14: 1063

Zoological Institute

Prof. Dr. Jochen Meier

Researcher's Career

- Full Professor for Cell Physiology at the TU Braunschweig
- Editor-in-Chief, Frontiers in Molecular Neuroscience
- Member of Scientific Program Advisory Group, Spring Hippocampal Research Conference
- Associate Professor for Molecular Neurophysiology, Charité Universitätsmedizin Berlin
- Venia Legendi et Docendi (Physiology), Charité Universitätsmedizin Berlin
- Helmholtz University Young Investigators Group
- Postdoc at Charité Universitätsmedizin Berlin
- Dr. rer. nat. at Université Pierre et Marie Curie, Paris
- Study of Biology, Heidelberg

Funding
DFG, BMBF, EU, BIH, HGF

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Mission Statement

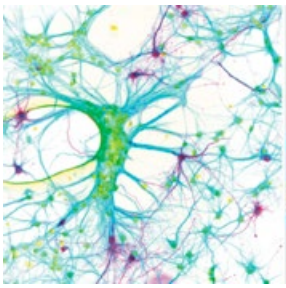
Excitatory and inhibitory transmission between neurons in the brain needs to be thoroughly regulated and coordinated. Deregulation of this coordination results in nervous system disorders. A core aspect of our work concerns study of the brain at the molecular level by investigating RNA editing and alternative RNA splicing.

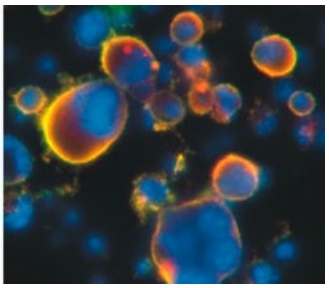
Research

Epilepsy is a devastating neurodegenerative disease that severely deteriorates life quality due to unpredictable occurrence of seizures and associated cognitive dysfunction. Moreover, epilepsy patients suffer from severe psychiatric comorbidities including anxiety and depression. Most epilepsy syndromes have no discernable genetic component. This indicates that epileptogenesis is governed by disease-promoting molecular and cellular mechanisms of neuronal plasticity, which may vary from patient to patient, resulting in diverse clinical pictures of cryptogenic/idiopathic epilepsies. Therefore, we need new therapeutic strategies to satisfy the variable demands of patients.

We are focusing on maladaptive forms of neuronal plasticity by studying RNA editing of the neurotransmitter receptor for glycine (GlyR) as well as other molecular targets. Recently, we generated a new animal model that allows the targeted and neuron type-specific expression of the RNA-edited GlyR variant that is upregulated in the hippocampus of patients with temporal lobe epilepsy (TLE). Our recent studies showed that the very same molecule triggers distinct psychopathological symptoms of TLE including cognitive dysfunction and memory impairment as well as persistence of contextual fear memory and anxiety, depending on the neuron type that expresses this pathogenic molecule. It is important to note that RNA-edited GlyR functions at the presynaptic site of synaptic transmission, which in our opinion is the compartment that is most vulnerable to maladaptive neuronal plasticity.

To tackle this maladaptive form of neuronal plasticity we are now performing drug screening to identify specific antagonists of the pathogenic GlyR variant produced by RNA editing. Furthermore, we are establishing elaborated imaging techniques that allow visualization of GlyR RNA editing at the single cell level. These techniques and recent methodological advances should help us to develop genuine therapeutic approaches.





Publications

- A. Knoll, S. Kankowski, S. Schöllkopf, J. C. Meier* & O. Seitz*. Chemo-biological mRNA imaging with single nucleotide specificity. Chemical Communications (Camb) 2019; 55(98): 14817-14820.
- L. Kraus, F. Hetsch, U. C. Schneider, H. Radbruch, M. Holtkamp, J. C. Meier & P. Fidzinski. Dimethylethanolamine decreases epileptiform activity in acute human hippocampal slices *in vitro*. Frontiers in Molecular Neuroscience 2019; 12:209.
- S. Kankowski, B. Förstera, A. Winkelmann, P. Knauff, E. E. Wanker, X. A. You, M. Semtner, F. Hetsch & J. C. Meier. A Novel RNA Editing Sensor Tool and a Specific Agonist Determine Neuronal Protein Expression of RNA-Edited Glycine Receptors and Identify a Genomic APOBEC1 Dimorphism as a New Genetic Risk Factor of Epilepsy. Frontiers in Molecular Neuroscience 2018; 10:439.
- G. Caliskan, I. Müller, M. Semtner, A. Winkelmann, A. S. Raza, J. O. Hollnagel, A. Rösler, U. Heinemann, O. Stork & J. C. Meier. Identification of parvalbumin interneurons as cellular substrate of fear memory persistence. Cerebral Cortex 2016; 26(5): 2325-2340.
- A. Winkelmann, N. Maggio, J. Eller, G. Caliskan, M. Semtner, U. Häussler, R. Jüttner, T. Dugladze, B. Smolinsky, S. Kowalczyk, E. Chronowska, G. Schwarz, F. G. Rathjen, G. Rechavi, C. A. Haas, A. Kulik, T. Gloveli, U. Heinemann & J. C. Meier. Changes in neural network homeostasis trigger neuropsychiatric symptoms. Journal of Clinical Investigation 2014; 124: 696-711.

Institute of Plant Biology – Molecular and Cell Biology

Prof. Dr. Ralf-R. Mendel

- Chair, Department of Plant Biology Coordinator of the DFG-Collaborative Research Unit FOR 1220 “PROTRAIN”
- Coordinator of the DFG-Research Training Group 2223 “PROCOMPAS”.

Researcher’s Career
- Full Professor of Plant Biology at the TU Braunschweig
- Adjunct Research Professor, University of Tennessee (USA)
- Research Group Leader, Institute of Genetics and Crop Plant Research, Gatersleben
- Dr. rer. nat. at the Martin-Luther-University Halle-Wittenberge
- Study of Biochemistry, Humboldt University Berlin

Funding
DFG, EU, State Lower Saxony

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Mission Statement

Our work combines state-of-the-art methods of molecular biochemistry, cell biology and cell technology, bioimaging, physiology, and genetics to study basic principles of molybdenum metabolism and sulfur detoxification in plants, humans and fungi.

Research

Enzymology of molybdenum metabolism: The metal molybdenum is essential for all forms of higher life. We have deciphered the metabolism of molybdenum in plants and humans where five enzymes need this metal for catalysis. These enzymes are vital for nitrogen nutrition, sulfur detoxification, and hormone synthesis. In order to become active, molybdenum has to be bound to a carrier compound within the cell, and in this form it is called 'Molybdeum Cofactor'. We have also deciphered the biosynthesis pathway for the molybdenum cofactor in plants and humans.

Detoxification of an environmental pollutant: The gas sulfur dixoide is toxic for plants and humans. We identified the enzyme sulfite oxidase to detoxify this harmful gas in plants, and we deciphered the enzymology of this process. The physiological importance has been studied both in the laboratory and on volcanic islands with naturally occurring sulfur dioxide.

Dynamics of protein-protein interactions: Using confocal laser scanning microscopy and labelled proteins we identify the interaction of proteins within living cells. We also developed a method to quantify the strengths of these interactions in living cells. We applied these approaches to decipher the interaction matrix of proteins of molybdenum metabolism in plant cells.

Cell technology and gene transfer into trees and cereals: We developed highly specific protocols to keep cells of trees and cereals in cell culture and used these cell cultures as recipients for gene transfer to study molybdenum and sulfur metabolism.

***Neurospora crassa* as new model organism:** We introduced the filamentous fungus *Neurospora crassa* as model organism to study molybdenum metabolism. It permits not only faster research but offers also molecular and genetic possibilities that cannot be met by plants and humans.

Publications and Patents

- Mendel, R. R., and Hercher, T. W. (2019). Harvesting Moco. Nature Chem Biol 15:429–430.
- Mendel R. R. (2013). The molybdenum cofactor. J Biol Chem 288: 13165–13172.
- Baillie, C. K., Meinen, R., Kaufholdt, D., Hänsch, S., Schmidt, N., Zwerschke, D., Rennenberg, H., Hu, B., Mendel, R. R., Hänsch, R. (2019). Apoplastic peroxidases enable an additional sulphite detoxification strategy and act as first line of defence upon exposure to sulphur containing gas. Environmental and Experimental Botany 157:140–150.
- Krausze, J., Hercher, T. W., Zwerschke, D., Kirk, M. L., Blankenfeldt, W., Mendel, R. R., Kruse, T. (2018). The functional principle of eukaryotic molybdenum insertases. Biochem J 475:1739–1753
- Kaufholdt, D., Baillie, C. K., Meinen, R., Mendel, R. R., Hänsch, R. (2017). The molybdenum cofactor biosynthesis network: In vivo protein-Ppotein interactions of an actin associated multi-protein complex. Frontiers in plant science, 8:1946.

Institute of Technical Chemistry (ITC)

Prof. Dr. Henning Menzel

- Member of the DFG Review Board 326 “Polymer Research”
- Co-coordinator of the DFG Research Unit FOR 2180 “Graded implants for bone-tendon junctions”
- Member, managing board “Franz-Patat-Zentrum”, a scientific forum for interdisciplinary polymer research, Braunschweig

Researcher’s Career

- Professor for Macromolecular Chemistry at TU Braunschweig
- Adjunct Professor for Macromolecular Chemistry at the Leibniz University Hannover
- Visiting Scientist, Department of Chemistry, University of Michigan
- Habilitation at the Leibniz University Hannover, Institute for Macromolecular Chemistry
- Dr. rer. nat. at the Leibniz University Hannover, Institute for Macromolecular Chemistry
- Study of Chemistry, University of Technology Clausthal

Funding
DFG, BMBF, State Lower Saxony, Industry

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Mission Statement

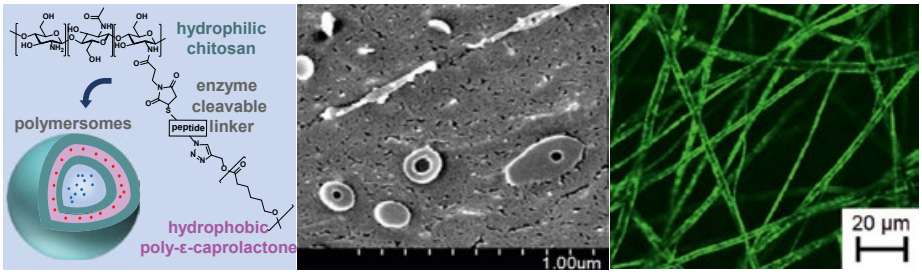
Application oriented problems in synthetic macromolecular chemistry, with special interest in biomedical and biotechnological applications: Ultrathin polymer coatings are used to tailor the biointerfacial interactions with cells and bacteria. Polymeric drug delivery systems are used to implement biological signaling in biomedical devices.

Research

Self-Binding ultrathin copolymer films on implants: One focus area is the preparation of copolymers, which show a self-binding to metallic and ceramic implant surfaces. The resulting coatings, just a few nanometer thin, introduce new functionalities to the implant surface, like e.g. the prevention of biofilm formation. For this, the coatings have to have a selective effect, being antibacterial without compromising the integration of the implant in normal tissue.

Drug delivery systems: Macroscopic hydrogels are prepared to investigate the possibilities to tailor the release profile for therapeutic proteins. The topic was expanded towards micro-particular hydrogels as injectable delivery systems for antibodies or nanogels for immobilization and delivery of growth factors at implant surfaces. The latter are further developed to act as a drug release system implemented on electro spun fiber mats. In this way, novel, cell-free implants shall be prepared, which activate and instruct endogenous stem cells to “regenerate” a tendon-bone junction. Enzyme degradable nanogels and polymersomes are drug delivery systems with spatially and temporally controlled release which can be used as theranostic systems.

Functionalized homo-polypeptides: Controlled polymerization of amino acid *N*-carboxyanhydrides result in well-defined synthetic homo-polypeptides with adjustable secondary structure. Since many years, we explore the possibilities of this system to prepare polymers with interesting architectures and functionalities. Currently we focus on glycosylated peptides and the influence of glycosylation on their secondary structure. We also study their interaction with lectins, as specific carbohydrate-binding proteins, which are involved in cell-cell interaction but also mediate attachment and binding of bacteria and viruses to cells in infection processes. Conjugation of these glycosylated peptides with hydrophobic polymers yields amphiphilic blockcopolymers which form micelles with a carbohydrate corona for specific interaction with cells, bacteria and viruses.



Publications and Patents

- Sydow, S.; de Cassan, D.; Hänsch, R.; Gengenbach, T.; Easton, C. D.; Thissen, H.; Menzel, H., (2019) Layer-by-layer deposition of chitosan nanoparticles as drug-release coatings for PCL nanofibers. Biomater. Sci. , 7: 233-246.
- de Cassan, D., S. Sydow, N. Schmidt, P. Behrens, Y. Roger, A. Hoffmann, B. Glasmacher, R. Hänsch and H. Menzel (2018). “Attachment of nanoparticulate drug-release systems on poly(-caprolactone) nanofibers via a graftpolymer as interlayer.” Colloids Surf. B Biointerfaces 163: 309-320.
- Tolle, C., J. Riedel, C. Mikolai, A. Winkel, M. Stiesch, D. Wirth and H. Menzel (2018). “Biocompatible Coatings from Smart Biopolymer Nanoparticles for Enzymatically Induced Drug Release.” Biomolecules 8: 103-124.
- Mildner, R., & Menzel, H. (2014). Hydrophobic Spacers Enhance the Helicity and Lectin Binding of Synthetic, pH-Responsive Glycopolypeptides. Biomacromolecules 15:4528-4533.
- Bertz, A., Wöhl-Bruhn, S., Miethe, S., Tiersch, B., Koetz, J., Hust, M., Bunjes, H., & Menzel, H. (2013). Encapsulation of Proteins in Hydrogel Carrier Systems for Controlled Drug Delivery: Influence of Network Structure and Drug Size on Release Rate. J Biotechnol 163:243-249.

Department of Systems Immunology

Prof. Dr.
Michael Meyer-Hermann

- Head of Department of Systems Immunology at Helmholtz Centre for Infection Research/TU Braunschweig
- Board member of the Braunschweig Integrated Centre of Systems Biology
- Adjunct Fellow at the Frankfurt Institute for Advanced Studies

Researcher's Career

- Head of research group Systems Immunology at the Frankfurt Institute for Advanced Studies
- Marie-Curie Fellowship at the Centre for Mathematical Biology, Oxford University.
- Head of research group Theoretical Biophysics at Dresden University of Technology
- Ph.D. in Theoretical Elementary Particle Physics at the Institute for Theoretical Physics in Frankfurt/Main
- Studies in Physics, Mathematics, and Philosophy at Johann Wolfgang Goethe-University, Frankfurt/Main and University Pierre et Marie Curie, Paris

Funding
HFSP, BMBF, VW, Engelhorn Stiftung

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Mission Statement

Our main interest is the development of quantitative dynamic models of immunological systems to gain insights into the mechanisms of infection and immunity in close collaboration with experimental partners. Besides questions in basic research, we increasingly focus on improvement and exploration of novel therapeutic strategies.

Research

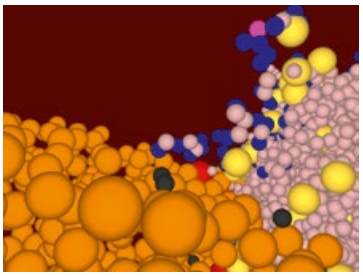
The human immune system consists of a multitude of specialised but complex subsystems that are critical for survival. Our research is dedicated to understanding the dynamics of infection and immunity in health and disease on a systemic level using tools from mathematics, physics, and computer science. As part of the Helmholtz Centre for Infection Research and the Braunschweig Integrated Centre of Systems Biology, we follow a multidisciplinary approach, and our work is driven by questions and data from biological and biomedical research.

Quantitative methods: We employ and actively develop quantitative methods. Besides traditional methods such as ordinary and partial differential equations, agent-based models are at the core of many projects in our department.

Adaptive immune responses: The adaptive immune response is essential for the effective resolution of infections, but also induces autoimmunity. Our interests include regulation, differentiation, and interaction of T cells as well as the maturation of B cells and the evolution of targeted antibody in the lymph node in response to particular pathogens.

Infectious diseases: Despite all medical progress and scientific efforts, infectious diseases continue to be a significant cause of individual and economic damage. Our research includes particularly widespread or severe viral infections such as Influenza, HIV or Ebola, but also bacterial and protozoan infections and aims at understanding the dynamics and interactions of the respective pathogen and its host.

Infection-associated and autoimmune diseases: In addition to its important role for defense against and resolution of infectious diseases, the immune system is also involved in the pathogenesis of various diseases. Our research in this area includes models of development and therapy of metabolic dysfunctions as well as chronic inflammatory diseases. There is particular interest in the interaction of the nervous, the endocrine, and the immune system.



Snapshot of a simulation of lymphoid tissue ontogenesis in space and time generated within the Delaunay – Object – Dynamics framework available at the SIMM department.

"Delaunay – Object – Dynamics framework"
(see Kempf et al, PLoS Comput Biol 9 (2013) e1003295 and references therein)"

Publications

- Roco JA, Mesin L, Binder SC, Nefzger C, Gonzalez-Figueroa P, Canete PF, Ellyard J, Shen Q, Robert PA, Cappello J, Vohra H, Zhang Y, Schiepers A, Toellner K-M, Polo J, Meyer-Herman M, Victora G, Vinuesa CG. Class-switch recombination occurs infrequently in germinal centers. Immunity 2019 Aug 20; 51: 337-350. PMID 31375460.
- Meyer-Hermann M. Injection of antibodies against immunodominant epitopes tunes germinal centers to generate broadly neutralizing antibodies. Cell Reports 2019 Oct 29; 29: 1066-1073.
- Siokis A, Robert* PA, Demetriou P, Dustin ML, Meyer-Hermann* M. F-actin driven CD28-CD80 localization in the immune synapse. Cell Reports 2018 Jul 31; 24(5): 1151-1162 [*shared corresponding author].
- Papa I, Ponzoni M, Saliba D, Canete PF, Gonzalez-Figueroa P, Bustamante S, Grimbaldeston M, Sweet RA, Vohra H, Meyer-Hermann M, Dustin ML, Doglioni C, Vinuesa CG. TFH-derived dopamine accelerates productive synapses in germinal centers. Nature 2017 Jul 20; 547(7663): 318-323.
- Zhao G, Wirth D, Schmitz I, Meyer-Hermann M. A mathematical model of the impact of insulin secretion dynamics on selective hepatic insulin resistance. Nature Commun 2017 Nov 8; 8(1): 1362.

Institute of Psychology

Prof. Dr. Beate Muschalla

- Professor of Psychotherapy and Diagnostics at TU Braunschweig
- Editor of the journal Praxis Klinische Verhaltensmedizin und Rehabilitation

Researcher's Career

- 2017 Professor of Applied Psychology at SRH University of Applied Health Sciences
- 2015–2017 Leading Psychologist at German Federal Pension Authority (Deutsche Rentenversicherung Bund)
- 2016 qualification as a supervisor (training of psychotherapists)
- 2012–2016 project leader of randomized controlled intervention studies at University of Potsdam and the German Armed Forces
- 2006–2012 research projects on work ability measurement, bibliotherapy, work anxiety at Charité Berlin
- 2006–2010 postgraduate training in behavior therapy (inpatient rehabilitation and Charité Berlin), state-licensed in 2010
- 2006 diploma in psychology, 2008 PhD

Funding

German Federal Pension Agency, EU, State Lower Saxony, BMBF

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Google Scholar: https://scholar.google.de/citations?user=bMKIL7kAAAAJ&hl=de
ORCID-ID: 0000-0001-5285-6618

Mission Statement

Sick leave due to mental health problems is a problem known worldwide. Work ability among people with mental disorders can be improved by finding a good person-job fit. Assessment of a person's capacities (soft skills) can be done precisely and in a differentiated manner. This helps to solve sick-leave problems.

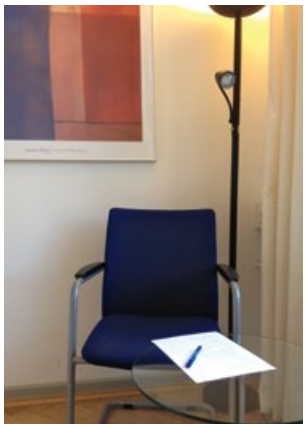
Research

Work-anxiety and work-ability: Our research focuses on the differential diagnosis and description of work-anxiety, work ability and work-directed training options in clinical and non-clinical populations.

Mini-ICF-APP: The Mini-ICF-APP is an internationally evaluated and translated instrument for measuring 13 psychological capacity dimensions (Linden, Baron, Muschalla, 2009). It is widely used for social-medicine purposes (work ability measurement). The Mini-ICF-APP-Family covers observer-rating, self-rating scales and instruments for capacity-oriented workplace description (useful for mental hazard analysis).

Side effects of psychotherapy interventions: Beside their known positive effects, psychological interventions can also have negative effects. This is especially true for group interventions because of the group setting, the content, or the interaction between participants. Side effects become more and more relevant in intervention research and practice in clinical and work-oriented settings.

Towards a rehabilitation perspective in mental disorders: Rehabilitation means treatment of chronic health problems. Common mental disorders, such as mood disorders, personality disorders or anxiety disorders, are chronic disorders. Symptoms are often persistent or recurring. These disorders are regularly associated with enduring participation problems in everyday life, especially long-term sick leave.
In- and outpatient mental health care thus needs to focus not only on reducing illness symptoms. Overcoming participation problems by
a) training psychological capacities and
b) in some cases adjusting context factors,
are important rehabilitation-oriented intervention strategies.



"Head- or heart condition?" Psycho-Somatic differential diagnostic and treatment: Feeling unwell after a stroke or heart infarction may look like a depression, but is not an illness! Our aim is to improve understanding of healthy suffering.

Publications

- Muschalla, B., Flöge, B., & Linden, M. (2020). Unwanted Effects within a Cognitive Behavioral Therapy Group in comparison with a recreational group – a cluster-randomized controlled trial. Psychiatria Danubina, in press.
- Muschalla, B., Rau, H., Willmund, G.D., & Knaevelsrud, C. (2018). Work Disability in Soldiers with Posttraumatic Stress Disorder, Posttraumatic Embitterment Disorder and Not-Event-Related Common Mental Disorders. Psychological Trauma: Theory, Research, Practice and Policy, 10, 30-35.
- Muschalla, B., Linden, M., & Jöbges, M. (2016). Work-Anxiety and Sickness Absence After a Short Inpatient Cognitive Behavioral Group Intervention in Comparison to a Recreational Group Meeting. Journal of Occupational and Environmental Medicine, 58, 398-406.
- Muschalla, B. (2016). Different work capacity impairments in patients with different work-anxieties. International Archives of Occupational and Environmental Health, 89, 609-619.
- Linden, M., Muschalla, B., Hansmeier, T., & Sandner, G. (2014). Reduction of sickness absence by an occupational health care management program focusing on self-efficacy and self-management. Work: A Journal of Prevention, Assessment, and Rehabilitation, 47, 485-489.
- Linden, M., & Muschalla, B. (2012). Standardized diagnostic interviews, criteria, and algorithms for mental disorders: garbage in, garbage out. European Archives of Psychiatry and Clinical Neuroscience,262, 535-544.

Microbial Genome Research

Prof. Dr. Ulrich Nübel

Researcher's Career

- Head of research unit for Microbial Genome Research at Leibniz Institute DSMZ
- Associate Professor for Microbial Genomics at TU Braunschweig
- Scientist at Robert Koch Institute
- Postdoc at Montana State University, USA
- Dr. rer. nat. at Max Planck Institute for Marine Microbiology, Bremen, and the University of Bremen
- Study of Biotechnology at the TU Braunschweig

Funding

BMBF, EU Horizon 2020, State Lower Saxony, Leibniz Association, DAAD

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Mission Statement

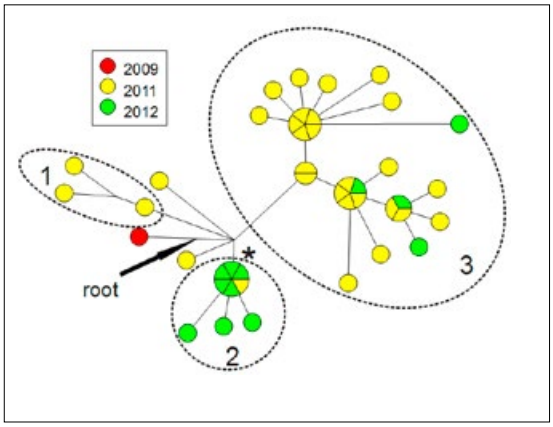
To understand the emergence, evolution and spatial spread of bacterial populations, with a focus on drug resistance and secondary metabolite biosynthesis.

Research

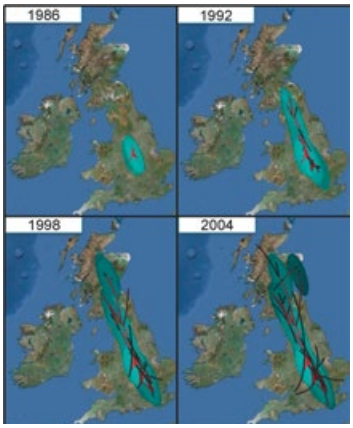
Population genomics and phylogeography: We apply genomic analyses at the level of bacterial populations to gain fundamental insights into the dynamics of bacterial evolution and dispersal. We investigate the mechanisms that cause genetic change, the rates at which variation accumulates and spreads in a population, and the functional and selective consequences it may have.

Genome-based molecular epidemiology: We trace the emergence and transmission of bacterial pathogens at high spatial and temporal resolution based on large-scale bacterial whole-genome sequence analyses. We develop sequence-based tools for early detection of outbreaks of infections in healthcare-associated settings and we investigate major spreading routes and reservoirs of the pathogen *Clostridium difficile*.

Functional genomics of novel microbial producers: Prokaryotes represent an enormously diverse potential resource for novel bio-active compounds. We seek to accelerate natural product discovery by using high-throughput genome sequencing and genome mining to identify novel producer organisms outside of commonly studied bacterial groups (DZIF).



Phylogenetic analysis of Klebsiella pneumoniae outbreak



Genome-based analysis of MRSA spread

Publications

- Frentrup M., Zhou Z., Steglich M., Meier-Kolthoff J. P., Göker M., Riedel T., Bunk B., Spröer C., Overmann J., Blaschitz M., Indra A., von Müller L., Kohl T. A., Niemann S., Seyboldt C., Klawonn F., Kumar N., Lawley T. D., García-Fernández S., Cantón R., Del Campo R., Zimmermann O., Gross U., Achtman M., Nübel U. (2020) A publicly accessible database for Clostridioides difficile genome sequences supports tracing of transmission chains and epidemics. Microbial Genomics 6: e000410
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- Gröschel M. I., Meehan C. J., Barilar I., Diricks M., Gonzaga A., Steglich M., Conchillo-Sole O., Scherer I. C., Mamat U., Luz C. F., De Bruyne K., Utpatel C., Yero D., Gibert I., Daura X., Kampmeier S., Rahman N. A., Kresken M., van der Werf T. S., Alio I., Streit W. R., Zhou K., Schwartz T., Rossen J. W. A., Farhat M. R., Schaible U. E., Nübel U., Rupp J., Steinmann J., Niemann S., Kohl T. A. (2020) The phylogenetic landscape and nosocomial spread of the multidrug-resistant opportunist Stenotrophomonas maltophilia. Nature Communications 11: 2044.
- Szafrańska, A., Junker, V., Steglich, M. & Nübel, U. (2019) Rapid cell division of Staphylococcus aureus during colonization of the human nose. BMC Genomics 20: 229. doi: 10.1186/s12864-019-5604-6.

Institute of Technical Chemistry – Technical Electrocatalysis

Prof. Dr. Mehtap Özaslan

- EFZN-Kompetenznetzwerk Brennstoffzelle
- Steering Board of the NFDI4Cat, Digitalization in Catalysis
- Executive Board of the Division Electrochemistry at GDCh – Gesellschaft Deutscher Chemiker
- Scientific Advisory Board Energy Research at KIT – Karlsruhe Institute of Technology
- Fast Track Program of Robert Bosch Foundation
- Umicore Scientific Award 2014

Researcher's Career

- Full Professor (W3) for Technical Electrocatalysis, Technische Universität Braunschweig, Germany
- Junior Professor (W1) for Electrochemistry, Carl von Ossietzky University of Oldenburg, Germany
- Scientist at The Electrocatalysis and Interface Group, Paul Scherrer Institut (PSI), Switzerland
- Dr. rer. nat. at The Electrochemical Energy, Catalysis, and Materials Science Group, Technische Universität Berlin, Germany
- Study of Chemistry, Technische Universität Berlin, Germany

Funding
DFG, BMBF, FCI and industry

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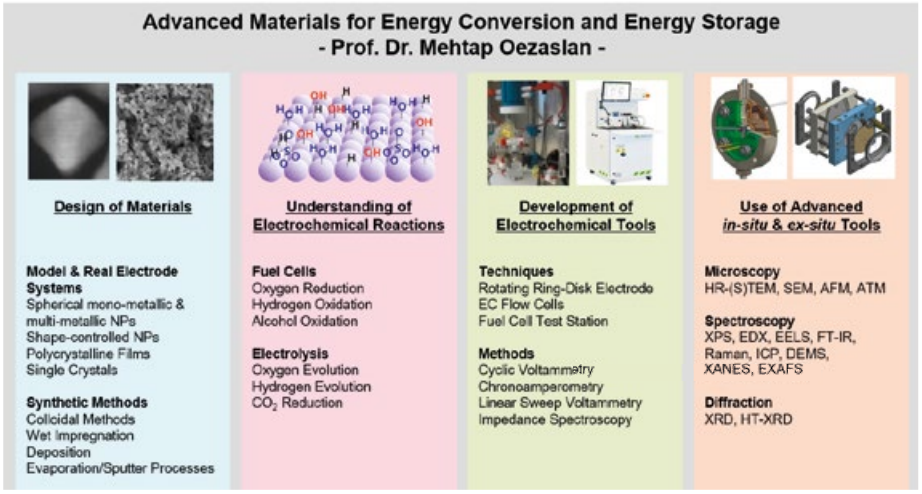
Mission Statement

"Understanding of electrocatalytic processes which are occurring on the electrolyte-electrode interface is the main key to predict and to ultimately design properties of materials on different length and time scales."

Research

- Fuel Cell
- Water Electrolysis
- CO_2 and N_2 Reduction
- In-Operando Spectroscopic and Microscopic Studies
- Electrocatalysis
- Membrane Electrode Assembly
- Electrochemical Interfaces
- and more

How can valuable products be generated from carbon dioxide (CO_2) and nitrogen (N_2)?
What are the requirements of electrode materials for technical applications such as fuel cells and electrolyzers?
What are the causes of the electrode aging processes on different length and time scales?
The Technical Electrocatalysis Group deals with these research topics to secure the energy storage and energy conversion in the near future. Our research activities build a bridge from the atomic level to technical application.



Publications

https://orcid.org/0000-0001-8545-7576

- Self-supported Pt-CoO networks combining high specific activity with high surface area for oxygen reduction, G. W. Sievers, A. W. Jensen, J. Quinson, A. Zana, F. Bizzotto, M. Oezaslan, A. Dworzak, J. J. K. Kirkensgaard, T. E. L. Smitshuysen, S. Kadkhodazadeh, M. Juelsholt, K. M. Ø. Jensen, K. Anklam, H. Wan, J. Schäfer, K. Čépe, M. Escudero-Escribano, J. Rossmeisl, A. Quade, V. Brüser, M. Arenz, Nature Materials (2020) https://doi.org/10.1038/s41563-020-0775-8
- CO_2 Electrolysis – Complementary operando XRD, XAS and Raman Spectroscopy Study on the Stability of CuxO Foam Catalysts, A. Dutta, M. Rahaman, B. Hecker, J. Drnec, K. Kiran, I. Zelocualtecatl Montiel, D. J. Weber, A. Zanetti, A. Cedeño López, I. Martens, P. Broekmann, M. Oezaslan, Journal of Catalysis, 389 (2020), p.592-603. https://doi.org/10.1016/j.jcat.2020.06.024
- Effect of Monovalent Cations on the HOR/HER Activity for Pt in Alkaline Environment, D. J. Weber, M. Janssen, M. Oezaslan, Journal of The Electrochemical Society, 166 (2019) 2, p. F66-F73. https://doi.org/10.1149/2.0301902jes
- Pt-based Core-Shell Catalyst Architectures for Oxygen Fuel Cell Electrodes, M. Oezaslan, F. Hasché, P. Strasser, Journal of the Physical Chemistry Letters, 4 (2013) 19, p. 3273-3291. https://doi.org/10.1021/jz4014135
- Size-Dependent Morphology of dealloyed bimetallic Catalysts: Linking the Nano to the Macro Scale, M. Oezaslan, M. Heggen, P. Strasser, Journal of The American Chemical Society, 134 (2012) 1, p. 514-524. http://dx.doi.org/10.1021/ja2088162

Institute of Medicinal and Pharmaceutical Chemistry

Prof. Dr. Ingo Ott

Researcher's Career

- Professor for Medicinal and Pharmaceutical Chemistry, Technische Universität Braunschweig
- Guest professor, Institute of General, Inorganic and Theoretical Chemistry, University of Innsbruck
- Postdoc, Shanghai Key Laboratory of Chemical Biology, East China University of Science and Technology (with Prof. Xuhong Qian)
- Research associate, Freie Universität Berlin
- Dr. rer. nat., Institute of Pharmacy, Freie Universität Berlin (with Prof. Ronald Gust)
- Approbation as pharmacist
- Mag. pharm., University of Innsbruck

Funding

DFG, DAAD, Ministry of Science and Culture of Lower Saxony

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Mission Statement

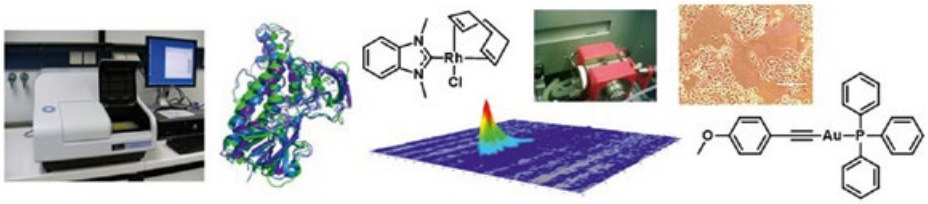
Innovative drug development is one of the biggest challenges in medicinal chemistry. Metal complexes offer a rich, yet largely unexplored, chemical space for drug design. The mission of the group is to contribute to the understanding of the pharmacological properties of metal complexes and to shape novel concepts for the design of metal-based pharmacophores and drugs.

Research

Medicinal Chemistry of Gold Complexes: The use of gold and its complexes in medicine dates back thousands of years, however, the most relevant biochemical mechanisms in gold pharmacology have been discovered only recently and are not yet fully understood. Nowadays, gold metallodrugs are used in the treatment of rheumatoid arthritis, and ongoing clinical trials evaluate their therapeutic application as anticancer or antibacterial agents. The enzyme thioredoxin reductase (TrxR), which is involved in several pathophysiological pathways, is a critical target for gold species. This is due to the high affinity of gold to cysteine and selenocysteine residues in the active site of the enzyme and so a direct consequence of the chemical properties of gold. Following this concept, several types of improved TrxR inhibitors with high selectivity were developed, additional relevant mechanisms of action have been identified, and their strong effects as anticancer and anti-infective drugs have been studied.

Organometallics in Drug Development: Organometallic complexes feature a metal-carbon bond, which is not present in any currently registered and approved drug. The high chemical stability of many organometallic centers, in combination with their geometric and electronic properties that differ fundamentally from functional groups used in synthetic medicinal chemistry, make them ideal sources for the design of truly innovative drugs. Complexes with N-heterocyclic carbene (NHC) or alkynyl ligands represent such organometallics, for which very interesting biological properties have been observed (e.g. tumor cell proliferation, apoptosis induction, anti-angiogenic effects).

Methods: The group applies methods ranging from synthetic chemistry over analytical chemistry (e.g. atomic absorption spectroscopy, HPLC-MS) to cell culture (e.g. proliferation assays) in an interdisciplinary manner.



Organometallics in Medicinal Chemistry and Drug Development

Publications and Patents

- Gil-Moles M., Basu U., Büssing R., Hoffmeister H., Türck S., Varchmin A., Ott I., Gold Metallodrugs to Target Coronavirus proteins: Inhibitory effects on the spike-ACE2 Interaction and on PLpro Protease Activity by Auranofin and Gold Organometallics. Chem. Eur. J. (2020), 26, 15140-15144.
- Zhang J.-J., Abu el Maaty, M. A., Hoffmeister H., Schmidt C., Münzner J. K., Schobert R., Wölfl S., Ott I., A Multi-target Gold(I) Complex Induces Cytotoxicity Related to Aneuploidy in HCT-116 Colorectal Carcinoma Cells. Angew. Chem. Int. Ed. (2020), 59, 16795-16800.
- Oehninger L., Spreckelmeyer S., Holenya P., Meier S. M., Can S., Alborzinia H., Schur J., Keppler B. K., Wolfl S., Ott I., Rhodium(I) N-Heterocyclic Carbene Bioorganometallics as in Vitro Antiproliferative Agents with Distinct Effects on Cellular Signaling. J. Med. Chem. (2015), 58, 9591-9600.
- Meyer A., Bagowski C. P., Kokoschka M., Stefanopoulou M., Alborzinia H., Can S., Vlecken D. H., Sheldrick W. S., Wolfl S., Ott I., On the Biological Properties of Alkynyl Phosphine Gold(I) Complexes. Angew. Chem. Int. Ed. (2012), 51, 8895-8899.
- Rubbiani R., Can S., Kitanovic I., Alborzinia H., Stefanopoulou M., Kokoschka M., Monchgesang S., Sheldrick W. S., Wolfl S., Ott I., Comparative In Vitro Evaluation of N-heterocyclic Carbene Gold(I) Complexes of the Benzimidazolylidene Type. J. Med. Chem. (2011), 54, 8646-8657.

Microbial Ecology and Diversity

Prof. Dr. Jorg Overmann

Researcher's Career

- Scientific Director DSMZ and Professor (W3) TU Braunschweig
- Acting Director (3 terms), Department Biologie I, LMU München
- Professor (C3), Ludwig-Maximilians-Universität München
- Habilitation, venia legendi for Microbiology, University of Oldenburg
- Junior group leader (Habilitand), ICBM, University of Oldenburg
- Post-Doc at the University of British Columbia, Canada (Prof. Dr. J. T. Beatty)
- Dissertation in Microbiology, University of Konstanz (summa cum laude)
- Appointed member of the Council of Scientists of the Human Frontier Science Program Organization, Strasbourg, France
- Appointed member of the Permanent Senate Commission on Fundamental Issues of Biological Diversity of the DFG
- Appointed member of the advisory board of the Staatliche Naturwissenschaftliche Sammlungen Bayerns
- Appointed member of the foundation council of the Technische Informationsbibliothek, Hannover
- Member of the scientific advisory board of the Catalan Institute for Water Research (ICRA, Institut Català de Recerca de L'Aigua)

Funding

DFG, BMBF, Horizon 2020, EU, Lower Saxony, VW Stiftung

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Mission Statement

The DSMZ is one of the largest microbial resource centers worldwide and provides a wide diversity of biological resources and services. Research at the DSMZ focuses on microbial diversity and the underlying evolutionary mechanisms, biological interactions at the community and species level, molecular cancer research, and improved methods for access and preservation of biodiversity.

Research

Microbial Diversity & Evolution: How microbes interact, what their functional roles are, and how they evolve in their natural environments are fundamental questions in microbiology. The marine genus Phaeobacter and freshwater sphingomonads are used to understand population structure and evolutionary processes using comparative genomics (part of SFB Roseobacter). Within the DFG-funded Exploratories for Biodiversity Research, community composition, physiological traits, species interactions, and the biogeochemical role of Acidobacteria are elucidated using metagenomics, transcriptomics, and modelling. Phototrophic consortia serve as models to understand evolution, ecophysiology, and the molecular basis of heterologous bacterial multicellularity.

Bioeconomy & Health: Building on DSMZ's basic research and expertise in microbial cultivation, new uses of microbial biodiversity are actively pursued. With German, EU, and international partners in the BiCFAM and MIKROBIB projects, we are taking advantage of high-throughput cultivation and screening techniques to assess the functional role of bacteria and their possible future applications. Through the *CDiff* consortium, we are examining the environmental distribution and role of the clinical pathogen, *C. difficile*.

Bioinformatics & Genomics: The above research areas are accomplished in partnership with a strong bioinformatics team that harnesses next-generation sequencing methods and provides in-house software development of new bioinformatics tools. DSMZ plays key roles in the Global Biodiversity Information Facility (GBIF), German Network for Bioinformatics Infrastructure (de.NBI), German Federation for Biological Data (GFBio), the national research data infrastructure (NFDI4BioDiversity), and has recently developed BacDive – The Bacterial Metadata-base, which digitalizes, mobilizes, and enables the comparison of taxon-associated microbial metadata.

Publications

- Vieira S, Sikorski J, Dietz S, Herz K, Schrumpf M, Bruelheide H, Scheel D, Friedrich MW, Overmann J (2020) Drivers of the composition of active rhizosphere bacterial communities in temperate grasslands. ISME J 14, 463-475
- Vieira S, Sikorski J, Gebala A, Boeddinghaus R, Marhan S, Rennert T, Kandeler E, Overmann J (2020) Bacterial colonization of reactive minerals in grassland soils is selective and highly dynamic. Environ Microbiol 22, 917-933
- Dedysh SN, Henke P, Ivanova AA, Kulichevskaya IS, Philippov DA, Meier-Kolthoff JP, Göker M, Huang S, Overmann J (2020) 100-year-old enigma solved: identification, genomic characterization and biogeography of the yet uncultured Planctomyces bekefii. Environ Microbiol 22, 198-211
- Riedel T, Neumann-Schaal M, Wittmann J, Schober I, Hofmann JD, Lu C-W, Dannheim A, Zimmermann O, Lochner M, Groß U, Overmann J (2020) Characterization of Clostridioides difficile DSM 101085 with A-B-CDT+ phenotype from a late recurrent colonization. Genome Biol Evol 12, 566-577
- Bajerski F, Bürger A, Glasmacher B, Keller ERJ, Müller K, Mühldorfer K, Nagel M, Rüdel H, Müller T, Schenkel J, Overmann J (2020) Factors determining microbial colonization of liquid nitrogen storage tanks used for archiving biological samples. Appl Microbiol Biotechnol 104, 131-144

Institute of Microbiology & Leibniz Institute DSMZ

Prof. Dr. Michael Pester

- Head of the Department Microorganisms at the Leibniz Institute DSMZ
- Zukunftskolleg-Fellow at the University of Konstanz, Germany
- Alexander-von-Humboldt fellow at the University of Vienna, Austria
- Fulbright fellow at the University of North Carolina, USA

Researcher's Career

- Full Professor for Evolutionary Systematics of Microorganisms at the TU Braunschweig
- Group Leader at the University of Konstanz, Germany
- Postdoc at the University of Vienna, Austria
- Dr. rer. nat. at the Max-Planck Institute for Terrestrial Microbiology, Marburg, Germany
- Study of Biology, University of Konstanz & University of North Carolina, USA

Funding
DFG, EU, FWF

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Mission Statement

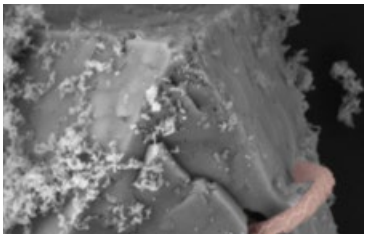
Microbial ecosystem services and their relevance for biogeochemical, ecological, and biotechnological processes. We use environmental systems biology combined with our leading expertise in cultivation to identify key microorganisms and their ecological relevance in freshwater, terrestrial, and marine habitats.

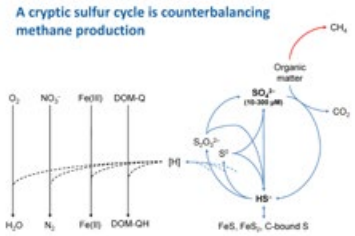
Research

Microbe-Mineral-Interactions: Pyrite, better known as fool's gold, is the most abundant iron-sulfur mineral in sediments. Over geological times, its burial in sediments controlled oxygen levels in the atmosphere and sulfate concentrations in seawater. We study bacteria capable of converting iron sulfide and hydrogen sulfide to pyrite when coupled to methanogenic archaea. Our research has impact on the understanding of global biogeochemical cycles on geological time scales and provides an experimental window into a postulated primordial iron-sulfur world predating the origin of life.

Nitrification in lake ecosystem: Here, we study the influence of climate change on microorganisms driving the conversion of ammonia to nitrate in freshwater habitats. This is important since ammonia levels should not exceed 0.5 mg/L in drinking water. Using process measurements of ammonia conversion, high-throughput 16S rRNA gene amplicon sequencing, metagenomics and metatranscriptomics, we are aiming to understand how steadily increasing water temperatures in lakes influence population dynamics of nitrifying microorganisms and as a consequence the process of nitrification itself.

The cryptic freshwater sulfur cycle: Freshwater wetlands are important for sustainability of biodiversity, water quality, flood protection and have recreational value. They are also considered key habitats in the upcoming climate change, influencing both positive and negative feedback cycles to the atmosphere in a warmer world. We study the cryptic sulfur cycle in freshwater wetlands, which plays an important role in controlling the emission of the greenhouse gas methane from these environments. Our aim is to identify microorganisms that drive the cryptic sulfur cycle in wetlands using amplicon sequencing and genome-centric metagenomics and to study their ecophysiology using metatranscriptomics and metaproteomics.





Publications

- Herber J, Klotz F, Frommeyer B, Weis S, Straile D, Kolar A, Sikorski J, Egert M, Dannenmann M, Pester M. 2020. A single Thaumarchaeon drives nitrification in deep oligotrophic Lake Constance. Environmental Microbiology 22:212-228.
- Thiel J, Byrne JM, Kappler A, Schink B, Pester M. 2019. Pyrite formation from FeS and H2S is mediated through microbial redox activity. Proc. Natl. Acad. Sci. USA 116:6897-6902.
- Hausmann B, Pelikan C, Rattei T, Loy A, Pester M. 2019. Long-term transcriptional activity at zero growth of a cosmopolitan rare biosphere member. mBio 10:e02189-18.
- Zecchin S, Mueller RC, Seifert J, Stingl U, Anantharaman K, von Bergen M, Cavalca L, Pester M. 2018. Rice paddy *Nitrospirae* encode and express genes related to sulfate respiration: proposal of the new genus *Candidatus* Sulfobium. Applied and Environmental Microbiology 84:e02224-17.
- Hausmann B, Knorr K-H, Schreck K, Tringe SG, Glavina del Rio T, Loy A, Pester M. 2016. Consortia of low-abundance bacteria drive sulfate reduction-dependent degradation of fermentation products in peat soil microcosms. ISME Journal 10:2365-2375.

Zoological Institute – Division of Molecular Biology

Prof. Dr. Klemens Rottner

- Head of Division
- Research Group Leader: Helmholtz Centre for Infection Research
- Co-Coordinator of DFG Priority Program SPP1464

Researcher's Career

- Associate Professor for Molecular Cell Biology, TU Braunschweig
- Associate Professor for Genetics, Rheinische Friedrich-Wilhelms-Universität Bonn
- Group Leader, HZI Braunschweig
- EMBO long-term fellow, HZI Braunschweig
- Dr. rer. nat. at Paris-Lodron Universität, Salzburg, Austria
- Study of Biology, Salzburg, Austria

Funding

DFG, EU

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Mission Statement

In our work, we elucidate the molecular inventories and collective biochemical activities of selected cellular actin structures, such as those mediating cell migration and host-pathogen interaction. Full understanding of these processes will allow the development of novel drugs combating cancer and infection.

Research

Imaging actin dynamics and reorganization processes of the actin cytoskeleton: We are using live cell imaging approaches to follow assembly and disassembly of actin structures driving actin-based cell motility, allowing elucidation of both the dynamics of these structures and the mobility of structural components within them. We are also employing advanced photomanipulation techniques for determining rates of turnover of individual building blocks within these structures.

Molecular dissection of specific actin structures using genome editing: We are employing state-of-the-art genome editing approaches, such the CRISPR/Cas9 system to separate the essential from modulatory components of specific actin structures of interest. These structures include actin-based cell-edge protrusions such as lamellipodia or filopodia and specific actin-rich structures (e.g. ruffles) stimulated by specific virulence factors evolved by bacterial pathogens.

Establishment of signaling networks downstream of Rho-GTPases: Over the years, our research has focused around uncovering the precise signalling networks and pathways downstream of Rho-subfamily of small GTPases, many of which are implicated in cellular processes as fundamental as establishment of cell polarity or the regulation of cell migration and cell division.

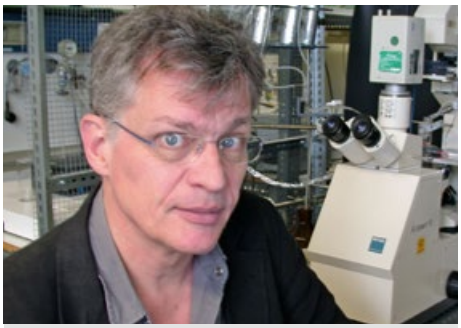
Assessment of force development by and ultrastructural composition of actin-based protrusions: In recent efforts, our studies have been extended to determining the precise contributions of specific molecular components to ultrastructural organization of actin-based cell-edge protrusions (as unravelled by electron tomography) and to the development of forces exerted by these protrusions (directly measured, for instance, by atomic force microscopy).

None of these projects would be possible without our collaborators, including Profs. Jan Faix (Hannover), Josef Käs (Leipzig), Michael Schnoor (Mexico City), Michael Sixt (Klosterneuburg, Austria) and Theresia Stradal (Braunschweig).

Publications

- Koestler SA, Steffen A, Nemethova M, Winterhoff M, Luo N, Holleboom JM, Krupp J, Jacob S, Vinzenz M, Schur F, Schlüter K, Gunning PW, Winkler C, Schmeiser C, Faix J, Stradal TE, Small JV, Rottner K (2013) Arp2/3 complex is essential for actin network treadmilling as well as for targeting of capping protein and cofilin. Mol Biol Cell 18: 2861-2875.
- Steffen A, Ladwein M, Dimchev GA, Hein A, Schwenkmezger L, Arens S, Ladwein KI, Margit Holleboom J, Schur F, Victor Small J, Schwarz J, Gerhard R, Faix J, Stradal TE, Brakebusch C, Rottner K (2013) Rac function is crucial for cell migration but is not required for spreading and focal adhesion formation. J Cell Sci 126: 4572-4588.
- Block J, Breitsprecher D, Kühn S, Winterhoff M, Kage F, Geffers R, Duwe P, Rohn JL, Baum B, Brakebusch C, Geyer M, Stradal TE, Faix J, Rottner K (2012) FMNL2 drives actin-based protrusion and migration downstream of Cdc42. Curr Biol 22: 1005-1012.
- Lai FP, Szczodrak M, Oelkers JM, Ladwein M, Acconcia F, Benesch S, Auinger S, Faix J, Small JV, Polo S, Stradal TE, Rottner K (2009) Cortactin promotes migration and platelet-derived growth factor-induced actin reorganization by signaling to Rho-GTPases. Mol Biol Cell 14: 3209-3223.
- Lai FP, Szczodrak M, Block J, Faix J, Breitsprecher D, Mannherz HG, Stradal TE, Dunn GA, Small JV, Rottner K (2008) Arp2/3 complex interactions and actin network turnover in lamellipodia. EMBO J. 27: 982-992.

Institute of Pharmacology – Toxicology and Clinical Pharmacy



Prof. Dr. Ingo Rustenbeck

Researcher's Career

- Professor of Pharmacology, Institute of Pharmacology, University of Braunschweig
- Bertram-Award of the German Diabetes Society
- Lecturer, Institute of Clinical Biochemistry, Hannover Medical School
- DFG Postdoctoral Fellow, Institute of Pharmacology, University of Göttingen
- Junior House Officer, Internal Medicine, University of Marburg
- Study of medicine, University of Göttingen

Funding

DFG, Lower Saxony, Deutsche Diabetesgesellschaft

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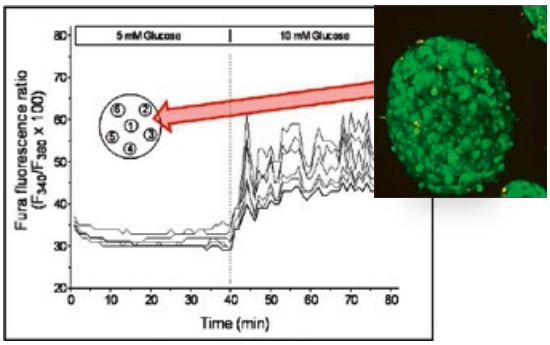
Mission Statement

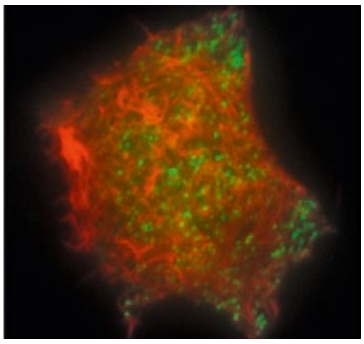
To understand what happens inside the pancreatic beta-cell

Research

The scientific interest of our group is directed towards the mechanisms which shape the **biphasic kinetic of insulin secretion**. The biphasic kinetic is regarded as indispensable for the maintenance of the glucose homeostasis of the organism. The diminution or even loss of the first phase secretion in response to a glucose challenge is the hallmark of the transition from impaired glucose tolerance to overt type 2 diabetes. Currently, a hypothesis is predominant in which the biphasic pattern is explained by different pools of secretory granules which become differentially recruited to exocytosis by a set of plasma membrane ion channels. New live cell imaging techniques for the visualisation of secretory granules and the growing perception that signals circumventing plasma membrane depolarisation are involved in early secretion events have put this "pool size hypothesis" into question. The pathophysiological perspective of our work is to clarify which events lead to the loss of the first phase and the pharmacological perspective is the reconstruction of the first phase by a beta cell-directed therapy.

By stimulating isolated pancreatic islets or single beta-cells in a closely comparable manner in a variety of measuring stands we intend to create an encompassing view of the intracellular events underlying the kinetics of insulin secretion. The plasma membrane potential, whole cell currents and the currents of K_{ATP} channels and voltage-dependent Ca^{2+} channels are registered by patch-clamping. The cytosolic calcium concentration and other parameters of signal transduction are measured by conventional live-cell imaging. Endpoint measurement of adenine nucleotides and Krebs cycle metabolites complement the assessment of beta cell energy metabolism. Finally, objective-based TIRF-microscopy with an integrated cell perifusion system permits the visualization of submembrane insulin granule mobility and fusion under physiologically relevant conditions. These events are analyzed by an observer-independent program, developed in cooperation with colleagues from the Institute of Medicinal Chemistry. Standard molecular biology techniques are employed to generate fluorescent fusion proteins as granule labels. Thus, an integrated view on the beta-cell is generated which should lead to the above mentioned aims.





Publications

- Willenborg M, Belz M, Schumacher K, Paufler A, Hatlapatka K, Rustenbeck I. (2012) Ca2+-dependent desensitization of insulin secretion by strong potassium depolarization. Am J Physiol Endocrinol Metab. 303:E223-33.
- Panten U, Willenborg M, Schumacher K, Hamada A, Ghaly H, Rustenbeck I. (2013) Acute metabolic amplification of insulin secretion in mouse islets is mediated by mitochondrial export of metabolites, but not by mitochondrial energy generation. Metabolism 62:1375-86.
- Schulze T, Morsi M, Reckers K, Brüning D, Seemann N, Panten U, Rustenbeck I. Metabolic amplification of insulin secretion is differentially desensitized by depolarization in the absence of exogenous fuels. Metabolism. 2017; 67:1-13.
- Brüning D, Reckers K, Drain P, Rustenbeck I. Glucose but not KCl diminishes submembrane granule turnover in mouse beta-cells. J Mol Endocrinol. 2017; 59:311-324.
- Seemann N, Welling A, Rustenbeck I. The inhibitor of connexin Cx36 channels, mefloquine, inhibits voltage-dependent Ca^{2+} channels and insulin secretion. Mol Cell Endocrinol. 2018; 472:97-106.

Institute for Biochemistry, Biotechnology and Bioinformatics

Prof. Dr. Anett Schallmey

Researcher's Career

- Professor for Biochemistry, TU Braunschweig
- Associate Professor for Biocatalysis, University of Amsterdam, Netherlands
- Junior Professor for Biocatalysis, RWTH Aachen University
- Postdoc at the Rijksuniversiteit Groningen, Netherlands
- Doctorate at the University of Greifswald, Department of Biotechnology and Enzyme Catalysis
- Biochemistry studies at the University of Greifswald

Funding

DFG, EU, BMWi, Industry

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Mission Statement

Enzymes are excellent and sustainable catalysts applicable for many chemical reactions and thus present a valuable alternative to many chemical catalysts. Our interdisciplinary research focusses on the investigation, utilization and engineering of novel enzymes as biocatalysts for various industrially relevant applications.

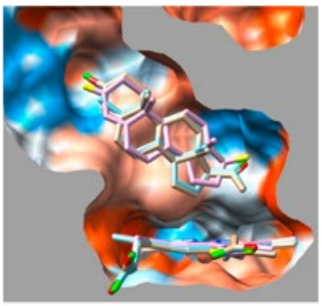
Research

Novel enzymes: The identification of novel enzyme catalysts, especially for yet biocatalytically underexplored reactions, is a major research focus in our group. Using enzyme-specific motifs and specific bioinformatics tools, we are mining the wealth of sequence data available in public databases for the discovery of interesting novel biocatalysts with valuable properties.

Selective transformations: The major advantage of enzymes compared to chemical catalysts is their intrinsic high selectivity. We are exploring the regio- and stereoselectivity of various oxygenases and lyases for the selective synthesis of fine chemicals and pharmaceuticals. This not only involves the application of free enzymes but also the generation of suitable whole-cell biocatalysts as well as the combination of different enzyme activities in biocascades.

Enzyme engineering: Many naturally occurring enzymes do not exhibit all characteristics required for their application in industrial processes. Hence, protein engineering is often the method of choice to adjust specific enzyme properties. In our projects, we apply different protein engineering techniques to modify the activity, selectivity or stability of our biocatalysts. This also includes the development of reaction-specific enzyme activity assays.

Biomass valorization: The establishment of biorefinery concepts for the valorization of lignocellulosic biomass will be the key to reach sustainability targets in the future. In this area, biomass-degrading enzymes are attracting significant research interest for their potential in the production of chemicals and biofuels from renewable feedstock. Specifically, our group investigates the valorization of lignin by selective biocatalytic depolymerisation of this aromatic polymer.



Active site of CYP154C5, a cytochrome P450 monooxygenase.

Enzymatic lignin depolymerisation.

Publications

- H. Voß, C.A. Heck, M. Schallmey, A. Schallmey. Database mining for novel bacterial β-etherases, glutathione-dependent lignin-degrading enzymes. Appl. Environ. Microbiol., 86: e02026-19, 2020.
- J. Solarczek, T. Klünemann, F. Brandt, P. Schrepfer, M. Wolter, C.R. Jacob, W. Blankenfeldt, A. Schallmey. Position 123 of halohydrin dehalogenase HheG plays an important role in stability, activity, and enantioselectivity, Sci. Rep., 9: 5106, 2019.
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- J. Koopmeiners, C. Diederich, J. Solarczek, H. Voß, J. Mayer, W. Blankenfeldt, A. Schallmey. HheG, a halohydrin dehalogenase with activity on cyclic epoxides, ACS Catal., 7: 6877-6886, 2017.
- P. Picart, L. Liu, P.M. Grande, N. Anders, L. Zhu, J. Klankermayer, W. Leitner, P. Dominguez de Maria, U. Schwaneberg, A. Schallmey. Multi-step biocatalytic depolymerization of lignin, Appl. Microbiol. Biotechnol., 101: 6277-6287, 2017.

Institute of Pharmacology – Toxicology and Clinical Pharmacy

Prof. Dr. Stephan Scherneck

Researcher's Career

- Junior Professor for Clinical Pharmacy, TU Braunschweig
- Postdoc and Consultant Pharmacist at Charité – Universitätsmedizin Berlin, Institute for Clinical Teratology and Drug Risk Assessment in Pregnancy
- Postdoc at Max Delbrück Center for Molecular Medicine, Berlin, Research Team "Genetics of Metabolic and Reproductive Disorders"
- Postdoc at German Institute of Human Nutrition Potsdam-Rehbruecke, Departments of Experimental Diabetology and Pharmacology
- Dr. rer. nat. at the University of Potsdam/ German Institute of Human Nutrition Potsdam-Rehbruecke, Department of Pharmacology
- Studies of Pharmacy at the Humboldt-Universität zu Berlin

Funding

Deutsche Diabetes Gesellschaft, Lower Saxony, Auriga Service GmbH & Co. KG, Bürgerstiftung Braunschweig

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Mission Statement

The aim of our research is to improve our understanding of the pathophysiology of metabolic diseases, in particular type 2 and gestational diabetes. Therefore, we use mouse models that reflect the human disease. We also focus on the investigation of cohorts to optimize treatment strategies.

Research

Investigation of functional links of type 2 and gestational diabetes: Both diseases show many similarities regarding their risk factors and pathomechanisms. Our group investigates alterations of physiological adaptation processes that occur in obesity and during pregnancy. Therefore, we use mouse models that are remarkably similar to humans in their clinical picture. In addition to in vivo models, isolated cell systems such as primary islets of Langerhans are used. These are examined ex vivo for impaired processes in the secretion of various hormones. Furthermore, abnormalities in glucose and lipid metabolism of the liver are of interest. In the context of the PVZ - Center of Pharmaceutical Engineering we are focusing on transferring our techniques to microfluidic ex vivo-systems. This provides new and innovative tools for the analysis of impaired metabolic processes and their interaction with compounds for the treatment of the disease.

Investigation of drug therapy safety in specific patient groups: Modern drug therapy is shifting more and more from a "one size fits all" strategy to individualized treatment. An important example is the treatment of pregnant women, where, in addition to the efficacy of a drug, its safety plays a particularly important role. Other critical patient groups show comorbidities in addition to their primary disease and receive a polymedication. In collaboration with the Institute for Clinical Teratology and Drug Risk Assessment in Pregnancy at the Charité - Universitätsmedizin Berlin, we recently examined a large cohort with regard to the safety of metformin in early pregnancy. Furthermore, in collaboration with the Klinikum Braunschweig, we are investigating the characteristics of drug therapy for high-risk patients in the field of nephrology. The optimization of therapy for diabetes patients by integrating pharmacists in an interdisciplinary team in the clinical area is another focus of our work.

Publications

- Grupe K, Asuaje Pfeifer M, Dannehl F, Liebmann M, Rustenbeck I, Schürmann A, Scherneck S: Metabolic changes during pregnancy in glucose-intolerant NZO mice: A polygenic model with prediabetic metabolism. Physiol Rep 8: e14417, 2020
- Kluth O, Stadion M, Gottmann P, Aga H, Jähnert M, Scherneck S, Vogel H, Krus U, Seelig A, Ling C, Gerdes J, Schürmann A: Decreased Expression of Cilia Genes in Pancreatic Islets as a Risk Factor for Type 2 Diabetes in Mice and Humans. Cell Rep 26: 3027-3036, 2019
- Scherneck S, Schlinke N, Beck E, Grupe K, Weber-Schoendorfer C, Schaefer C: Pregnancy outcome after first-trimester exposure to metformin: A prospective cohort study. Reprod Toxicol 81: 79-83, 2018
- Scherneck S, Nestler M, Vogel H, Blüher M, Block MD, Diaz MB, Herzig S, Schulz N, Teichert M, Tischer S, Al-Hasani H, Kluge R, Schürmann A, Joost HG: Positional Cloning of Zinc Finger Domain Transcription Factor Zfp69, a Candidate Gene for Obesity-Associated Diabetes Contributed by Mouse Locus Nidd/SJL. PLoS Genetics 5, e1000541, 2009
- Chadt A, Leicht K, Deshmukh A, Jiang LQ, Scherneck S, Bernhardt U, Dreja T, Vogel H, Schmolz K, Kluge R, Zierath JR, Hultschig C, Hoeben RC, Schürmann A, Joost HG, Al-Hasani H: Tbc1d1 mutation in lean mouse strain confers leanness and protects from diet-induced obesity. Nature Genetics 40: 1354-1359, 2008

Institute of Genetics

Prof. Dr. Ralf Schnabel

Researcher's Career

- Full professor for Genetics at the TU Braunschweig
- Independent group leader, Max-Planck-Institut für Biochemie, Martinsried
- Junior Group leader, Max-Planck-Institut für Entwicklungsbiologie, Tübingen
- Postdoc at Laboratory for Molecular Biology, Cambridge UK
- Dr. rer. nat. at Max-Planck-Institut für Biochemie/LMU München
- Master of Science at Louisiana State University, Baton Rouge USA
- Study of Biochemistry, Universität Tübingen

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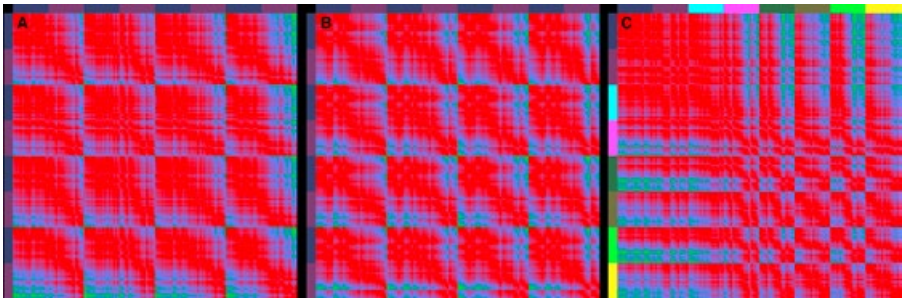
Mission Statement

Exploration of basic principles in developmental biology to unravel general strategies building animals from the fertilized zygote. The current focus concerns the question how the linear information of the DNA is translated into shape and form.

Research

Life is order. Therefore, it is a key question as to how the linear genetic information of the DNA is coded for the plethora of forms of organisms. A worm will produce a worm, a fly will produce a fly and families will pass on their facial features. The classical model suggests that form is created by a series of inductions that organise tissues, convoyed by growth, migration, and modulation of cell shape. In contrast, using 4D microscopic analyses and new bioinformatics tools, we showed that in the C. *elegans* embryo, pattern and form are the result of a cell sorting process involving long-range migrations coordinated by local comparison of cell 'addresses', which are intrinsic features of individual cell fates.

We termed this novel process guiding the generation of form 'cell-focussing'. Revolutionary work in tissue engineering has recently shown that eyecups or small brains can develop *de novo* from stem cells *in vitro*. Because this opposes the general model of morphogenesis, the existence of a 'latent intrinsic order principle' causing dynamic self-patterning is postulated. Cell-focussing embodies these principles and has therefore the potential to explain self-patterning. The creation of cell addresses used to arrange cell position should be an ingenious solution to translate the linear information of DNA into form. In a large genetic screen we isolated a mutant, which hinted that glycoproteins may code for the enigmatic cell addresses. However, it turned out that glycoproteins are only involved in migrations per se, cells just move less efficiently, as if they were now on slippery ground. Nevertheless, as can be seen in the corresponding distance maps of cells (picture A) they are still able to resort in a completely new, although blurred, pattern, which is expected when cell fates are specifically manipulated using a glp-1 mutant (B) compared to wild-type (C). Therefore, it is rather improbable that glycoproteins code for cell addresses. The search must go on.



Publications

- J. R. Priess, H. Schnabel, & R. Schnabel (1987) The glp-1 locus and cellular interaction in early C. *elegans* embryos. Cell 51, 601-611
- H. Schnabel & R. Schnabel (1990) An organ-specific differentiation gene, pha-1, from *Caenorhabditis elegans*. Science 250, 686-688
- R. Schnabel (1994) Autonomy and nonautonomy in cell fate specification of muscle in the *Caenorhabditis elegans* Embryo: A reciprocal induction. Science 263, 1449-1452
- Titus Kaletta, Heinke Schnabel & Ralf Schnabel (1997) Binary specification of the embryonic lineage in *Caenorhabditis elegans*. Nature, 390, 294-298
- Hoeppner DJ, Hengartner MO, Schnabel R (2001) Engulfment genes cooperate with ced-3 to promote cell death in *Caenorhabditis elegans*. Nature 412, 202-206

Institute of Organic Chemistry

Prof. Dr. Stefan Schulz

Researcher's Career

- Former President of the International Society of Chemical Ecology
- Full Professor of Organic Chemistry at the TU Braunschweig
- Rejected Calls for Professor of Organic Chemistry at Würzburg, TU Munich, LMU Munich
- Junior Group Leader at Institute of Organic Chemistry, Hamburg
- Postdoc at Cornell University, Ihaca, USA
- Dr. rer. nat. at the Universität Hamburg, Institute of Organic Chemistry
- Study of Chemistry, Hamburg

Funding

DFG, BMBF, State Lower Saxony, Industry

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Mission Statement

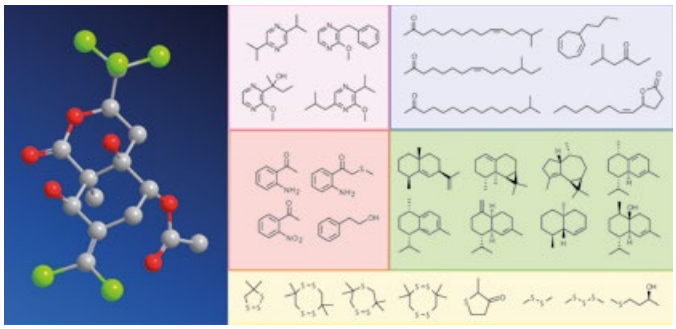
Chemical Communication and Chemical Ecology are the focus of our Natural Products Research. Identification and isolation of compounds, stereoselective synthesis, and biosynthesic investigations are used to understand why and for what purpose natural organisms produce signalling compounds, defence compounds, or antibiotics.

Research

Chemical Communication: Arthropods are well known for their widespread use of semiochemicals, compounds mediating inter- and intraspecific interactions among individuals. Such compounds occur usually in low concentrations and need organic trace analysis methods such as gas chromatography/mass spectrometry (GC/MS) or gas chromatography/direct deposition infrared spectroscopy (GC/DD-IR) for their identification as well as spectral computer calculations. Structural proposals based on data spectra need to be verified by synthesis. Often stereochemistry is important for biological activity and therefore stereoselective synthesis and analysis is performed. Our research includes various vertebrates such as insects and arachnids, amphibia, reptiles, as well as mammals, projects are investigated in close cooperation with biologists from all parts of the world.

Bacterial Volatiles and Communication: Bacteria can produce a wealth of volatile compounds, the function of which is currently only poorly understood. We aim to clarify the structural space used by the bacteria and investigate the function of these compounds. While volatiles are analyzed as described above, bacteria also communicate by "quorum sensing" using non-volatile com-pounds. These compounds are analyzed by HPLC/MS. Target compounds are synthesized to determine their structure and evaluated for their activity in cooperation with biologists.

Antibiotics and other active compounds: We are searching for new natural products from various sources to find new compounds potentially beneficial for health of agriculturze. Current approaches like genome mining make it possible to detect even minute amounts of new compounds. Because these compounds are difficult to obtain in enough quantities for NMR analysis, total syntheses may shorten the time needed for their identification. Structural proposals are made from MS, IR and/or NMR spectra as well as microderivatization methods developed by us.



Sigillin A, a unique poly-chlorinated natural benzopyranone from a springtail (left) and volatile ompounds produced by bacteria, belonging to five major compound classes: pyrazines, aliphatic compounds, aromatic compounds, terpenes, and sulfur compounds (right).

Publications

- Montes Vidal D, Rymon-Lipinski A-L von, Ravella S, Groenhagen U, Herrmann J, Zaburannyi N, Zarbin PHG, Varadarajan AR, Ahrens CH, Weisskopf L, Müller R, Schulz S (2017). Angew. Chem. Int. Ed. 56: 4342–4346.
- Schlawis C, Kern S, Kudo Y, Grunenberg J, Moore BS, Schulz S (2018) Structural Elucidation of Trace Components Combining GC/MS, GC/IR, DFT-Calculation and Synthesis—Salinilactones, Unprecedented Bicyclic Lactones from Salinispora Bacteria. Angew. Chem. Int. Ed. 57: 14921–14925.
- Melnik K, Menke M, Rakotoarison A, Vences M, Schulz S (2019) Identification and Synthesis of Luteolide, a Highly Branched Macrolide Semiochemical from the Mantellid Frog Gephyromantis luteus. Org. Lett. 21: 2851–2854.
- Steinbiss M, Maczka M, Langewald J, London B, Vallinayagam R, Jones PG, Bastiaans H, Schulz S (2020) Sigillins from Springtails Are Potent Natural Insecticides. J. Nat. Prod. 83: 468-472.
- Weisskopf L, Schulz S, Garbeva P (2021) Microbial volatile organic compounds in intra-kingdom and inter-kingdom interactions. Nat Rev Microbiol 19: 391–404 (2021).

Institute of Microbiology – Department Microbial Drugs

Prof. Dr. Marc Stadler

- Head of Department Microbial Drugs, Helmholtz Centre for Infection Research

Researcher's Career

- Acting Vice President and Executive Board member, International Mycological Association (IMA)
- Executive Board Member, International Commission for the Taxonomy of fungi (ICTF)
- Task Leader, German Centre for Infection Research (DZIF)
- Researchers Career
- Visiting Professor, CAS State Key Lab of Mycology, Beijing, P.R. China, 2013
- Head of Department Microbial Drugs, HZI Braunschweig, 2012
- Professor, TU Braunschweig, 2012
- Lecturer (Mycology, Organic Chemistry), Univ. Bayreuth, Habilitation 2009
- Co-founder, shareholder and Director of InterMed Discovery GmbH, Dortmund, Germany 2006-2012
- Principal Research Scientist, Bayer AG, (Pharma Division, Natural Products Research) Wuppertal, Germany 1995-2006
- Postdoc (Natural Product Chemistry, University of Lund, Sweden) 1994-1995
- Dr. rer. nat. (Biotechnology, Universität Kaiserslautern) 1993

Funding

BMBF/DZIF, EU, Alexander-von Humboldt-Stiftung, DAAD, DFG, Bill and Melinda Gates Foundation

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Mission Statement

Our mission is the discovery and preclinical development of novel anti-infectives and other useful compounds from natural sources in order to combat the newly arising multi-resistant human pathogens in an interdisciplinary, international scenario.

Research

Our interdisciplinary team consists of **microbiologists, mycologists, analytical chemists and biotechnological engineers.** We are involved in training students in the aforementioned disciplines and are also steadily recruiting Ph.D. students with respective qualifications from around the world who graduate at the Technical University of Braunschweig.
Our research involves several major tasks that all relate to **natural products-based drug discovery from bacterial and fungal sources.**

As taxonomy and the ability to produce biologically active secondary metabolites are known to be closely correlated, we are undertaking great efforts in the isolation and characterisation of strains (in particular, actinobacteria, **myxobacteria and fungi**) by means of classical taxonomy and molecular phylogeny.

In a **world-wide scientific network** involving many experts in **biodiversity research**, young researchers come to work, in our laboratory, on the biological sources from their home countries. The cultures of these organisms are first subjected to small scale fermentation and their extracts are studied for production of **antibiotics, antivirals** and other useful biologically active compounds. We are continuously finding new chemical entities from **new species and hitherto unexplored organisms**.

The **production, isolation and structure elucidation** of these compounds using state-of-the-art fermentation techniques and **analytical and chromatographic instruments (HPLC, NMR, MS)** is one of our major tasks. Moreover, we design **sustainable biotechnological production processes** for interesting lead compounds in up to multi-gram scale for exploratory studies and **preclinical development** and can perform **fermentations up to pilot scale** including adequate downstream processing procedures.

We collaborate with partners in academia and industry to improve the production rates and optimise the bioactivities of our compounds by means of synthetic biotechnology or medicinal chemistry.

Publications

- Wittstein K, Cordsmeier A, Lambert C, Wendt L, Sir EB, Weber J, Wurzler N, Petrini LE, Stadler M (2020) Identification of *Rosellinia* species as producers of cyclodepsipeptide PF1022 A and resurrection of the genus Dematophora as inferred from polythetic taxonomy. Stud Mycol 96:1-16.
- Sandargo B, Michehl M Praditya D,.Steinmann E, Stadler M, Surup F .(2019) Antiviral meroterpenoid rhodatin and sesquiterpenoids rhodocoranes A-E from the wrinkled peach mushroom, *Rhodotus palmatus*. Org Lett 21:3286-3289
- Surup F, Narmani A, Wendt L, Pfütze S, Kretz R, Becker K, Menbrivès C, Giosa A, Elliott M, Petit C, Rohde M, Stadler M (2018) Identification of fungal fossils and novel azaphilone pigments in ancient carbonised specimens of *Hypoxylon fragiforme* from forest soils of Châtillon-sur-Seine (Burgundy). Fungal Divers 92:345-356.
- Rupcic Z, Rascher M, Kanaki S, Köster RW, Stadler M, Wittstein K (2018) Two new cyathane diterpenoids from mycelial cultures of the medicinal mushroom *Hericium erinaceus* and the rare species, *Hericium flagellum*. Int J Mol Sci 19(3):740.
- Chepkirui C, Yuyama K, Wanga L, Decock C, Matasyoh J, Abraham WR, Stadler, M (2018) Microporenic acids A-G, biofilm inhibitors and antimicrobial agents from the basidiomycete *Microporus* sp. J Nat Prod 81:778-784.

Institute of Microbiology

Prof. Dr. Michael Steinert

- Flying Faculty Member of the Türk-Alman Üniversitesi, Istanbul
- Scientific Advisory Board of the Leibnitz-Institut DSMZ-Deutsche Sammlung von Mikroorganismen und Zellkulturen
- Board of the Helmholtz International Graduate School for Infection Research
- Member of the Braunschweiger Zentrum für Systembiologie
- Coordinator of the thematic priority "Infection Biology" (Master Biology)

Researcher's Career

- Prof. for Microbiology at the TU Braunschweig
- Scientific group leader at the University of Würzburg
- Postdoc at the Centers for Disease Control, USA
- Dr. rer. nat. at the University of Würzburg, Institut for Molecular Infection Biology
- Study of Biology, Würzburg

Funding
DFG, BMBF, State Lower Saxony, Industry

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Mission Statement

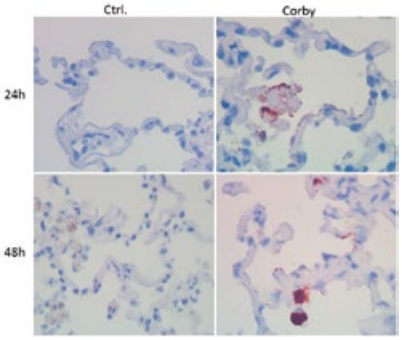
Infectious diseases are a continous threat to human and animal health. Our mission is to discover principles of infection at the molecular, cellular, organ, host, and population level with the goal to develop novel infection intervention and prevention strategies.

Research

Ecology, transmission and pathogenicity of *Legionella pneumophila:* We analyse the pathogen-host interactions of the causative agent of Legionnaires' disease. In addition to protozoa and human host cells we study the infection of human lung tissue explants. Special emphasis is placed on peptidyl-proly-cis/trans-isomerases (PPIases), the bacterial secretome and outer membrane vesicles.

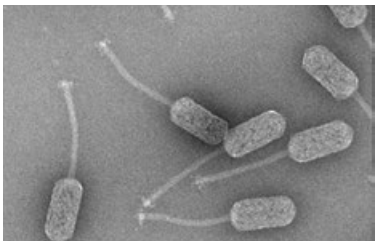
Novel therapeutic strategies for *Clostridium difficile* infections: *C. difficile* has become the primary cause of antibiotic-associated diarrhea and pseudomembranous colitis. We analyze the virulence mechanisms of *C. difficile* including tissue colonization and spore-mediated persistence. Moreover, we aim to identify new bacterial drug targets and to develop alternative treatment strategies.

Pneumococcal-Host-Interactions (PD Dr. Simone Bergmann): We analyze the interaction between the opportunistic pathogen *Streptococcus pneumoniae* and different human host niches including the pharyngeal epithelium, the lung tissue and the vascular system. In addition to a detailed biochemical deciphering of protein interactions, various cell culture-based infection models are utilized (e.g. microfluidic pump system for simulation of bloodstream infections, venous endothelium model).



Uninfected (left) and Legionella-infected (right) human lung tissue explants.

Evolution and pathogenicity of *Paenibacillus larvae:* *Paenibacillus larvae* is the causative agent of American foulbrood (AFB), the most serious bacterial infection in honey bees. We use biochemistry, molecular biology and modern Omics technologies to elucidate AFB outbreaks and the virulence mechanisms of *P. larvae.* Moreover, we characterize *P. larvae*-specific bacteriophages and develop criteria for a safe phage therapy.



Paenibacillus larvae-directed bacteriophages.

Publications and Patents

- Beims, H., Bunk, B., Erler, S. Mohr, K., Spröer, C., Pradella, S., Günther, G., Rohde, M., von der Ohe, W., Steinert, M. (2020) Discovery of *Paenibacillus larvae* ERIC V: Phenotypic and genomic comparison to genotypes ERIC I-IV reveal different inventories of virulence factors which correlate with epidemiological prevalences of American Foulbrood. International Journal of Medical Microbiology, 310(2): 151394.
- Ünal, C.M., Karagöz, M.S., Berges, M., Priebe, C., Borrero de Acuna, J. M., Wissing, J., Jänsch, L., Jahn, D., Steinert, M. (2019) Pleiotropic *Clostridioides difficile* cyclophilin PpiB controls cystein-tolerance, toxin production, the central metabolism and multiple stress responses. Frontiers in Pharmacology, 10:340. doi: 10.3389/fphar.2019.00340.
- Rasch, J., Ünal, C.M., Klages, A., Karsli, Ü., Heinsohn, N., Brouwer, R.M.H.J., Richter, M., Dellmann, A., Steinert, M. (2018) PPIases Mip and PpiB of Legionella pneumophila contribute to surface translocation, growth at suboptimal temperature and infection. Infection and Immunity, 15.pii:IAI00939-17.
- Beims, H., Wittmann, J., Bunk, B., Spröer, C., Rohde, C., Günther, G., Rohde, M., von der Ohe, W., Steinert, M. (2015) Paenibacillus larvae-directed bacteriophage HB10C2 and its application in American Foulbrood-affected honey bee larvae. Applied and Environmental Microbiology, 81(16): 5411-5419.
- Ünal, C. & Steinert, M. (2014) Microbial peptidyl-prolyl cis/trans isomerase (PPIase)-virulence factors and potential alternative drug targets. Microbiology and Molecular Biology Reviews, 78(3):544-571.
- Jäger, J., Marwitz, S., Tiefenau, J., Rasch, J., Shevchuk, O., Kugler, C., Goldmann, T. & Steinert, M. (2014) Human lung tissue explants reveal novel interactions during *Legionella pneumophila* infections. Infection and Immunity 82(1): 275-85.

Department of Cell Biology

Prof. Dr. Theresia E. B. Stradal

Researcher's Career

- Full Professor at TU Braunschweig and Head of the Department of Cell Biology at the HZI
- Associate Professor for Molecular Cell Biology at the University of Münster (WWU)
- Habilitation at Hannover Medical School, Biochemistry
- Group leader, Helmholtz Centre for Infection Research (HZI formerly GBF), Braunschweig
- FEBS Letters Young Scientist Award
- Postdoc in the Department of Cell Biology, German Research Centre for Biotechnology (GBF), Braunschweig, Germany
- Dr. rer. nat at the Institute of Molecular Biology, Austrian Academy of Sciences, Salzburg
- Studies in Biology, University of Salzburg, Austria

Funding

DFG, HGF

Contact

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Mission Statement

We address host-pathogen interactions at the level of single cells, embodying the smallest living unit on both sides. Pathogens need to manipulate the normal behavior of host cells in order to establish a niche for survival and to evade the host's defense mechanisms. We study this interplay at the cellular and molecular level.

Research

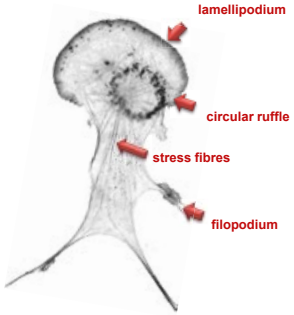
Recent reports published by the World Health Organization (WHO) entitled "The Global Burden of Disease" (GBD) highlight the importance of research on host-pathogen interactions. Evolution is an ongoing process, driving the development of highly virulent and multi-resistant bacteria strains or so called "emerging pathogens". A deeper understanding of the complex interactions between pathogenic bacteria and their hosts is indispensable in order to face these problems in the future.

The HZI department Cell Biology studies both the defense mechanisms of the host and the virulence mechanisms of the pathogens. Our core expertise is the combination of video-microscopy and protein biochemistry, applied to different models of cell movement in the context of bacterial infections. In the past, we were able to uncover regulatory mechanisms in cell movement and how bacterial virulence factors influence them.

Pathogenic bacteria frequently manipulate eukaryotic host cells by targeting actin cytoskeletal turnover. This is achieved, for example, by manipulating or mimicking the regulator's controlling actin dynamics such as members of the Rho family of small GTPases. Rho-GTPases serve as molecular switches that – while cycling - turn entire signalling pathways on and off, like those driving actin remodelling.

Interestingly, bacterial virulence factors have also emerged to bind to host cell signalling adaptors, highlighting the fact that these factors do not simply elicit global signals, but assemble larger complexes guiding the signal to a specific destination in the cell.

To gain more insight into these intricate mechanisms, we have begun to identify host targets of bacterial effectors by using proteomics and performing yeast-2-hybrid screens. Potential candidates are validated and tested for their influence on virulence factor-elicited signalling using state of the art biochemistry, cell biology and imaging. Finally, crystal structures of these complexes disclose the molecular details of these interactions at the host-pathogen interface. Our research has shown that during the infection process bacterial pathogens are highly dependent on cooperation with host proteins – an insight which might lead to new strategies for fighting infections.



F-actin organization in a migrating cell

Publications

- Blasche, S., Arens, S., Ceol, A., Siszler, G., Schmidt, M.A., Häuser, R., Schwarz, F., Wuchty, S., Aloy, P., Uetz, P., Stradal, T.E., Kögl, M. (2014) The EHEC-host interactome reveals novel targets for the translocated intimin receptor. Sci Rep. 18(4), 7531.
- Hänisch, J., Kölm, R., Wozniczka, M., Bumann, D. Rottner, K, Stradal, T.E. (2011) Activation of a RhoA/myosin II-dependent but Arp2/3 complex-independent pathway facilitates Salmonella invasion. Cell Host & Microbe 9(4), 273-285.
- Rottner, K., Stradal, T.E. (2011) Actin dynamics and turnover in cell motility. Curr. Opin. Cell. Biol. 23(5), 569-578.
- Klink, B.U., Barden, S., Heidler, T.V., Borchers, C., Ladwein, M., Stradal, T.E., Rottner, K., Heinz, D.W. (2010) Structure of Shigella IpgB2 in complex with human RhoA: implications for the mechanism of bacterial guanine nucleotide exchange factor mimicry. J. Biol. Chem. 285(22), 17197-17208.
- Weiss, S.M., Ladwein, M., Schmidt, D., Ehinger, J., Lommel, S., Städing, K., Beutling, U., Disanza, A., Frank, R., Jänsch, L., Scita, G., Gunzer, F., Rottner, K., Stradal, T.E. (2009) IRSp53 links Tir to EspFU/N-WASP-mediated actin assembly in EHEC pedestal formation. Cell Host & Microbe 5, 244-258.

Institute of Inorganic and Analytical Chemistry

Prof. Dr. Dr. h.c. Dr. h.c. Matthias Tamm

- Member of the Senate
- Director of the Institute of Inorganic and Analytical Chemistry

Researcher's Career

- Full Professor of Inorganic and Analytical Chemistry, TU Braunschweig
- Temporary Professorship, TU München
- Privatdozent and Hochschuldozent, Westfälische Wilhelms-Universität Münster
- Visiting Research Scientist, DuPont Central Research and Development (USA)
- Ph.D. at the TU Berlin
- Study of Chemistry at the TU Berlin

Funding

DFG, GIF, Lower Saxony, FCI, EU

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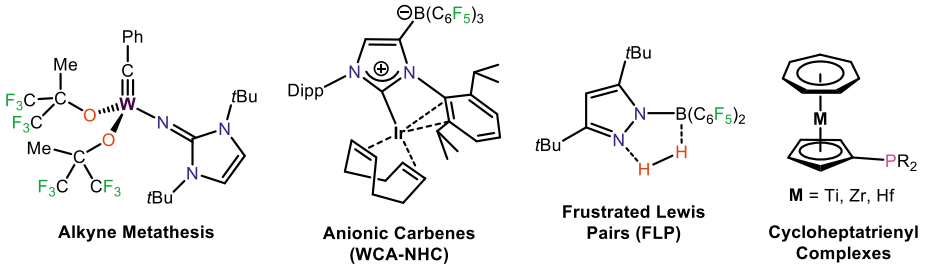
Mission Statement

Our mission is the advancement of organometallic chemistry by creating transition metal complexes with unusual electronic and structural properties and by exploiting their reactivitiy for the development of homogeneous catalysts for selective molecule activation and sustainable synthesis.

TAMM Group
Organometallic Chemistry and Catalysis

Research

Our research activities lie in the areas of preparative organometallic and coordination chemistry with an emphasis on the development of novel, unusual ligand systems and on the investigation and application of their transition metal complexes. With these ancillary ligands at hand, we have developed numerous homogeneous catalysts with particularly important contributions in the field of catalytic alkyne metathesis, while highly active catalysts for olefin polymerization, hydroamination, hydrosilylation, hydrogenation and cross-coupling reactions were also established. In the course of our studies on so-called "frustrated Lewis pairs", we aim at the development of metal-free catalysts and systems for reversible H_2 activation and storage. Furthermore, we have a long-standing interest in advancing the organometallic chemistry of cycloheptatrienyl ligands, which can be regarded as neglected carbocyclic ligands in comparison with their cyclopentadienyl and arene congeners. The figure below shows selected representative compounds from our current and future research activities.



Reviews

- Ehrhorn, H.; Tamm, M. (2019) Well-Defined Alkyne Metathesis Catalysts: Developments and Recent Applications. Chem. Eur. J. 25: 3190-3208.
- Doddi, A.; Peters, M.; Tamm, M. (2019) N-Heterocyclic Carbene Adducts of Main Group Elements and Their Use as Ligands in Transition Metal Chemistry. Chem. Rev. 119: 6994-7112.
- Nasr, A.; Winkler, A.; Tamm, M. (2016) Anionic N-Heterocyclic Carbenes: Synthesis, Coordination Chemistry and Applications in Homogeneous Catalysis. Coord. Chem. Rev. 316: 68-124.
- Wu, X.; Tamm, M. (2014) Transition metal complexes supported by highly basic imidazolin-2-iminato and imidazolin-2-imine N-donor ligands. Coord. Chem. Rev. 260: 116-138.
- Kolychev, E. L.; Theuergarten, E.; Tamm, M. (2013) N-Heterocyclic Carbenes in FLP Chemistry. Top. Curr. Chem. 334: 121-155.
- Glöckner, A.; Tamm, M. (2013) The Organometallic Chemistry of Cycloheptatrienyl Zirconium Complexes. Chem. Soc. Rev. 42: 128-142.

Department of Traffic and Engineering Psychology

Prof. Dr. Mark Vollrath

Researcher's Career

- Full Professor for Traffic and Engineering Psychology, TU Braunschweig
- Head of Department Human Factors, German Aerospace Center (DLR) Braunschweig
- Habilitation about Alcohol Tolerance at Julius-Maximilans-Universität, Würzburg
- Dissertation on Articulation Pauses in Speech at Julius-Maximilans-Universität, Würzburg
- Study of Psychology at Julius-Maximilans-Universität, Würzburg

Funding

DFG, Bast, BMBF, BMWI, EU, UDV, Industry

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Background and Aims

Mobility is a core component of life quality. Understanding the mobile human is the most important step towards improving traffic safety and protecting the environment by cycling and walking. This is used for designing and evaluating human-machine-interaction in a human-centered manner.

Research

Psychological models of driver (cyclist, pedestrian) behavior: Perception, attention and situation awareness are the key components of the human information process that governs behavior in general and human error in particular. Additionally, attitudes, motivation and social norms influence dangerous behavior, but also the choice of transportation modes. This research area is concerned with the fundamental psychological processes in mobility.

Information and warning systems: Computer technology provides information that can be used to support the driver and prevent driver errors. However, additional information can always lead to distraction and thus cause new problems. Taking the human information processing resources into account leads to solutions that really improve safety and comfort, with special regard to older and younger drivers.

Driver state: Being able to easily manage the demands of the current traffic situations depends, to a large part, on the driver state. Driving experience and training provide the basic abilities which are then influenced by factors such as fatigue, stress, emotion or distraction. Additionally, driver state may be changed by alcohol, licit or illicit drugs. Research is targeted to detecting the driver's state, evaluating the risk due to different factors, but also developing concepts to manage driver state.

Driver assistance systems and automation: Driver assistance systems can support the driver by taking over parts of the driving task or even completely taking over driving for certain time-periods in special situations. However, this changes the role of the driver fundamentally. How do drivers cope with their new driving situation and how can it be assured that the resulting man-machine-system is safer and more efficient than the old driver-vehicle system? Driving simulator studies are conducted to examine these issues.

Cycling: Severe accidents in urban surroundings often involve cyclists. Risk factors may be risky behaviors like cycling in the wrong direction, cycling with alcohol or without lights. However, very few studies really analyze this in such detail that adequate countermeasures can be developed. A cycling simulator as well as observation studies facilitate examination of these topics.

Publications

- Vollrath, M. (2015). Ingenieurpsychologie. Psychologische Grundlagen und Anwendungsgebiete (Grundriss der Psychologie Band 30). Stuttgart: Kohlhammer.
- Beller, J., Heesen, M., & Vollrath, M. (2013). Improving the driver-automation interaction: An approach using automation uncertainty. Human Factors, 55(6), 1130–1141.
- Muhrer, E., Reinprecht, K. & Vollrath, M. (2012). Driving with a partially autonomous forward collision warning system: how do drivers react? Human Factors, 54(5), 698-708.
- Werneke, J. & Vollrath, M. (2013). How to present collision warnings at intersections? – A comparison of different approaches. Accident Analysis and Prevention, 52, 91-99.
- Winkler, S., Werneke, J. & Vollrath, M. (2016). Timing of early warning stages in a multi stage collision warning system: Drivers' evaluation depending on situational influences. Transportation Research Part F, 36, 57-68.

Department of the History of Sciences and Pharmacy

Prof. Dr. med. Bettina Wahrig

- Head of the Division for the History of Science and Pharmacy at Technische Universität Braunschweig

Researcher's Career

- Studied medicine and philosophy in Mainz and Marburg
- PhD in Marburg in 1984
- Free-lance cooperation with the editor of the critical edition of Nietzsche's works in Florence
- Researcher and senior researcher at the Institute for the History of Medicine in Lübeck
- Habilitation at University of Lübeck
- Holds the chair for the history of science and pharmacy since 1997
- Guest researcher at the Max Planck-Institute für the History of Science in Berlin and at the University of Strasbourg
- President of the Gesellschaft für Wissenschaftsgeschichte (2008-2013)
- President of the National Committee of the International Union for History and Philosophy of Science and Technology (2005-2014)
- Member of the standing committee of the Deutsche Forschungsgemeinschaft (2008-2016)

Funding
DFG, MWK

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Mission Statement

We interpret the dynamics of knowledge and science in a historical and cultural context. History is not about the lonesome (male) hero discovering eternal truths. Instead we ask: How have the dynamics of the living body and the effects of pharmaceuticals been explained in a gender and cross-cultural perspective?

Research

History of precarious substances in the life sciences: This is about the histories of dangerous, highly effective and ambiguous substances, e.g. pharmaceuticals, poisons, food additives. In the course of its history a precarious substance may migrate across different fields of research and application. Cooperators have been Viola Balz (now Dresden), Alexander von Schwerin (now Berlin), Heiko Stoff (now Hannover), Florence Vienne and myself, focusing on the history of hormones, enzymes and vitamins, of radioactivity research within life sciences, of the history of mutagens and food additives, and the history of the first neuroleptics in the 20th century. We have also looked into the concepts and the forms of "biologics" in the 20th century and the political history of the cell.

Poisons and poisonings in the history of science, literature and film: In a cooperative project with the film historian Heike Klippel (HBK Braunschweig), we explore the motives, narratives, and interdiscourses concerning poisoning. In my department, the emphasis is on the history of the understanding of the nature of poisons, on experimental practices concerning the effects and the proof procedures for poisons, and on medical and court cases, casting some glances on the mutual influence between science and fiction in the long 19th century. Our research questions concern longue durée aspects of motives and narratives around poisons and poisonings, especially in the perspective of gender studies.

Drugs and gender: In a cooperative project with Ljiljana Verner (Hannover), we explore the interrelations between gendered concepts of drug effects, drug policies, consumer attitudes and gender stereotypes within the drug market of today.

Material cultures of knowledge: German/Taiwanese research on the history of material cultures in the perspective of comparison and of cultural exchange. Topics are the history of drugs, gender relations, natural history, the history of humanities, health care systems around 1900, and colonialism.

Aerugo (Grünspan). Specimen from the "Arzneimittelhistorische Sammlung Schneider"(the division's collection of ca. 1000 historical medicinal substances

Publications

- Schwerin, Alexander von; Stoff, Heiko; Wahrig, Bettina (Hg.) (2013): Biologics. A History of Agents Made From Living Organisms in the Twentieth Century. London: Pickering & Chatto .
- Wahrig, Bettina (2015): Eigenes und Fremdes: Paolo Mantegazza und die Geburt der europäischen Coca, in: Polubojarinova, Larissa et al. (Hg.): Phänomenologie, Geschichte und Anthropologie des Reisens. Kiel, pp. 208-220.
- Wahrig-Burfeind, Renate; Wahrig, Bettina (2014): Der Lexikograf Gerhard Wahrig – Systemgrenzen und Ressourcen: Zur Entstehung seines Projekts "Wörterbuch als Datenbank", in: Ber. Wissenschaftsgesch. 37, pp. 263-286.
- Wahrig, Bettina (2014): Zeit der Aufklärung: Instrumente und Hände in der Geburtshilfe des 18. und frühen 19. Jahrhunderts, in: Stauf, Renate et al. (Hg.): Wechselwirkungen. Die Herausforderung der Künste durch die Wissenschaften. Heidelberg, pp. 99-111.
- Wahrig, Bettina (2013): Clocks with Hands: Instruments, Hands and Parturients in a Changing Horizon of Time, in: History and Philosophy of the Life Sciences 35, pp. 62–67.

Institute for Physical and Theoretical Chemistry – Biophysical Chemistry

Prof. Dr. Peter J. Walla

Researcher's Career

- Associate Professor for Chemistry, University of Braunschweig.
- Head of Research Group, Max-Planck-Institute for Biophysical Chemistry, Göttingen.
- Assistant Professor for Chemistry, University of Braunschweig.
- Head of Department Optics Detection, DIREVO Biotech AG, Cologne, Germany.
- Emmy-Noether Award, German Science Foundation.
- Postdoc, University of California at Berkeley, USA.
- Dr. rer. nat. University of Göttingen and Max-Planck-Institute for Biophysical Chemistry, Göttingen.
- Studies of Chemistry, Universities of Heidelberg and Göttingen.

Funding

DFG, Fonds der chemischen Industrie

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Mission Statement

Sustainable energy supply is rapidly becoming one of the most critical issues for upcoming decades. We explore in detail the very efficient photophysical molecular mechanisms by which nature harvests solar energy and develop concepts for artificial light-harvesting and energy converting devices using state-of-the art laser- and microscope technology.

Research

Solar light-harvesting and energy conversion: Nature has achieved remarkable efficiency in harvesting photons (the smallest units of light), transferring their excitation energy in an energy-funnel-like manner to reaction centres and converting it into electrical energy through charge separation (Fig .1). In low light conditions the efficiency by which photons are converted into charge separation is close to unity. To achieve this extremely high efficiency the individual energy transfer steps in nature occur on ultrafast timescales that are faster than the molecular conversion into heat.

State-of-the art laser- and microscope technology: These processes occur on a femtosecond (10^{-15} s) timescale and can only be observed with modern laser technology as even the fastest electronic devices can only detect processes being several orders of magnitude slower. We explore the natural photophysical light-harvesting, energy transfer, energy conversion mechanisms and the regulation of the energy flow in detail and try to use this knowledge to construct artificial devices that make similar mechanisms available for utilization in artificially engineered solar light-harvesting and energy converters. To unveil and develop these mechanisms we use the latest state-of-the-art laser as well as microscope technology (Fig.2).

Exploring communication between nervecells: The same tools are also used to unveil other important biomolecular and biological questions in close collaboration with biologically oriented groups. An important focus is on neurobiologcal questions such as the molecular mechanisms by which the fast signal transmission between nerve cells occurs (Fig. 3) or how changes in nerve cells enable memory.

Figure 1: Nature is remarkably efficient in harvesting solar energy.

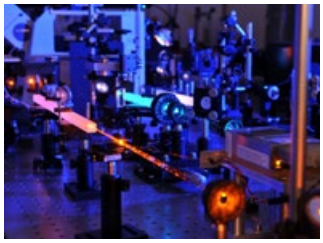

Figure 2: Using state-of-the art spectroscopy and microscopy we investigate the underlying processes of light harvesting and engineer artifical light-harvesting devices.

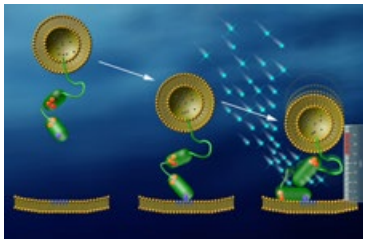

Figure 3: The same tools are also used in other projects exploring, for example, the proteins that trigger nerve cell communication.

Publications

- C.-C. Lin, J. Seikowski, A. Pérez-Lara, R. Jahn, C. Höbartner, P. J. Walla, "Control of membrane gaps by synaptotagmin-Ca^{2+} measured with a novel membrane distance ruler", Nature Commu., 5, 5859 (2014).
- P.-J. Walla, C.-P. Holleboom, G. R. Fleming, "Electronic Carotenoid-Chlorophyll Interactions Regulating Photosynthetic Light Harvesting of Higher Plants and Green Algae", in: Demmig-Adams B., Adams W. W. III, Garab G., Govindjee (eds.), Vol. 40 Series: Advances in Photosynthesis and Respiration, 40, 229-243 (2014).
- P. J. Walla, "Modern Biophysical Chemistry, 2nd Edition", Wiley-VCH (2014).
- L. Wilk, M. Grunwald, P.-N. Liao, P. J. Walla, W. Kühlbrandt, "Direct interaction of the major light-harvesting complex II and PsbS in nonphotochemical quenching", PNAS, 110, 5452-5456 (2013).
- J. M. Hernandez, A. Stein, E. Behrmann, D. Riedel, A. Cypionka, Z. Farsi, P. J. Walla, S. Raunser and R. Jahn, "Membrane Fusion Intermediates via Directional and Full Assembly of the SNARE Complex", Science, 336, 1581-1584 (2012).

Institute of Medicinal and Pharmaceutical Chemistry

Prof. Dr. Hermann Wätzig

Researcher's Career

- Appointment to the Scientific Board of CE Pharm
- Appointment to the Scientific Board of DPhG
- Appointment to the Scientific Board of ISEAC
- Public appointment to member of the European Pharmacopoeial Commission Expert Group
- Public appointment to member of the Pharmacopoeial Commission of the Federal Institute of Pharmaceuticals and Medicinal Products (BfArM), board of pharmaceutical chemistry
- Editorial Board Member of the journal Electrophoresis

Funding

Pharmaceutical Industry, Analytical Instrument Industry

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Mission Statement

Quality of pharmaceuticals means quality of analytical research in the first place. This particularly includes the thorough characterization of biopharmaceuticals and setting quality standards in drug screening.

Research

In close collaboration with pharmaceutical companies and national as well as European competent authorities we work on analytical topics, emphasizing separation techniques, protein and proteome analysis, quality assurance of biotechnically produced pharmaceuticals and statistical issues from quality control.

Hence we employ capillary and gel electrophoresis (CE and SDS-PAGE, 2-DE), HPLC and mass spectrometry, we develop strategies to economically qualify analytical instrumentation, we optimize and validate methods, especially in order to improve precision and accuracy. We have recently achieved percental relative standard deviations RSD% of approximately 1 to 2% for various analytical applications of chromatography in bioanalysis (SEC, SAX, RP-LC), further we have obtained similar numbers even for gel electrophoresis.

We work out concepts for how to set specifications and how to use statistical process control (SPC) with the goal of facilitating the parametric release. Moreover trend test, data evaluation related to method transfers and outlier detection are related to this branch.

One recent research topic deals with affinity capillary electrophoresis (ACE). This is an efficient and precise possibility for studying interactions in solutions. We use this approach to investigate specific interactions of proteins with, for example, metal ions or anions from organic acids. In this way we also like to better understand how proteins influence their direct environment and how this is related to various mechanisms of biochemical regulation and to the efficacy of pharmaceuticals.

Publications and Patents

- Deeb, Sami El; Wätzig, Hermann; El-Hady, Deia Abd; AlBishri, Hassan M.; de Griend, Cari Sänger-van; Scriba, Gerhard K E (2014): Recent advances in capillary electrophoretic migration techniques for pharmaceutical analysis. In: Electrophoresis 35 (1), S. 170-189. DOI: 10.1002/elps.201300411.
- Deeb, Sami El; Wätzig, Hermann; El-Hady, Deia Abd (2013): Capillary electrophoresis to investigate biopharmaceuticals and pharmaceutically-relevant binding properties. In: TrAC Trends in Analytical Chemistry 48, S. 112-131. DOI: 10.1016/j.trac.2013.04.005.
- Grotefend, Sandra; Kaminski, Lukas; Wroblewitz, Stefanie; Deeb, Sami El; Kühn, Nancy; Reichl, Stephan et al. (2012): Protein quantitation using various modes of high performance liquid chromatography. In: Journal of pharmaceutical and biomedical analysis 71, S. 127-138. DOI: 10.1016/j.jpba.2012.08.024.
- El-Hady, Deia; Kühne, Sascha; El-Maali, Nagwa; Wätzig, Hermann (2010): Precision in affinity capillary electrophoresis for drug-protein binding studies. In: Journal of pharmaceutical and biomedical analysis 52 (2), S. 232-241. DOI: 10.1016/j.jpba.2009.12.022.1234. DOI: 10.1021/pr700589s.

Institute of Organic Chemistry

Prof. Dr. Daniel B. Werz

Researcher's Career

- Associate Professor of Organic Chemistry at TU Braunschweig
- Deputy Full Professor of Organic Chemistry at University of Göttingen
- Emmy Noether Junior Research Group Leader at the University of Göttingen
- Postdoc at ETH Zurich, Switzerland
- Dr. rer. nat. at the University of Heidelberg
- Studies of Chemistry (Diploma) at the Universities of Heidelberg and Bristol, UK

Funding
DFG, AvH, DAAD, State Lower Saxony, Fonds der Chemischen Industrie, EU (ERC Consolidator Grant)

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Mission Statement

State of the art organic chemical research is performed, developing novel synthetic and catalytic methods for the efficient and elegant preparation of simple and complex organic molecules.

Research

Donor-Acceptor Cyclopropanes and Cyclobutanes: The weak bond between vicinal donors and acceptors in a cyclopropane or a cyclobutane paves the way for a plethora of unusual reactions leading to aliphatic and aromatic heterocycles under mild and efficient conditions.

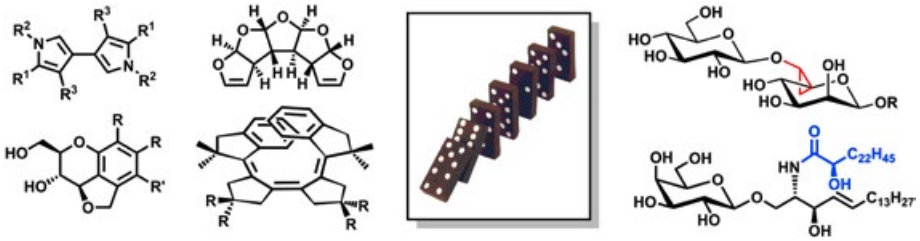
Pd-Catalyzed Reactions: Pd acts as one of the most versatile metals for catalysis. Novel reaction types using this metal and specific ligands are developed.

Domino Cascades: Transformations that involve several bond-forming or bond-breaking steps are designed to build up great molecular complexity in a single step. Such procedures are not only appealing in terms of chemical creativity, but do also save waste, time and energy.

Bacterial Carbohydrates and Glycolipids: Unusual bacterial monosaccharides are synthesized and incorporated into more complex glycans. In the framework of SFB 803 defined mammalian glycolipids with distinct fatty acids are prepared to elucidate their effect on the membrane dynamics etc.

Carbohydrate Mimics: Slight differences in the structure of carbohydrates (which need to be synthesized) will provide improved properties or pave the way to decipher enzymatic reactions.

Novel Fluorophores: Novel scaffolds based on heterocyclic chemistry for the preparation of near-infrared fluorophores are designed and synthesized.



Typical molecules synthesized in the Werz lab by cyclopropane chemistry and domino reactions (left) and glycolipids and carbohydrate mimics (right).

Publications

- Pawliczek, M., Schneider, T. F., Maaß, C., Stalke, D., Werz, D. B. (2015) Formal anti-Carbopalladation Reactions of Non-Activated Alkynes: Requirements, Mechanistic Insights and Applications. Angew. Chem. Int. Ed. 54: 4119-4123.
- Milde, B., Leibeling, M., Pawliczek, M., Grunenberg, J., Jones, P. G., Werz, D. B. (2015) π-Helicenes Truncated to a Minimum: Access Through a Domino Approach Involving Multiple Carbopalladations and a Stille Coupling. Angew. Chem. Int. Ed. 54:1331-1335.
- Schütte, O. M., Ries, A., Orth, A., Patalag, L. J., Römer, W., Steinem, C., Werz, D. B. (2014) Influence of Gb3 glycosphingolipids differing in their fatty acid chain on the phase behaviour of solid supported membranes: Chemical syntheses and impact of Shiga toxin binding. Chem. Sci. 5: 3104-3114.
- Kaschel, J., Schneider, T. F., Kratzert, D., Stalke, D., Werz, D. B. (2012) Domino Reactions of Donor-Acceptor-Substituted Cyclopropanes for the Synthesis of 3,3'-Linked Oligopyrroles and Pyrrolo [3,2-e] indoles. Angew. Chem. Int. Ed. 51: 11153-11156.
- Leibeling, M., Koester, D. C., Pawliczek, M., Schild, S. C., Werz, D. B. (2010) Domino access to highly substituted chromans and isochromans from carbohydrates. Nature Chem. Biol. 6: 199-201.

Institute of Food Chemistry

Prof. Dr. Peter Winterhalter

Researcher's Career
- Full Professor for Food Chemistry, TU Braunschweig
- Associate Professor for Food Chemistry, University Erlangen-Nürnberg
- Scientific Assistant at Würzburg University
- Postdoctoral fellow at the Australian Wine Research Institute, Adelaide
- Dr. rer. nat. at Würzburg University, Institute of Food Chemistry
- Practical year for food chemist
- Study of Food Chemistry at Karlsruhe University

Funding
BMBF, BMWi, DAAD, Industry

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Mission Statement

Isolation and identification of bio-active natural compounds using a broad spectrum of analytical methods including preparative countercurrent chromatography and structural elucidation by modern spectroscopic and spectrometric techniques

Research

Development of preparative separation systems: Analysis of complex natural extracts requires preparative separation techniques. We mainly focus on all-liquid countercurrent chromatographic separation systems, such as High Speed Countercurrent Chromatography, Low Speed Rotary Countercurrent Chromatography (LSRCCC) as well as Spiral-Coil LSRCCC for separations in a scale up to 100 g; separation of biopolymers is achieved by Centrifugal Precipitation Chromatography).

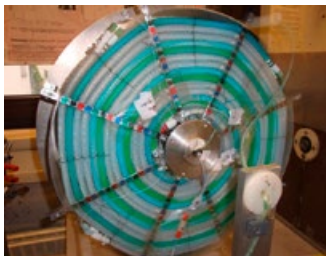
Bioactive compounds in fruits and vegetables: including anthocyanins, proanthocyanidins, stilbenes, lignans, isoflavones, glucosinolates: structural elucidation and biological activity (e.g. antioxidant, antidiabetic, anticancer).

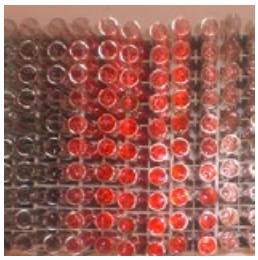
Analysis of wine and fruit juices: antioxidative compounds in red and white wines, "French Paradox", structural elucidation, biological screening; pigments in red wine, stability, contribution to color; authenticity; aging of wine and fruit juices, indicators for aging, influence of climatic change.

Aroma compounds in fruits and wine: pathways of formation, precursors, sensory contribution, application of precursors for the aromatization of convenience food.

Carotenoids and carotenoid metabolites: structural elucidation, pathways of formation, isolation and characterization of carotenases

Bioactives from side streams of the food industry: isolation and structural characterization, bioactivity and application in functional food.





Publications

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- J. B. Althaus, G. Jerz, P. Winterhalter, M. Kaiser, R. Brun, T. J. Schmidt. Antiprotozoal activity of Buxus sempervirens and activity-guided isolation of O-tigloylcycloviro-buxeine-B as the main constituent active against Plasmodium falciparum. Molecules 19, 6184-6201 (2014).
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- I. Mädge, L. Cramer, I. Rahaus, G. Jerz, P. Winterhalter, T. Beuerle. Pyrrolizidine alkaloids in herbal teas for infants, pregnant or lactating women. Food Chem. 187, 491-498 (2015).

Institute of Pharmaceutical Biology

Prof. Dr. Ute Wittstock

Researcher's Career
- Full Professor for Pharmaceutical Biology at the TU Braunschweig
- Project group leader at Max-Planck Institute for Chemical Ecology, Jena
- Postdoc at Plant Biochemistry Laboratory, Royal Veterinary and Agricultural University Frederiksberg, Copenhagen, Denmark
- Dr. rer. nat. at Ernst-Moritz-Arndt-Universität Greifswald, Institute of Pharmacy
- Study of Pharmacy, Greifswald

Funding
DFG, PSI, Industry

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Mission Statement

To gain insight into the biosynthesis and ecological roles of plant specialized metabolites, to understand how their structural diversity has been generated during evolution, and to provide a basis for their biotechnological production and application in medicine and agriculture.

Research

Biochemistry and evolution of biosynthetic enzymes of plant specialized metabolism: We mainly focus on glucosinolates, a class of thioglycosides found in important food crops of the crucifers and related plant families. We are especially interested in the enzymatic machinery that allows plants to metabolize glucosinolates to signalling and defense compounds such as isothiocyanates and nitriles or to exploit them as nutrient reservoir. In order to understand the network of tightly controlled breakdown pathways, we investigate the properties and interactions of thioglycosidases and specifier proteins, a group of non-heme iron proteins which determine structural diversity of products derived from glucosinolates upon hydrolysis.

Regulation and roles of glucosinolate breakdown in plants: Using *Arabidopsis thaliana* as a model plant, we study the regulation of the glucosinolate breakdown machinery and its roles in growth and development as well as below-ground interactions, e.g. with microorganisms of the rhizosphere.

Insect adaptations to plant chemical defenses: We use the interaction between glucosinolate-containing plants and major insect pests such as the cabbage white butterfly or diamond back moth as examples to study how insect herbivores overcome chemical defenses produced by plants in an evolutionary context. Present research aims at understanding which factors determine host plant range and host plant specificity.

Production platforms for plant specialized metabolites: In the framework of the Center for Pharmaceutical Engineering (PVZ), we establish plant-based systems for biotechnological production of plant specialized metabolites.

Pharmaceutical analytics of plant-based drugs: We collaborate with pharmaceutical companies to develop analytical techniques for quality assessment of herbal drugs and products.

Cabbage white larva

Arabidopsis thaliana

Plant suspension culture

Tropaeolum majus used as antiinfective

Publications

- Meier K, Ehbrecht MD, Wittstock U (2019) Glucosinolate content in dormant and germinating Arabidopsis thaliana seeds is affected by non-functional alleles of classical myrosinase and nitrile-specifier protein genes. Front Plant Sci 10:154
- Eisenschmidt-Bönn D, Schneegans N, Backenköhler A, Wittstock U, Brandt W (2019) Structural diversification during glucosinolate breakdown: mechanisms of thiocyanate, epithionitrile and simple nitrile formation. Plant J 99:329-343
- Backenköhler A, Eisenschmidt D, Schneegans N, Strieker M, Brandt W, Wittstock U (2018) Iron is a centrally bound cofactor of specifier proteins involved in glucosinolate breakdown. PLOS ONE 13(11): e0205755
- Steiner AM, Busching C, Vogel H, Wittstock U (2018) Molecular identification and characterization of rhodaneses from the insect herbivore Pieris rapae. Sci Rep 8:10819
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Leichtweiß-Institute for Hydraulic Engineering and Water Resources

Division of Hydraulic Engineering and River Morphology

Prof. Dr.-Ing. Jochen Aberle

Researcher's Career

- Full Professor for Hydraulic Engineering and River Morphology at LWI
- Full Professor for Hydraulic Engineering at Norwegian University of Science and Technology (NTNU), Trondheim, Norway
- Head of Hydraulic Laboratory at LWI, TU Braunschweig
- Research Associate at LWI, TU Braunschweig
- Postdoctoral Researcher, National Institute of Water and Atmospheric Research Ltd. (NIWA), Christchurch, New Zealand
- Research Assistant at Institute for Water Resources Management, Hydraulic and Rural Engineering University of Karlsruhe (TH)
- Dr.-Ing. in Hydraulic Engineering at University of Karlsruhe (TH)
- Dipl.-Ing. in Civil Engineering at University of Karlsruhe (TH)

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Mission Statement

Our research contributes to the better understanding of complex natural and anthropogenic flow and transport processes shaping riverine environments. We combine theoretical and experimental work to address knowledge gaps at the water-biota and water-sediment interface to aid the development of tools for sustainable and ecologically-appropriate river management strategies and to solve practical problems mainly related to morphodynamics and flood prevention.

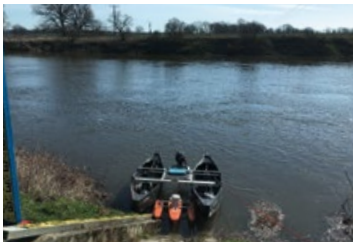
Research

The research topics tackled at our division are highly relevant for the development of sustainable river management strategies taking into account morphodynamic processes, flood management, and ecology. The different and sometimes even contradicting requirements related to these fields reflect the area of conflict in which a modern hydraulic engineer is working today. Our research aims at providing scientifically based tools to overcome these difficulties. The key to developing such tools is the assessment of physical processes controlling the complex interaction between water flow, vegetation, morphology, hydraulic structures, and ecology – these topics are thus in our focus.

Our research is both experimentally and numerically based. Experiments are carried out in the LWI hydraulic laboratory and in the field. The LWI hydraulic laboratory is uniquely equipped with differently sized hydraulic flumes and state-of-the-art hydraulic instrumentation which are predominantly used for basic research applications, e.g. the characterization of turbulent flow over rough-beds. Custom-made hydraulic scale models are mainly used in applied research projects to solve practical problems. The development of innovative experimental methods is another important aspect in our research work.

We use techniques of Computational Fluid Dynamics coupled with Discrete Element Methods to conduct numerical simulations of sediment transport phenomena on high-performance computing infrastructures. In particular, we focus on the settling and erosion behaviour of cohesive sediments in open-water bodies. The highly resolved data is a valuable addition to the experimental data from the hydraulic laboratory. The cross-validated complimentary approaches can be used to derive constitutive equations for continuum type models that are relevant for engineering type practices.

Scale model production of an unlined rock blasted tunnel (white structure shows the digital elevation model of the tunnel). Source: R. Eikenberg



Preparing for flow velocity measurements and topographical survey at the River Mulde. Photo: Ka. Koll

Publications

- Aberle, J., Rennie, C. D., Admiraal, D. & Muste, M. (eds) (2017). Experimental Hydraulics, Volume II: Instrumentation and Measurement Techniques, Taylor & Francis, New York, NY.
- Baynes, E. R. C., van de Lageweg, W. I., McLelland, S. J., Parsons, D. R., Aberle, J., Dijkstra, J., Henry, P.-Y., Rice, S. P., Thom, M. & Moulin, F. (2018). "Beyond equilibrium: Re-evaluating physical modelling of fluvial systems to represent climate changes." Earth-Science Reviews, 181, 82-97, doi:10.1016/j.earscirev.2018.04.007
- Gutierrez, R. R., Lefebvre, A., Núñez-González, F. & Avila, H. (2020) Towards adopting open and data-driven science practices in bed form dynamics research, and some steps to this end. Earth Surface Processes and Landforms, doi:10.1002/esp.4811
- Kazemi, E., Koll, Ka., Tait, S. & Shao, S. (2020). SPH modelling of turbulent open channel flow over and within natural gravel beds with rough interfacial boundaries. Advances in Water Resources, 140, doi:10.1016/j.advwatres.2020.103557
- Vowinckel, B., Withers, J., Luzzatto-Fegiz, P. & Meiburg, E. (2019). Settling of cohesive sediment: particle-resolved simulations. Journal of Fluid Mechanics, 858, 5-44.

Institute of Geoecology

Prof. Dr. Harald Biester

Researcher's Career

- Professor for Environmental Geochemistry
- Assistant Professor, Environmental Geochemistry, University of Heidelberg
- Post-Doc, Environmental Geochemistry, University of Heidelberg
- Habilitation, Geology, Mineralogy, University of Heidelberg
- Dr. rer.nat. University of Heidelberg
- Study of Geology, University of Heidelberg and University of Freiburg

Funding

DFG, State Lower Saxony, State Baden-Württemberg, Industry

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Mission Statement

Estimating anthropogenic contributions to biogeochemical cycling of trace elements and pollutants is based on profound knowledge of biogeochemical processes and interactions in entire ecosystems.

Research

Biogeochemical Cycles: We investigate coupling of trace element and organic matter cycling on a micro- to ecosystem scale. Main emphasis is the understanding of processes of trace element organic matter interactions and their coupling to hydrological and climatic drivers, which both control release of trace element and carbon from soils to aquatic systems. Currently, we study the role of primary production on the biogechemical cycle of mercrury in lakes and the ocean.

Geochemical Archives and Formation of Environmental Signals: We conduct several projects on the formation of environmental signals based on biogeochemical proxies. We are interested in understanding what geochemical signals indicate and how they are preserved in geo-archives such as peat bogs and lake sediments. We apply multi-element analytical methods including organic matter characterization and multivariate statistics.

Mercury Speciation and Risk Assessment: We have developed analytical methods which allow speciation of mercury phases and species in all kinds of solid matter such as soils, sediments and mining residues. We apply these methods in combination with geochemical modeling to several mercury contaminated sites worldwide for risk assessment and remediation strategies.

Remediation of Mercury Contaminated Sites: We investigate mercury contaminated sites and develop methods to stabilize or remove mercury from polluted soils or groundwater. Our current emphasis is on the species – based development and application of filtering materials for removal of mercury from contaminated groundwater and on species transformation processes which reduce mercury mobility in soils and groundwater.

Filtration experiments to remove mercury from contaminated groundwater by means of amalgamation on brass.

Investigation of particle-bound mercury transport in mercury mining areas (Idrija, Slovenia)

Studies on the release of heavy metal by dissolved organic matter from peatlands (Harz, Germany).

Publications

- Kaal, J., Plaza, C., Nierop, K. G., Pérez-Rodríguez, M., Biester, H., (2020). Origin of dissolved organic matter in the Harz Mountains (Germany): A thermally assisted hydrolysis and methylation (THM-GCMS) study. Geoderma. 378, 114635.
- Moreno-Brush, M., McLagan, D. S., Biester, H., (2020). Fate of mercury from artisanal and small-scale gold mining in tropical rivers: Hydrological and biogeochemical controls. A critical review. Critical Reviews in Environmental Science and Technology. 50, 437475.
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- Rastegari Mehr, M., Keshavarzi, B., Moore, F., Fooladivanda, S., Sorooshian, A., Biester, H., (2020). Spatial distribution, environmental risk and sources of heavy metals and polycyclic aromatic hydrocarbons (PAHs) in surface sediments-northwest of Persian Gulf. Continental Shelf Research. 193, 104036.
- Schütze, M., Gatz, P., Gilfedder, B.-S., Biester, H., 2020. Why productive lakes are larger mercury sedimentary sinks than oligotrophic brown water lakes. Limnol Oceanogr.
- Zaferani, S., Biester, H., (2020). Biogeochemical processes accounting for the natural mercury variations in the Southern Ocean diatom ooze sediments. Ocean Sci. 16, 729741.

Institute of Urban Design

Prof. Uwe Brederlau

- CEO, TU Braunschweig, Department Architecture, Institute of Urban Design
- Chair, Johannes Göderitz Foundation
- Member of the Deutsche Akademie für Städtebau und Landesplanung (DASL)
- Member of the Deutscher Werkbund (DWB)
- Member of the Bund Deutscher Architekten (BDA)

Researcher's Career

- Office BREDERLAU + HOLIK, Architecture and Urban Design, Braunschweig
- Full Professor for Urban Design, Technische Universität Braunschweig, since 2000
- Urban Planner, Chamber of Architects of Lower Saxony (Federal Republic of Germany)
- Architect, Chamber of Architects of Lower Saxony (Federal Republic of Germany)
- Assistant Professor at the Institut für Städtebau, Wohnungswesen und Landesplanung, Leibniz Universität Hannover
- Office of Urban Design and Architecture, 1993-2010, Hannover
- Meisterschüler at the Hochschule für Bildende Künste (HBK) Braunschweig
- Study of Architecture, degree Dipl.-Ing., at the Leibniz Universität Hannover

Funding
BMWi, DBU, BMBF

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Mission Statement

The city of the future – how shall we live? How will the city of tomorrow be characterized and shaped by urban spaces, technologies and social developments? In this context, the question of designing our new urban spaces is more important than ever before. It is not just a social, economic, energetic and ecological necessity – it is our passion as well. In this context the goal of our research is that the city of the future will become the city we dream of.

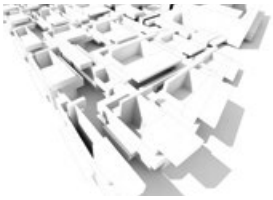
Research

"Zukunftsstadt" – The City of the Future: The Professorship of Urban Design by Univ. Prof. Uwe Brederlau is in charge of researching and testing strategies and concepts for sustainable city development, and examining current, theme-based individual aspects in terms of future town and settlement structures. Urban planning is considered to be a diverse, multidimensional and dynamic design process projected onto the future.

Sustainable Urban Design: Topics are the European contemporary city, development of urban agglomerations of international level as well as urban public spaces and countryside as a whole. This includes in particular research of urban processes and the sustainable parameters of city and settlement development. The present challenge is to approximate a future sustainable and, at best, CO_2-neutral city in an appropriately aesthetic manner.

Urbanism and Design Methods: In terms of conceptual, urban design, the creation of contemporary, urban development and transformation processes thus forms the basis of the potential design of cities. When designing urban areas, the main focus is on the experimental city planning designs, in conjunction with analog as well as digital simulation and drafting methods.

Parametric Design Processes: A particular motivation is to expand the available design methods in urban planning to parametric design processes. The opportunity of rule-based designing consists of both refining the design capability within the complexity of urban systems as well as optimizing action and intervention. This approach is especially interesting if, instead of a conventional master plan, which establishes a future development, a dynamic urban structure should be developed which is able to respond to future growth and / or shrinking processes as well as to climatic requirements.



Publications

- Brederlau, U., Holik, F., Jureit, A., Lubahn, S., Nestler, J. (2019). ZUKUNFTSRAUM WOLFSBURG, Strategien zur Umsetzung der Energiewende im städtischen Kontext, ISBN 978-3-9817355-1-2
- Brederlau, U., Tsvetkova, L., Nestler, J. (2018): COLIVING CAMPUS, Johannes-Göderitz-Preis 2018, ISBN 978-3-927115-83-5Brederlau, U., Jureit, A., Lubahn, S., Nestler, J. (2015): CAMPUS+STADT: Analysen, Strategien und Szenarien für die stadträumliche Entwicklung der Technischen Universität Braunschweig. ISBN 9783981735505. Braunschweig: Oedingprint GmbH.
- Brederlau, U., Jureit, A., Lubahn, S., Nestler, J. (2015). Schwerpunktthema Städtebau. In: TU Braunschweig (Hrsg.), EnEff:Campus: blueMAP TU Braunschweig: Integraler energetischer Masterplan TU Braunschweig 2020/2050. www.tu-braunschweig.de/MedienDB/igs/EnEff_Campus/booklet.pdf.
- Brederlau, U., Holik, F., Lubahn, S. (2011). Concept: Urban Visions for China. German – ChineseStudent Competition. ISBN 9783941737525.
- Brederlau, U. (2011). Parametric Design Processes in Urbanism. In: Tomas Valena with Tom Avermate and Georg Vrachliotis (Hrsg.), Structuralism Reloaded – RuleBased Design in Architecture & Urbanism. ISBN 9783936681475.Verlag Edition Axel Menges.
- Brederlau, U. (2006). Dream City – oder Städtebau und konzeptionelles Entwerfen. In: Eberhard Eckerle und Joachim WolschkeBulmahn (Hrsg.), Landschaft – ArchitekturKunst – Design. ISBN 3899750764.

Institute for Sustainable Urbanism (ISU)

Prof. Dr. Vanessa M. Carlow

Architect and Planner, MAA, BDA

Researcher's Career

- Speaker of the core research area "Future City"/"Stadt der Zukunft", TU Braunschweig
- Visiting Professor, Cornell University, Dept. Architecture Art Planning AAP, Ithaca, USA
- Visiting Professor Pennsylvania State University, USA
- Full Professor (W3) and Director of the Institute for Sustainable Urbanism (ISU),TU Braunschweig
- Guest Professor, RISEBA Riga, Latvia
- Phd at the Royal Danish Academy of Fine Arts Copenhagen, Centre for Planning
- MA Urban Management, Copenhagen University, Erasmus University Rotterdam, Ca Foscari University Venice, Antwerp University, Autonomous University Barcelona
- Study of architecture and urban design at Berlin University of Technology and Delft University of Technology

Funding

Alexander von Humboldt Foundation, BMBF, DAAD, MWK (Lower Saxony), BMU, Robert Bosch Foundation, Volkswagen Foundation

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Mission Statement

"Sustainable Urbanism." These two words represent the biggest challenge and the biggest hopes of our generation. ISU explores, co-designs, engineers, and promotes all strata of sustainable development. As think-tank and design laboratory, we work on inter- and trans-disciplinary projects within the TU Braunschweig core research area FUTURE CITY and cooperate with more than fifty cities, municipalities and NGOs worldwide.

Research

Space as Resource: Space is considered a valuable and limited resource to be properly managed and used efficiently to optimal effect, just like other resources of limited supply. As we face what the UN (2006) calls the Urban Age, this idea will become increasingly true and imperative.

City in Society: Cities are where people are. At the heart of good urban design is public space, accessible and open to multiple users and uses, connecting individuals, functions, and spaces, based on democratic participation. Urban design, both formal and process-oriented, has a role in supporting sustainable lifestyles, such as by understanding users' needs in providing environmentally friendly forms of mobility, or by enabling innovative recreational or economic activities.

Impossible Sites: Large, global-scale trends affect the local, urban-scale conditions. What was previously considered an uninhabitable or un-occupiable site, can, through a tilt in macropolitical, economic, environmental, or sociological forces, become again possible, and vice versa. These forces produce particular observable and measureable phenomena that affect neighbourhoods at the local scale, highlighting the inherent contradictions and excesses of globalization and its neoliberal forces.

Urban-Rural Relations: Where the city stops, the country does not begin. We understand cities as encompassing their footprints. They must thus be managed in a context larger than their compact urban cores and downtown areas, to include their hinterlands, water- and waste-sheds, their reaches of networks of transportation and human resources. Likewise, villages are not just remote, rural places, but also providers and consumers of various forms of urban capital. These new dynamics involve processes of proximity and distance between the city and the countryside.

Sustainability Criteria: While the goal of producing socially equitable, ecologically robust, sustainable urban conditions is paramount worldwide, the means to provide them are different. Testing sustainability criteria in different climatic, geographic, cultural and economic backgrounds of fast growing societies and young democracies broadens the toolkit of sustainable development criteria.

In our work, the **ISU Space Lab** expands possibilities of investigating and expanding the digital realm of urbanism through exploring data, methods, processes and infrastructures routed in the digital.

Publications

- Carlow VM, Mumm O, Neumann D, Schneider AK, Schröder B, Sedrez M, Zeringue R. 2021. TOPOI – a method for analysing settlement structures and their linkages in an urban rural fabric. Environment and Planning B: Urban Analytics and City Science. doi: 10.1177/23998083211043882.
- Verma D, Mumm O, Carlow VM. 2021. Identifying Streetscape Features Using VHR Imagery and Deep Learning Applications. Remote Sensing, 13(17), 3363. doi:10.3390/rs13173363.
- Carlow VM, Mumm O, Neumann D, Schmidt N, Siefer T. 2021. TOPOI Mobility: Accessibility and settlement types in the urban rural gradient of Lower Saxony – opportunities for sustainable mobility. Urban, Planning and Transport Research, 9(1), 208–233. doi:10.1080/21650020.2021.1901603.
- Tempelmeier N, Rietz Y, Lishchuk I, Kruegel T, Mumm O, Carlow VM, Dietze S, Demidova E. 2019. Data4UrbanMobility: Towards Holistic Data Analytics for Mobility Applications in Urban Regions. Companion Proceedings of The 2019 World Wide Web Conference, 137–145. doi:10.1145/3308560.3317055.
- Carlow VM. 2016. Limits. Space as Resource. Jovis Verlag, Berlin.

Institute of Geoecology, Biodiversity of Agricultural Landscapes

Prof. Dr. Jens Dauber

Researcher's Career

- Professor for Biodiversity in Agricultural Landscapes, TU Braunschweig
- Head of Institute, Thünen-Institute of Biodiversity, Johann Heinrich von Thünen Institute, Braunschweig
- Senior research officer, Thünen-Institute of Biodiversity, Johann Heinrich von Thünen Institute, Braunschweig
- Research fellow and scientific project manager, School of Natural Sciences, Botany, Trinity College Dublin, Ireland
- Research fellow, Institute of Integrative and Comparative Biology, Faculty of Biological Sciences, University of Leeds, UK
- Dr. rer. nat. habil., Justus-Liebig-University Giessen, Department of Animal Ecology
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EU Horizon2020, BLE, FNR, DBU, Landwirtschaftliche Rentenbank

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Mission Statement

Understanding how biodiversity is developing in agricultural landscapes, which are the causal factors for the development, which management options exist, and which effects alternative options would have is the basis for developing concepts for sustainable land use.

Research

Landscape and land-use change: Our research focus is on the relationships between agricultural production, land use systems, landscape structure and biodiversity. We investigate where, which and how abundantly plants and animals occur in open agricultural landscapes, which functional role they play there and how this biological diversity (biodiversity) responds to the type and intensity of agricultural land use and other influencing factors. We analyse changes of biodiversity in agricultural landscapes and apply landscape-ecological methods to gain basic and applied knowledge about the importance and functioning of biodiversity in agroecosystems. Our research covers spatial scales ranging from the field and farm to the national scale.

Ecosystem services and agroecology: We study various functional groups of species, pollinating insects and natural biocontrol agents in particular, on multiple spatial scales in order to better understand the complex relationships between agricultural production, ecosystem functions and services. For this purpose, we use field-ecology, experimental and modelling approaches. The knowledge gained from our studies helps to point out perspectives and strategies for the sustainable use of biodiversity in cropping systems, while maintaining agricultural productivity for provisioning of food and renewable resources.

Monitoring and indicators: Our work aims at developing, improving and testing of scientific monitoring and assessment methods of biodiversity change in agricultural landscapes. To monitor drivers, pressures, state, impact and response (DPSIR) in relation to biodiversity change we rely on scientifically sound and representative indicators and appropriate monitoring programmes. Our objective is to help in developing and testing indicators and monitoring techniques which are adequately robust and sensitive for deriving meaningful information about the development of biodiversity in agricultural landscapes.

Suction sampling of insects in a flower strip

Bumblebee visiting the flower of the cup plant (Silphium perfoliatum), a novel energy crop

Pan traps for sampling flower visiting insects in a maize field

Publications

- Beyer N, Gabriel D, Kirsch F, Schulz-Kesting K, Dauber J, Westphal C (2020) Functional groups of wild bees respond differently to faba bean (Vicia faba L.) cultivation at landscape scale. J Appl Ecol 57(12):2499-2508
- Dauber J, Baum S, Masur D, Sevke-Masur K, Glemnitz M (2018) Agrarholzanbau und Biodiversität. In: Veste M, Böhm C (eds) Agrarholz - Schnellwachsende Bäume in der Landwirtschaft : Biologie - Ökologie - Management. Wiesbaden: Springer Spektrum, pp 391-432
- Kühl HS, Bowler DE, Bösch L, Bruelheide H, Dauber J, Eichenberg D, Eisenhauer N, Fernandez N, Guerra CA, Henle K, Herbinger I, Isaac NJB, Jansen F, König-Ries B, Kühn I, Nilsen EB, Pe er G, Richter A, Schulte R, Settele J, et al (2020) Effective biodiversity monitoring needs a culture of integration. One Earth 3(4):462-474
- Müller AL, Biertümpfel A, Friedritz Lennart, Power EF, Wright GA, Dauber J (2020) Floral resources provided by the new energy crop, Silphium perfoliatum L. (Asteraceae). J Apicult Res 59(2):232-245
- Pérez Sánchez AJ, Schibalski A, Schröder B, Klimek S, Dauber J (2020) Disentangling the effects of host resources, local, and landscape variables on the occurrence pattern of the dusky large blue butterfly (Phengaris nausithous) in upland grasslands. J Insect Conserv 24:327-341

Institute of Structural Analysis

Prof. Dr.-Ing. Dieter Dinkler

- Chair of the DFG-Graduiertenkolleg 432 – Fluid-Structure-Interaction
- Chair of the DFG-Graduiertenkolleg 2075 – Modelling of Aging of Materials and Structures

Researcher's Career
- Full Professor for "Statik", Technische Universität Braunschweig
- Full Professor for "Aeroelasticity", Universität Stuttgart
- Habilitation in "Statik", Technische Universität Braunschweig
- Dr.-Ing., Technische Universität Braunschweig
- Studies of Civil Engineering, TU Berlin, TU Braunschweig

Funding
DFG, BMWi

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Mission Statement

Structural analysis is the basis for all kinds of civil-engineering buildings and infrastructure properties, since it holds true for the computation of the design variables. This includes the understanding of the deformation behavior of structures, the development of modern computational methods for the numerical investigation of structures and the investigation of multiphysical processes, which may rectify instability and degradation of structures.

Research

The design of future buildings and infrastructure properties will be influenced by changing environmental conditions, changing demands of our societies and the permanent development of new materials and life-cycle-engineering concepts.

Structural analysis is responsible for the modelling of all kinds of physical processes, which occur during the life-time of structures. In general, multi-physical processes are modelled by mathematical equations, which are solved by modern numerical discretization techniques. This includes the development and solution of models for initial boundary value problems describing material degradation during the long-term deformation phenomena with respect to ordinary and unscheduled effects on structures and the interaction of different physical and chemical processes on different fields.

Modelling of material behavior
Degradation of concrete. Concrete under high temperature. Low cycle fatigue and damage behavior of metals. Visco-plastic deformation behavior of asphalt. Aging of civil engineering materials and structures. Life-cycle assessment.

Investigation of structural behavior
Buckling of shells. Aeroelastic instabilities in fluid-structure-interaction phenomena. Dynamics of structures.

Particle dynamics
Modelling of the deformation behavior of solids and granular media by means of the Discrete Element Method (DEM). Thermo-elastic deformation behavior of porous media. Modelling of landsliding and silo emptying processes.

Discretization methods for initial boundary value problems
Development and application of the Finite Element Method (FEM) to multiphysical processes in the field of volume – coupled and surface – coupled field equations.

Renewable energy
Development of highly-sophisticated water wheels. Development and design of water wheels. *In-situ* measurements. Optimization of shape and performance with respect to efficiency and durability.

Publications

- I. Krukow and D. Dinkler. Flutter of circulation – controlled wings. CEAS Aeronautical Journal, 6(4):589-598, 2015.[DOI]
- F. Cramer, U. Kowalsky, and D. Dinkler. Coupled chemical and mechanical processes in concrete structures with respect to aging. Coupled systems mechanics, 3:53-71, March 2014. [DOI]
- U. Kowalsky, S. Bente, and D. Dinkler. Modeling of coupled THMC processes in porous media. Coupled systems mechanics, 3:27-52, March 2014. [DOI]
- L. Ostermann and D. Dinkler. Modelling and numerical simulation of concrete structures subjected to high temperatures. Coupled systems mechanics, 3:73-88, March 2014. [DOI]
- Ian Krukow and Dieter Dinkler. A reduced-order model for the investigation of the aeroelasticity of circulation-controlled wings. CEAS Aeronautical Journal, 5(2):145-156, 2014. [DOI]

Institute of Geoecology – Division of Soil Science and Soil Physics

Prof. Dr. Wolfgang Durner

Researcher's Career
- Full Professor for Geoecology and Soil Science
- Research Fellow at ETH Zürich
- Dr. rer. nat. at University of Bayreuth
- Diplom-Geoökologe at University of Bayreuth

Positions held
- Head of the Soil Science and Soil Physics Division at the Institute of Geoecology
- Speaker of the Department of Civil Engineering and Environmental Sciences
- Dean of the Faculty for Architecture, Civil engineering and Environmental Sciences
- Vice President of TU Braunschweig for Academic and Student Affairs
- Head of the Soil Physics Commission of the German Soil Science Society
- Associate Editor of five leading international Journals
- Coordinator of Vadose Zone Hydrology program at the European Geosciences Union (EGU)

Funding
DFG, DAAD, BMBF, BASt

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Mission Statement

Soil physics deals with the fluxes of energy, fluids and dissolved matter in the three-phase system soil. Important fields of application are the management of irrigation and drainage, the quantification and optimization of crop water use, soil erosion, organic matter management and carbon storage, soil compaction and its adverse effects on soil life and crop production, and the production and transport of greenhouse gases. Our primary research objective is the improvement in understanding, measuring and modeling the transport of water, energy and solutes in the subsurface between the atmosphere and groundwater. This is achieved by developing and combining state-of-the-art methods in measuring and numerical modelling of flow and transport on the lab and field scale.

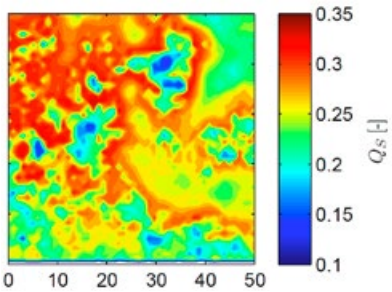
Research

Hydraulic properties of porous media: A particular focus of our research lies in the general methodological development of identification tools to determine effective transport processes for water in the unsaturated zone. To achieve this goal, we combine advanced measurement technology with state-of-the-art inverse numerical modeling using flow and transport models. This yields hydraulic properties in high resolution and quality and allows us to test existing parameterizations and to develop improved models.

Water resources and evaporation from soils: Soils play a prominent role in the evaporation dynamics of terrestrial surfaces. At sufficiently high water content, atmospheric conditions control the amount of evaporation. When the soils become dry, the unsaturated hydraulic conductivity and the vapor diffusion in the soil become limiting factors. Untangling the complex interactions between the topsoil and atmosphere helps to assess the consequences of a changing climate on evapotranspiration and groundwater recharge in arid and semiarid regions and the microclimate in future cities.

Soil physical measurement technology: In cooperation with a commercial manufacturer for soil physical instrumentation, we develop automated systems for determination of important soil hydraulic and soil physical properties. A recent example is an innovative method to determine the particle size distribution of soils, based on pressure measurements in a suspension of the soil. The particle size distribution is a key physical property of soils, controlling many macroscopic physicochemical properties.

Reactive solute transport in unsaturated soils: Understanding solute transport processes in soils is essential to minimize pollution of groundwater resources. We improve our knowledge of these processes by combining measurements on different scales (ranging from the laboratory to field scale) and apply and develop new model approaches.



Publications

- Iden, S.C., J. R. Blöcher, E. Diamantopoulos, A. Peters, and W. Durner (2019): Numerical test of the laboratory evaporation method using coupled water, vapor and heat flow modelling, J. Hydrol. 570, 574-583, https://doi.org/10.1016/j.jhydrol.2018.12.045
- Naseri, M., Iden, S.C., Richter, N. und Durner, W. (2019): Influence of stone content on soil hydraulic properties: experimental investigation and test of existing model concepts, Vadose Zone J. 18:180163. doi:10.2136/vzj2018.08.0163
- Durner, W., S.C. Iden, and G. von Unold (2017): The integral suspension pressure method (ISP) for precise particle-size analysis by gravitational sedimentation., Water Resources Research, 53, 33-48, doi:10.1002/2016WR019830.
- Peters, A., J. Groh, F. Schrader, W. Durner, H. Vereecken, and T. Pütz (2017): Towards an unbiased filter routine to determine precipitation and evapotranspiration from high precision lysimeter measurements, J. Hydrol. 549, 731–740, http://doi.org/10.1016/j.jhydrol.2017.04.015
- Peters, A., S.C. Iden, and W. Durner (2019): Local solute sinks and sources cause erroneous dispersion fluxes in transport simulations with the convection-dispersion equation, Vadose Zone Journal 18:190064, doi:10.2136/vzj2019.06.0064

Institute of Building Materials, Concrete Construction and Fire Safety (iBMB), Division of Concrete Construction

Prof. Dr.-Ing. Martin Empelmann

Researcher's Career

- Certifying Engineer for structural design
- Executive Director of the Civil Engineering Materials Testing Institute MPA Braunschweig
- University Full Professor for Concrete Construction at the TU Braunschweig
- Design Manager for Major International Projects, Hochtief Construction AG, Essen
- Award of the "Friedrich-Wilhelm Preis"
- Award of the "Borchers Plakette"
- Dr.-Ing. at the RWTH Aachen University, Institute of Structural Concrete
- Research Assistant at the Institute of Structural Concrete, RWTH Aachen University
- Award of the "Springorum-Denkmünze"
- Award of the "Hünnebeck-Preis"
- Study of Civil Engineering at the RWTH Aachen University, degree Dipl.-Ing.

Funding

DFG, BMWi, BMUB, PtJ, PRB, DIBt, DBV, BASt, DAfStb

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Mission Statement

The research at the Division of Concrete Construction aims at various aspects of construction, design, maintenance and strengthening of plain concrete as well as reinforced and prestressed concrete structures.

Research

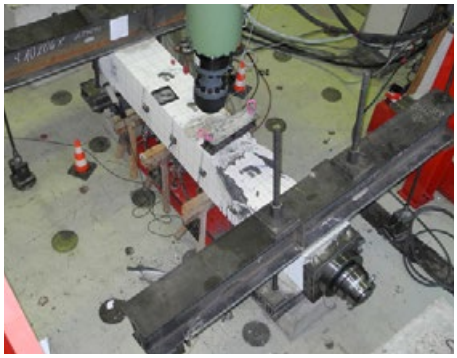
Lightweight and Ecological Concrete Constructions: The development of concrete constructions towards sustainability, energy efficiency and conservation of resources leads inevitably to shape- and material-optimized constructions. Within this research field, thin-walled components of UHPC and ultra-light, thin-walled, rod-shaped concrete hollow components are developed and tested. In order to simplify and industrialize the manufacturing process, thin-walled hollow components of previous research were produced within a spun concrete process.

Life-Cycle Engineering of Concrete Bridges: Since existing road bridges have to carry increasing traffic loads, we develop alternative concepts for life-cycle investigations of existing bridge girders, focussing in particular on life-cycle phenomena such as cyclic load effects and fatigue. Beside experimental large-scale tests in our testing facilities, efficient numerical solutions and monitoring systems as well as mechanical models are developed.

Serviceability and Durability of Concrete Constructions: Cracks in concrete have an important impact on the damage of the reinforcement due to corrosion and on maintaining the serviceability of concrete structures. In this regard, we are conducting tests on concrete beams and shell elements with conventional steel rebars as well as on components with alternative reinforcement forms such as micro-reinforcement and non-metallic rebars and grids. Our aim is to develop practical models and rules for crack width control.

Robust and Safe Concrete Constructions: Nowadays, not only the ultimate load but also post-fracture behavior and robustness are of high interest for reinforced concrete constructions. For this purpose, our research studies focus on robustness of structural components such as columns with large bar diameters and on columns made of UHPC and high-strength reinforcement.

Laboratory at iBMB



Thin-walled, hollow UHPC-Beam after testing

Publications

- Empelmann, M.; Remitz, J.: Spun Concrete Poles made of Ultra-High Performance Concrete – Tests on large-scale prototypes. In: Bauingenieur 93 (2018), Vol. 10, pp. 412-421.
- Empelmann, M.; Wichert, M.; Matz, H.: Spaltversagen von vermörtelten UHPC-Segmentfugen. In: Bauingenieur 95 (2020), Heft 2, S. 55-63.
- Empelmann, M.; Javidmehr, S.: Sustained load behaviour of normal-strength concrete. Beton- und Stahlbetonbau 115 (2020), Vol. 4, pp. 260-269.
- Empelmann, M.; Cramer, J.: Model for the description of time-dependent crack width development in reinforced concrete. In: Beton- und Stahlbetonbau 114 (2019), Vol. 5, pp. 327-336.
- Empelmann, M.; Matz, H.: Robustness of reinforced concrete columns. In: Beton- und Stahlbetonbau 114 (2019), Vol. 11, pp. 837-846.

Institute of Geodesy and Photogrammetry

Prof. Dr.-Ing. Markus Gerke

Researcher's Career

- Since 2017: Full Professor "Spatial Information" at the Institute of Geodesy and Photogrammetry, TU Braunschweig
- 2007 to 2016: Assistant Professor "Image Sequence Analysis", University of Twente, Enschede, The Netherlands
- 2007: Carl-Pulfrich-Award
- 2006: Dr.-Ing., (summa cum laude) Leibniz University Hannover, Germany
- 2000: Dipl.-Ing. Geodesy, Leibniz University Hannover, Germany

Funding

DFG, BMBF, BMWi, BMVI

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Mission Statement

We are performing research and education in the broad field of Geodesy, which is the science of measurement and representation of the Earth. Research questions range from the country or even continent level – such as quantification of land subsidence – to the individual (man-made) object, such as digital building documentation.

Research

Engineering Geodesy: The determination and modeling of dynamic processes in large temporal and geometric resolution is one of the core tasks in Engineering Geodesy. We derive such models for instance for bridge constructions using state-of-the-art measuring technology and statistic tools.

SAR Remote Sensing: Modern methods of satellite-based Synthetic Aperture Radar (SAR) allow the determining motions on the Earth's surface within the millimeter-range. In combination with other geodetic techniques such as levelling or GNSS, we model phenomena which are interesting for many scientific fields.

Photogrammetry and laser Scanning: To efficiently and accurately capture and model as-built (man-made) objects by developing techniques in the domains of photogrammetry and laser scanning is another research field. This might range from the representation of entire settlement areas or buildings to individual parts in civil or mechanical engineering. This is in particular interesting within the digital construction processes, which are in the focus of current research. One category of devices, so-called drones (or Unmanned Aerial Vehicles, UAV), have gained substantial attention in the last decade. We are also working with these instruments, for instance to retrieve reliable geometric and thematic information for urban or infrastructure planning purposes.

Geoinformatics: Geospatial object modeling, representation and querying in databases is done within the Geoinformatics domain. Here our focus is on distributed data, i.e. client-server architectures. One current application is to develop tools to enable citizen participation in planning processes.

Fusion: One current trend is the combination of these research fields. For instance, in order to guarantee highest precision in UAV-based photogrammetry, we need to ensure that a local geometric network is realized with state-of-the-art methods from engineering geodesy. Another example is the augmentation of geospatial databases with current data captured by UAV.

To create geometric (three-dimensional) models out of image sequences is one of the tasks of Photogrammetry. The images in this case were taken by a UAV.

Publications

- Fanta-Jende P., Nex F., Vosselman G., Gerke M. 2019. Co-registration of panoramic mobile mapping images and oblique aerial images, Photogrammetric Record 34(166): 148-173.
- Gerke M. 2018. Developments in UAV-Photogrammetry. Journal of Digital Landscape Architecture 2018 (3), 262-272.
- Vetrivel A., Gerke M., Kerle N., Nex F., Vosselman G. 2018. Disaster damage detection through synergistic use of deep learning and 3D point cloud features derived from very high resolution oblique aerial images, and multiple-kernel-learning. ISPRS Journal of Photogrammetry and Remote Sensing 140: 45-59.
- Zhang Z., Gerke M., Vosselman G., Yang M.Y. 2018. A patch-based method for the evaluation of dense image matching quality. International Journal of Applied Earth Observation and Geoinformation 70: 25-34.
- Gerke M. 2011. Using horizontal and vertical building structure to constrain indirect sensor orientation. ISPRS Journal of Photogrammetry and Remote Sensing, 66(3), 307-316.

Leichtweiß-Institute for Hydraulic Engineering and Water Resources

Division Hydromechanics, Coastal and Ocean Engineering

Prof. Dr.-Ing. habil. Nils Goseberg

Researcher's Career

- Full Professor of Coastal and Ocean Engineering at TU Braunschweig
- Managing Director of Coastal Research Center, Hannover (Forschungszentrum Küste. FZK) www.fzk.uni-hannover.de/de/das-fzk/
- Habilitation Thesis (venia legendi) at Leibniz University Hannover, Germany
- Senior Research Associate at Ludwig-Franzius-Institute for Hydraulic, Estuarine and Coastal Engineering, Leibniz University Hannover
- Marie Curie International Outgoing Fellow and Visiting Professor at Department of Civil Engineering. University of Ottawa, Canada
- Research Associate at Ludwig-Franzius Institute for Hydraulic, Estuarine and Coastal Engineering. Leibniz University Hannover
- Dr.-Ing. Coastal Engineering at Leibniz University Hannover
- Dipl.-Ing. Hydraulic Engineering/ Geotechnics at Technische University Dresden, Germany
- Editorial Assignments – Applied Ocean Research (Elsevier)

Funding

EU, DFG, DAAD, BMBF, BMBi, KFKI, State of Lower Saxony, Volkswagen Stiftung, Industry

Contact

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Mission Statement

State-of-the-art coastal, estuarine, and ocean engineering research that provides solutions to climate change-induced sea level rise, extreme coastal hazards, developing renewable energy technology and the increasing demand on natural marine resources. Our research aims at understanding and predicting hydro- and morphodynamic processes in the natural and constructed environment.

Research

Coastal Protection and Eco-Hydraulics: Our group provides state-of-the-art testing facilities and numerical modelling capabilities to sea walls, revetments, sea dikes, breakwaters, and other coastal protection structures. We also analyse the effects of the natural environment on civil coastal structures.

Sediment Transport and Morphodynamics: We use and develop numerical and experimental means to investigate the transport of sediments in oceanic and estuarine conditions, and provide solutions to dredging and management of sediments for maintenance and nourishments. Coastal erosion in temperate and arctic conditions are researched.

Marine Technology, Marine Constructions and Aquaculture: Offshore wind energy foundations, either fixed or floating, forces on marine structures as a result of waves and currents as well as marine floating platforms are in the focus of this research field. Challenges are technical, economic and environmental issues as well as efficiency and life cycle analysis.

Natural Hazards: We provide solutions and insight into natural hazards such as extreme storm surges and tsunami on coasts, and deliver guidance and recommendations for design standards of coastal structures to protect coastlines.

Waterways and Port Engineering: Processes related to marine traffic and about the planning or waterway and port infrastructure are another research interest. The hydromechanics of ship waves are researched to predict their interaction with embankments and ecosystems.

Water Waves and Flow-Structure-Interaction: The effects of water waves interacting with oceanic currents as well as their interaction with structures is a fundamental research field. This involves the modelling of marine growth on piles, and flexible structures such as vegetation of salt marshes.

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https://magazin.tu-braunschweig.de/pi-post/kuestenschutz-und-klimawandel-internationale-konferenz-costal-structures-2019-tagt-in-hannover/118_2019-bild-1-wellenbrecher_presse/

Publications and Patents

- S. Korte, R. Gieschen, J. Stolle, and N. Goseberg. "Physical Modelling of Arctic Coastlines–Progress and Limitations". In: Water 12.8 (2020)
- von Häfen H., N. Goseberg, J. Stolle, and I. Nistor. "Gate-Opening Criteria for Generating Dam-Break Waves". In: Journal of Hydraulic Engineering 145.3 (2019), p. 04019002. doi: 10.1061/(asce)hy.1943-7900.0001567
- J. Lang, P. Alho, E. Kasvi, N. Goseberg, and J. Winsemann. "Impact of Middle Pleistocene (Saalian) glacial lake-outburst floods on the meltwater-drainage pathways in northern central Europe: Insights from 2D numerical flood simulation". In: Quaternary Science Reviews 209 (2019), pp. 82–99.
- David, G., Roeber, V., Goseberg. N., Schlurmann T. (2017): Generation and Propagation of Ship-borne Waves - Solutions from a Boussinesqtype Model. Coastal Engineering, 127, 170•187
- Goseberg, N., Stolle, J., Nistor, I. and Shibayama, T. (2016): Experimental analysis or debris motion due the obstruction from fixed obstacles in tsunami-like flow conditions. Coastal Engineering. 118, 35-49

Institute of Building Materials, Concrete Construction and Fire Safety (iBMB)

Prof. Bohumil Kasal, PhD

Researcher's Career

- Since 2010, Director of the Fraunhofer Wilhelm-Klauditz-Institut, WKI in Braunschweig
- Prof. of Organic Materials at the Institute of Building Materials, Concrete Construction and Fire Protection (IBMB)
- Member of the DFG Graduate College focused on ageing of structural materials
- Hankin Chair of Residential Building Construction at The Pennsylvania State University and Director of the Pennsylvania Housing Research Center (2005 to 2010)
- Professor at the Department of Wood and Paper Science at North Carolina State University, (1993 to 2005)
- Honorary Research Fellow at the University of Bristol (2007 to 2012)
- Professor at the Czech Technical University in Prague
- Professor at the University of Primorska, Koper, (2017-present)
- Honorary Research Associate at the University of New Brunswick, Canada (2005 to 2015)
- Fulbright Scholar, IAWS Fellow, Elected Member of the American Society of Civil Engineers (ASCE), Registered Engineer

Funding

EU: DFG, AIF, MWK, Industry,
USA: NSF, USDA, FEMA

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Mission Statement

Our mission is to study and characterize organic materials used in construction including, the combination of organic and inorganic materials, development of new experimental methods and techniques for material and interface investigations.

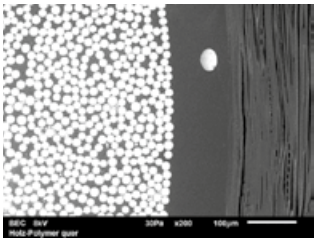
Research

Fraunhofer Center for Light and Environmentally-Friendly Structures: The newly established Center focuses on use of plant-fiber based materials in construction and optimization of their use with regard to their function in a complex system. The Center brings together the university fundamental research with the application-oriented research and development pursued by Fraunhofer WKI. Graduate and undergraduate students and faculty of Civil and Environmental Engineering and Architecture together with Fraunhofer WKI scientists address various topics ranging from modular light systems, to energy efficiency of buildings to rapid deployment systems and optimization. A new Fraunhofer research facility at the TU Braunschweig Campus opens in 2021.

Active-controlled moment connection with high energy-dissipation potential: Moment connections with adjustable (passive and/or active) stiffness are developed. Focus is thereby being placed upon activation of the moment connector which, in the event of an earthquake, will control energy dissipation through friction and prevent failure during large magnitude earthquakes.

Characterization of wood surface property in micro- and nanometer scale with atomic force microscopy: Localized surface properties are important for technological development in aereas such as adhesion, protective coating and surface functionalization. With the help of atomic force microscopy (AFM), it is possible to measure not only the true 3D surface topography in nanometer scale, but also localized surface forces. The goal of this project is to provide a detailed analysis of the surface properties of various components of cellular wood structures and a deeper understanding of wetting behavior, as well as the ageing of adhesive/wood interfaces.

Industrial research and research with small and medium enterprises (SMEs): The department conducts engineering industrial research that entails durability and fatigue tests of adhesives under realistic effects in the form of dynamic loads with simultaneous exposure to solvents (e.g. cleaning agents). A number of projects addressing development of composite-reinforced guardrail systems, inorganic foams, and fire-resistant foams are underway. Furthermore, the department conducts experimental failure analyses of materials and connections in construction as well as in mechanical systems.



Glass-fiber (GF) rod reinforced wood. The rod is oriented perpendicular to wood fibers. From left to right: white circles = GF fibers, gray = epoxy resin, gray with black spots and marks = wood. ©B. Kasal

Publications and Patents

- Kasal, B., Leschinsky M., Oehr C., Unkelbach G., and M. Wolperdinger. 2019. Das Wertstoff-Prinzip. In: Biologische Transformation. Berlin, Heidelberg: Springer Vieweg. S. 265-315. ISBN 978-3-662-58243-5
- Polocoser T., Kasal B., and Li X. 2017. Design of Experiment and Pitfalls of Low-Velocity Pendulum Impact Testing.
- Yan L.B., Kasal B., and L. Huang, 2016. A review of recent research on the use of cellulosic fibres, their fibre fabric reinforced cementitious, geo-polymer and polymer composites in civil engineering. Composites Part B: Engineering. 2016; 92:94-132.
- Kasal, B., and R. Blass. 2013. Experimental and analytical investigation of crack development in composite reinforced laminated arch. Journal of Materials and Structures. Vol. 46, Issue 1-2, 173-180. DOI 10.1617/s11527-012-9892-4
- Kasal, B., Tannert, T. (Editors). 2011. In situ assessment of structural timber. RILEM State of the Art Reports, Vol. 7. Springer Verlag. ISBN: 978-94-007-0559-3. 124 p
- Kasal, B., and R. Anthony. 2004. Advances in in situ evaluation of timber structures. Progress in Structural Engineering and Materials. John Villey & Sons Ltd. London. UK. Vol. 6 No 2 April-June 2004. 94-103.

Chair of Infrastructure and Real Estate Management

Prof. Dr.-Ing. Tanja Kessel

- Head of Chair of Infrastructure and Real Estate Management
- Member of the Executive Board and General Partner PSPC GmbH

Researcher's Career
- Partner and CEO of PSPC GmbH
- Dr.-Ing. at the TU Berlin
- Study of Civil Engineering, TU Berlin
- Study of Civil Engineering, Loyola Marymount University, Los Angeles

Funding
BMVI, BMUB, BBSR, ZDB, HDB, Industry

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Mission Statement

To meet the increasing demands of our fast moving modern society efficient management of infrastructure and real estate is needed within the whole lifecycle. Especially the aspects of sustainable development, operation, maintenance and financing become more important.

Research

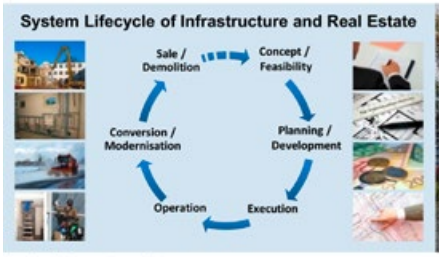
Infrastructure Management: Assessment of PPP infrastructure project conditions focusing on possibilities of participation of SME enterprises. The examination was instructed by the Zentralverband Deutsches Baugewerbe (ZDB) at the current design of PPP projects in federal highway construction and is characterized by high project volumes and long maturities, which are perceived by construction SMEs as restricting competition.

Member of the Advisory Board of the Federal Ministry of Transport and Digital Infrastructure (BMVI) for the assessment report "Alternative business and financing models in federal highway construction". Aim of the assessment is to examine what suitable development opportunities are available for the financing of federal highway PPP projects.

Expert for the Commission named "Construction and Maintenance of the Transport Network" of the Conference of State Minister of Transport, headed by Kurt Bodewig. The commission investigates potential financing and organizational models for the construction and operation of federal highways.

Real Estate Management: Evaluation of PPP real estate projects focusing on the operation phase. The examination is requested by the Hauptverband der Deutschen Bauindustrie to analyse the operative performance of PPP real estate projects which have been in use for a minimum of 2 years. The intended assessment criteria are:

- use costs
- performance quality
- innovations
- the change management / contract management
- dispute settlement
- PPP pulses
- the involvement of SMEs



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Publications

- Kessel, Tanja, Kessel, Martti: "Übertragung von Immobilienvermögen unter Berücksichtigung des Erbschafts- und Schenkungsgesetzes (ErbStG), Festschrift für Prof. Dieter Jacob", pp. 77 ff. (2015)
- Gottschling, Ines, Kessel, Tanja: "Wirtschaftlichkeitsuntersuchungen bei öffentlichen Hochbaumaßnahmen" in "Immobilien- und Bauwirtschaft aktuell – Entwicklungen und Tendenzen, Festschrift für Prof. Bernd Kochendörfer", pp. 47 ff. (2015)
- Kessel, Tanja, Völker, Wiebke: Nutzerverhalten ist wesentlich, Energieeffiziente Bauwerksbewirtschaftung, Behörden Spiegel Juni 2014, pp. 42
- Kohnke, Tanja, Riebeling, Klaus: PPP und Freibäder – zwei Praxismodelle, in: Knop, Detlef (Hrsg.), Public Private Partnership – Jahrbuch 2007, pp. 78-81 (2007)
- Kohnke, Tanja, Schauer, Werner: 3. Fallstudie PPP-Expresspaket der Stadt Köln in: Littwin, Frank/Schöne, Franz-Josef (Hrsg.), Public Private Partnership im öffentlichen Hochbau, Verlag W. Kohlhammer, pp. 416-422 (2006)

Institute of Landscape Architecture

Prof. Gabriele G. Kiefer

Researcher's Career

- 2015-2013, Dean of the Faculty of Architecture at the TU Braunschweig
- 2013-2008, Member of urban advisory council City of Salzburg
- since 2012, Jury member for the Villa Massimo-Scholarships
- since 2008, Teaching in Valdivia and Santiago de Chile, Chile
- since 2002, Professor at the Technical University of Braunschweig, Institute of Landscape Architecture
- since 1990, internatonal juries and lectures activities
- 1989, Foundation of planning office BÜRO KIEFER
- 1992-1987, Research Associate at the TU Berlin, Department of Landscape Architecture
- 1987-1979, Studies at the Technical University of Berlin, Department of Landscape Architecture

Funding
DAAD, BUND, City of Braunschweig, BS|Energy, local municipalities

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Mission Statement

Landscape architecture is a unique non-verbal communication medium for conducting dialogues about our built and natural environment. Designing characteristic places capable of endowing identities is one of the central duties of (landscape) architecture intending to offer viable and aesthetically appealing places in which people can live. We have to discuss new points of reference and models for tomorrow's open spaces.

Research

Recombinations: Developing landscape hybrids with an antithetical leitmotif as an expression of total creation which is linked to the idea of nature – this is the main focus of our landscape architectural work. We do research on the hybridization of space and atmosphere and develope interfaces between productive and reproductive spaces.

Sustainable Chile: We maintain partnerships with Chilean universities to discuss and develope tools and approaches for sustainable urban developments in South American contexts at all urban scales from object to citywide concepts.

Urban Biodiversity: The flora and fauna of Central European cities has long received little attention; nature was sought after outside the cities, in the countryside or in distant regions of the world. We focus on urban contexts and develop structures for wildlife architectures and analyze requirements for evolving habitat structures.

City of the Future: Whether it be climate change, social inequality or scarcity of resources – the challenges facing our society are great. We are part of the new strategic research project at our university discussing and developing principles and models of sustainable urban development.

Landscape for Architects – The 5 trilingual volumes – Building, Landscape, Park, Qualities, Use – together compromise more than 1000 pages.

Landscape for Architects: The design of landscapes requires a holistic approach but also in-depth specialist knowledge. In teaching and publications, however, the perspective of the generalist and concrete aspects of design are often neglected. "Landscape for Architects" is a design manual that is as comprehensive as it is practical and as holistic in its concept as it is lucid in detail. It presents a series of "questions" illustrated by abstract schematic drawings along with "answers" in the form of analytical drawings of case studies that aim to inspire creative reflection and exploration in the reader's own design process.

Publications

- Kiefer, G., Neubauer A.: Landscape for Architects I Landschaft für Architekten I Paisaje para arquitectos; Birkhäuser (Hrsg.); 2020
- Kiefer, G.: Armut, Ästhetik und Stadt.Architektur In: Grüne Reihe 117; Erich Fleischer Verlag (Hrsg.); 2017
- Kiefer, G.: Strategies for Optimizing Urban Resources - (Bio) Diversity of Public Space In: ISG Magazin; Internationales Städteforum in Graz (Hrsg.); 2016
- Kiefer, G.: Die Kehrseite der Schönheit – Die Vorstadt Salzburgs ist einer Kulturstadt nicht würdig In: ‚Frei Raum Szene Salzburg' Tagungsband, Magistrat Stadt Salzburg (Hrsg.); 2010
- Kiefer, G.: Wie Phönix aus der Asche In: Learning from Duisburg Nord; TU München, Prof. Udo Weilacher (Hrsg.); 2009
- Kiefer, G.: Stilisierte Leere und Möglichkeiten In: Architekturforum Zürich (Hrsg.): Garten des Poeten G59; 2009
- Kiefer, G.: Digital Presentations for Landscape Architecture Competitions In: Digital Design in Landscape Architecture 2008 - Proceedings at Anhalt University of Applied Sciences (Hrsg.); Verlag Wichmann; 2008
- Kiefer, G.; Schröder, T. (Hrsg.): Büro Kiefer – Recombinations; Ulmer Verlag; 2005

Institute of Structural Design (ITE)

Prof. Dr.-Ing. Harald Kloft

- Head of the Institute of Structural Design
- Dean of Faculty Architecture, Civil Engineering and Environmental Sciences
- Spokesman of the NTH-Research Group "Generative Fabrication in Building"
- Founding Partner of the engineering consultancy "osd – office for structural design"

Researcher's Career

- Full Professor for Structural Design at TU Braunschweig
- Full Professor for Structural Design at TU Kaiserslautern
- Full Professor for Structural Design at TU Graz
- Visiting Professor for Structural Design, Städelschule Frankfurt
- Founding Partner of osd – office for structural design, Frankfurt
- Project Leader at Bollinger + Grohmann, Frankfurt
- Dr.-Ing., Institute of Statics, TU Darmstadt
- Project Management at Strabag Bau AG
- Diploma in Civil Engineering, TH Darmstadt

Funding

DFG, State of Lower Saxony (MWK), AiF, Industry

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Mission Statement

With more than 80% of the building mass, structures are the key factor for resource-efficiency in building. In continuation of the approach to lightweight-structures with a targeted focus on minimizing building mass, the aim of research at ITE is to create resource-efficient structures as an integral part of the building design.

Research

Innovative Principles of Joining Lightweight Structural Members made from UHPFRC (Ultra High Performance Fibre Reinforced Concrete)

Based on economic justifications, load-bearing structures typically consist of bending-stress and mass-intensive components in today's industrial production. The goal of future development in the construction industry will be to save mass and primary energy through innovative structures and material efficiency. The DFG-promoted research projects are embedded in the DFG SPP 1542 program and executed in close cooperation with the IBMB, Prof. Harald Budelmann and his team. The results have revealed that innovative principles were applied in the process of joining prefabricated elements of columns, slabs, walls as well as novel hybrid structural systems.

Lightweight Composite Structures for Sustainable Buildings

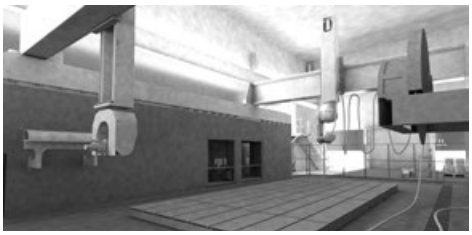
This ITE research is integrated in the interdisciplinary research group ZELUBA (Center of Lightweight and Sustainable Buildings). The project aims to design hybrid light-weight structural systems with a pre-defined life expectancy.

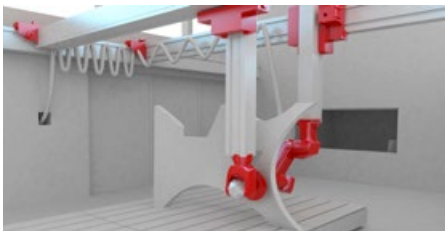
Generative Manufacturing of Resource-Efficient Concrete Elements

This transdisciplinary project is a work in progress by different six institutes from the fields of structural engineering, material technology, informatics and mechanical engineering. The research is government-funded by the state of Lower Saxony. The objective here is to develop a novel robot-controlled process for formwork-free fabrication of geometrically complex concrete elements.

Digital Building Fabrication Laboratory (DBFL)

The DBFL is a large-scale facility at ITE which allows the 1:1 fabrication of structural building elements. The concept comprises a cnc-controlled machining center used in the natural stone industry which is enlarged by an integrated industrial robot for simulating cooperative processes in building fabrication. The research topics are grouped into two main divisions: 1. Robot-controlled additive fabrications of large concrete elements. 2. Subtractive and precise machining/finishing of semi-finished industrial products.





DBFL – Digital Building Fabrication Laboratory

Publications

- Kloft, H.; Ledderose, L.: Preliminary Investigations for Magnetic rearrangement of Steel Fibers in UHPFRC, in: Reyolando M.L.R.F. BRASIL and Ruy M.O. PAULETTI (Hrsg.): Proceedings of the IASS-SLTE 2014 Symposium "Shells, Membranes and Spatial Structures: Footprints", Brasilia, Brazil
- Kloft, H.; Ledderose, L. u.a.: Neuartige Verbindungen für geometrisch komplexe Flächen- und Stabwerkelemente aus UHPFRC, in: Scheerer, S. und Curbach, M. (Hrsg.): Leicht Bauen mit Beton, Forschung im Schwerpunktprogramm 1542 Förderphase 1, TU Dresden, 2014, pp. 122-139
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- Kloft, H.: "Logic and Form – From Isler Shells to Nonstandard Structures" in: Journal of the International Assoziation for Shell and Spatial Structures (IASS), Vol. 25 (2011) No 3 September n. 169, pp. 191-199

Institute of Building Materials, Concrete Construction and Fire Safety – Division of Building Materials

Prof. Dr.-Ing. Dirk Lowke

Researcher's Career

- Full Professor for building materials, Technical University of Braunschweig
- Executive board member of the Materials Testing Institute Braunschweig
- Co-chair and secretary of RILEM Technical Committee Digital Fabrication with cement-based materials
- Visiting research scholar, University of California Berkeley
- Head of concrete technology, Centre for Building Materials, Technical University of Munich
- Researcher, Centre for Building Materials, Technical University of Munich
- Civil engineer, Hochtief building Dresden
- Dipl.-Ing. in civil engineering, Technical University of Cottbus

Funding

DFG, BMWi, EU, State Lower Saxony, industry

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Mission Statement

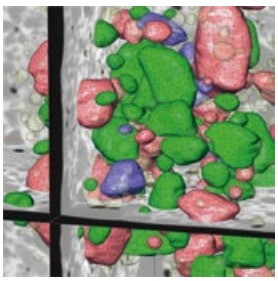
Civil engineering structures need well-suited materials to fulfill their demands throughout their entire service life. Our mission is building materials research and teaching with special emphasis on cement-based materials.

Research

Additive manufacturing for cement based materials: Automated additive manufacturing such as 3D printing or shotcrete 3D printing of concrete is finding its way into construction industry. A central task in the development of these technologies is the optimal setting of the concrete formulation parameters such as the type and amount of the binder as well as additives, grain size, water content and optionally choice and dosage of further additives for controlling the rheological and setting properties. The concrete formulations have to meet the requirements regarding strength, density, density gradients, surface quality, dimensional accuracy and subsequent machinability resulting from very different applications.

Rheology: The prerequisite for the development of additive manufacturing technologies such as 3D printing or robot-assisted spraying of cement based materials is the understanding of rheological fundamentals such as the knowledge of the flow and deformation behavior of multiscale cement based materials. In the fresh state, the cement based materials are highly concentrated suspensions of predominantly inorganic particles in water. In addition to the wide range of particle sizes between about 100 nm and 30 µm and the high solids fraction up to 90%, a specific feature of these suspensions is the reactivity of cement and other binders. The aim is to gain a basic understanding of the relevant processes that shape the rheological properties of fresh materials. The key to this is a detailed understanding of the energetic and mechanical interaction of reactive and non-reactive particles and the aqueous phase.

Computed tomography: Strength and durability of cement based materials are strongly influenced by the heterogeneous structure of the material. For closer investigations it is necessary to consider cement based materials as heterogeneous material and to identify and characterize the reactive and non-reactive particles of the cementitious material. One of the most innovative technologies for detecting and describing the particle structure and for the characterization of the particles inside cementitious materials is computed tomography, which can produce a three-dimensional scan of the material and the particles with high precision.



Publications

- D. Lowke, E. Dini, A. Perrot, D. Weger, C. Gehlen, B. Dillenburger, "Particle-bed 3D printing in concrete construction – possibilities and challenges," Cement and Concrete Research, vol. 112, pp. 50-65, 2018
- A. Pierre, D. Weger, A. Perrot, D. Lowke, "Penetration of cement pastes into sand packings during 3D printing: analytical and experimental study", Materials and Structures, vol. 51, no. 1, article 22, 2018
- D. Lowke, "Thixotropy of SCC - A model describing the effect of particle packing and superplasticizer adsorption on thixotropic structural build-up of the mortar phase based on interparticle interactions", Cement and Concrete Research, vol. 104, no. 2, pp. 94-104, 2018
- D. Lowke, C. Gehlen, "The zeta potential of cement and additions in cementitious suspensions with high solid fraction", Cement and Concrete Research, vol. 95, pp. 195-204, 2017
- O. Mazanec, D. Lowke, P. Schießl, "Mixing of high performance concrete: effect of concrete composition and mixing intensity on mixing time", Materials and Structures, vol. 43, no. 3, pp. 357-365, 2010

Institute of Geoecology – Soil Science and Soil Physics

Prof. Dr. Rolf Nieder

Researcher's Career

- Coordinator of the soil science group of the "Coltan Environmental Management Project" (Sustainable Recultivation of Artisanal Tantalum Mining Wasteland in Central Africa)
- Project co-leader of the Sino-German project "Recycling of Organic Residues from Agriculture and Municipal Origin in China" (BMBF-Verbundprojekt)
- Project co-leader of the Sino-German project "Innovative Nitrogen Management Technologies to improve Agricultural Production and Environmental Protection in intensive Chinese Agriculture" (BMBF-Verbundprojekt)
- Dean of students
- Extraordinary professor of soil science, TU Braunschweig
- Coordinator of the nutrient cycling group, SFB 179 (DFG), TU Braunschweig
- Dr. rer. nat. habil., TU Braunschweig
- Postdoc, Geologisches Landesamt Northrhine-Westphalia, Krefeld
- Dr. rer. nat., Leibniz University of Hannover
- Study of agricultural sciences, Georg August University of Göttingen

Funding

BMEL, BMBF, BMWi, DAAD, DFG, Volkswagen Foundation

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Mission Statement

Our activities focus on investigating transformation and transport processes in the soil-plant-atmosphere continuum, combining environment-related research with technology transfer.

Research

Carbon (C) and nitrogen (N) dynamics in soils: We evaluate land use system–specific C and N dynamics and the role of soils as a sink or source of climate-relevant CO_2 and N_2O. We also investigate sequestration and stabilization of soil organic matter.

Agricultural N cycle in Germany and China: We calculate N balances and analyze nutrient use efficiencies in upland and rice-based agroecosystems as indicators for N emissions to the environment. Laboratory experiments help to quantify N transformation processes. Measurements of NH_3 volatilization following application of fertilizers are carried out for identifying loss-reducing measures. Establishing demonstration experiments on farmers' field sites enables knowledge transfer to practitioners.

Reduction of greenhouse gas emissions in crop production: With respect to life cycle assessment of (energy) crops, N_2O, NH_3 and NO_3- are major drivers for the greenhouse effect, eutrophication, ozone depletion in the stratosphere and soil acidification. We elaborate recommendations for reduction of greenhouse gas emissions using a process-oriented model.

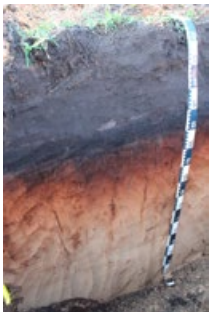
Effects of intensive animal husbandry on ecosystems: For evaluating the status quo of nutrient cycling in livestock systems, we calculate farm-gate balances for major nutrients and assess the soil nutrient status. We develop strategies for recycling of organic fertilizers of animal origin aiming at optimized organic fertilizer treatment and re-use. We further perform in situ-measurements of NH_3, N_2O and CH_4 following application of organic fertilizers.

Phosphorus status of soils: Plant-available phosphorus (P) contents in agricultural soils vary significantly among different world regions. While low levels of available P are a major factor limiting crop production in Sub-Saharan Africa, P levels are commonly high in countries such as China and Germany. We test and compare major soil test procedures to optimize P fertilizer recommendations for specific soil P conditions.

Relationships between soil components and human health: A wide spectrum of interactions exists between soil materials and humans. We highlight important links existing between soil materials and human health and encourage the exchange of ideas and concepts between soil and environmental scientists, and healthcare scientists.

Measurement of ammonia emissions in China

Fertilizer experiment in a rice-wheat cropping system in China



Carbon sequestration in a deep-ploughed soil in Germany

Publications

- Liao W, Liu C, Yuan Y, Gao Z, Nieder R, Roelcke M (2019) Trade-offs of gaseous emissions from soils under vegetable, wheat-maize and apple orchard cropping systems applied with digestate: An incubation study, J Air Waste Manage. DOI: 10.1080/10962247.2019.1694091
- Al-Dalain SA, Al-Rabadi GJ, Nieder R, Alnawaisch M, Küsters A, Torley PJ, Abdel-Ghani AH, Al-Nasir F (2018) Plant-soil-nutrient status of vegetables and wheat grown on calcareous soils, Crop Res 53 (3-4), 109-116, doi: 10.31830/2454-1761.2018.0001.1
- Knoblauch C, Naramabuye FX, Nieder R (2018) Phosphorus availability in selected soils of Rwanda: Comparison of four test procedures, Fmg & Mngmt 3(2), 123-135.
- Nieder R, Benbi DK, Reichl FX (2018) Soil Components and Human Health. Springer, Dordrecht, The Netherlands, 886 p. https://www.springer.com/gp/book/9789402412215
- Alcántara V, Don A, Well R, Nieder R (2017) Legacy of medieval ridge and furrow cultivation on soil organic carbon distribution and stocks in forests. Catena 154:85-94.

Institute of Railway Systems Engineering and Traffic Safety (IfEV)

Prof. Dr.-Ing. Jörn Pachl

- Dean of Studies and chair of the examination committee of the Transportation Engineering study program

Researcher's Career

- University professor and head of the Institute of Railway Systems Engineering and Traffic Safety
- Dr.-Ing. at TU Braunschweig, external candidate
- Project manager at German Railways
- Research assistant at the Institute of Traffic Safety at the Dresden College of Transportation
- Study of Transportation Engineering at the Dresden College of Transportation, degree Dipl.-Ing.

Funding

Industry, government authorities, DAAD

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Mission Statement

In many parts of the world, there is a growing demand for rail transportation. Our mission is to provide excellent expertise in railway operations and signalling to support the revitalisation and modernisation of railway systems wordwide. A key element of this is international knowledge transfer.

Research

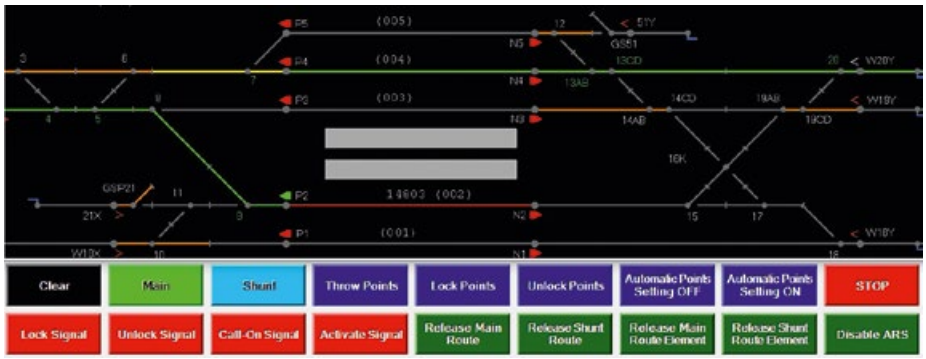
Centralisation: A main challenge is the change from rail traffic control by locally staffed control stations to operation control centres with a very high degree of centralisation. Beside new control technologies, there is a need for new operating rules and procedures that are designed for highly centralised control. A key element in this is an efficient procedural policy for degraded-mode operations.

Interoperability: Another challenge is to improve the international interoperability of the national railway systems. For historical reasons, the national railway systems differ significantly in their control systems, operating rules, and procedures. The differences are even relevant for very basic definitions. An important step in overcoming these differences is international knowledge transfer and comparative analysis of technologies and procedures.

Human Factors: Both challenges are closely connected with the design of user interfaces in control centres and locomotive cabs. So, human factors in these areas have become a key element in our research. Typical research questions are the evaluation of situation awareness and the optimum design of user interfaces for safe and efficient rail traffic control.

Laboratory: A key facility for our research is the Virtual Railway Operations Laboratory. In this laboratory, railway traffic is simulated in a virtual network controlled by distributed control stations. The control stations are equipped with user interfaces as used in real control centres. Several networks including samples from foreign railways and light rail systems can be simulated. In addition to the network control simulation, the laboratory also has a locomotive cab simulator, which is based on a real locomotive interior.

Knowledge transfer: Beside generating knowledge through research, knowledge transfer is one of our key activities. This is mainly done by providing lectures as a visiting professor or invited lecturer in several countries inside and outside Europe.



User interface in the railway operations laboratory

Publications

- Pachl, J.: Systemtechnik des Schienenverkehrs - Bahnbetrieb planen, steuern und sichern. 9th ed., Springer Vieweg, Wiesbaden 2018
- Pachl, J.: Railway Operation and Control. 4th ed., VTD Rail Publishing, Mountlake Terrace (USA) 2018
- Hansen, I. A.; Pachl, J. (editors): Railway Timetabling & Operations. 2nd ed., Eurailpress Hamburg 2014
- Pachl, J.: Betriebsführung der Infrastruktur. in: Fendrich, L.; Fengler, W. (editors): Handbuch Eisenbahninfrastruktur. 3rd ed., Springer Vieweg, Wiesbaden 2018, pp. 405-440
- Pachl, J.: Das Sperrzeitmodell in der Fahrplankonstruktion: Anwendung – Spezialfälle – Alternativen. Springer essentials, Springer Vieweg, Wiesbaden 2015

Institute of Construction Design, Industrial and Health Care Building (IKE)

Prof. Carsten Roth

Researcher's Career

- Member of the Freie Akademie der Künste in Hamburg
- Visiting professor for Design at the University of Kassel
- Leader of his own studio in Hamburg
- Fulbright scholarship at Virginia Polytechnic Institute in Blacksburg and Alexandria/USA
- Study of architecture at the Academy of Fine arts in Vienna
- Study of architecture at the Technical University of Braunschweig

Funding

BBSR, BMBF, BMG, BMWI, MWK

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Mission Statement

The IKE regards itself as a think tank that places emphasis on the exploration and implementation of innovative methods, technologies and theories in architecture at all scales. Dedicated research groups along with a network of specialists exchange ideas regarding building the framework for the interdisciplinary research activities of the institute, focusing on the fields of industrial and healthcare building. In an Innovation LAB, which has been set up since 2020, room solutions of research projects can presented virtualy.

Research

Industrial Building

The IKE holds core expertise in investigating typological and constructive aspects of industrial and functional building, as well as industrial construction. Recently, focus has been placed on the increasingly complex requirements and influential factors of industrial building.

In several research projects, the institute has successfully collaborated on research partnerships with specialists from the fields of plant design, city planning, business management and building services engineering, as well as key players from the private sector.

Recent Projects:

Urban Factory: This interdisciplinary research project investigates the symbiosis of cities and industrial production under the aspect of resource efficiency. It aims to develop an innovative, interactive knowledge base that can be used by all key players involved in maximizing integration potentials.

Health Care Building

The transfer of highly efficient planning and construction methods utilized in everything from industrial buildings to health care buildings is another research focus of the institute. In various research projects related to this matter, the IIKE has researched ways to optimize the planning process, to develop new building structures and to provide a higher level of infection protection in hospitals. Successful collaborations with hospital operators and healthcare companies have been established in the process, working jointly on various innovative research projects, research contracts and reports.

Recent Projects:

KARMIN: Architects, doctors and molecular biologists develop with industrial partners a prototype for an infection-preventive patient room. The central question is which bacteria live on the surfaces in patient rooms and how can new room planning prevent infections in clinics?

EFFO: This interdisciplinry project evaluates and develops structural measures for infection prevention and assists in the planning and construction of isolation wards in selected hospitals in Rwanda, Africa.

INTENSIVE CARE: In this project new, innovative structural solutions for the intensive care units are developed. The focus is the reduction of hospital infections through new evidence-based prevention concepts and improving patient care by adapting the ward structure.

Publications

- Roth C, Dombrowski U, Fisch N, Holzhausen J, Knöfler P, Riechel C, Sunder W, Zukunft.Klinik.Bau. Strategische Planung von Krankenhäusern, Springer Vieweg Verlag Wiesbaden, 1. Auflage 2015, 212 Seiten
- Roth C, Dombrowski U, Sunder W, Riechel C. Zukunftsfähige Gebäudestrukturen und Planungsorganisation von Krankenhäusern. Das Krankenhaus 2013, 2: 170-174
- Sunder W; Holzhausen J; Gastmeier P; Haselbeck A; Dreßler I (2018): Bauliche Hygiene im Klinikbau. Planungsempfehlungen für die bauliche Infektionsprävention in den Bereichen der Operation, Notfall- und Intensivmedizin. Bonn (Zukunft Bauen – Forschung für die Praxis, Band 13), 76 Seiten.OS: The aim of the project is to ensure safe infectious-medical care for highly infectious patients in hospitals. For this purpose, an innovative concept for a temporary isolation area is being developed.

Institute of Geoecology – Landscape Ecology and Environmental Systems Analysis

Prof. Dr.
Boris Schröder-Esselbach

- Member of Berlin-Brandenburg Institute of Advanced Biodiversity Research

Researcher's Career

- Full Professor for Environmental Systems Analysis, TU Braunschweig
- Liaison lecturer of the German National Academic Foundation (Vertrauensdozent der Studienstiftung), TU München
- Associate Professor for Landscape Ecology, TU München
- Guest Professor Environmental Modelling, Potsdam University
- Assistant Professor Landscape Ecology, Potsdam University
- Postdoc, Carl von Ossietzky University of Oldenburg
- Dr. rer. nat. habil. Potsdam University, Institute of Geoecology
- Dr. rer. nat. TU Braunschweig, Institute of Geoecology
- Study of Geoecology and Philosophy, TU Braunschweig

Funding

DFG, BMBF, BMWi, BfG, MWK State Lower Saxony, DBU, Robert-Bosch-Stiftung

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Mission Statement

Understanding the relationships between patterns, processes, and functions in dynamic landscapes is the basis for the development of models for the conservation and sustainable management of plant and animal species, landscapes, and related ecosystem functions and services.

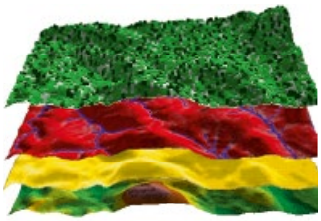
Research

Quantitative Landscape Ecology and Biogeography: We use advanced statistical and machine learning methods to understand the drivers of spatiotemporal dynamics of species and communities and to predict the effects of environmental change on plants, animals and ecosystem functions across scales. We work in urban (metapolis), forest (BiodivERsA-project GreenFutureForest), agricultural (BMWi-project Energy-4-Agri), tidal (BfG-project DyNaMo), and coastal landscapes (MWK-project SeaArt and BMBF-project SeaStore).

Ecohydrology: We conduct experiments and develop models to understand the effects of ecosystem engineers on hydrological processes. Within the DFG research unit 1598 (catchments as organised systems CAOS), we studied the effects of earthworms generating macropores on water dynamics in the soil at catchment scale. We also analyse the response and effect traits of plant species in riparian and coastal areas responding to and affecting ecohydraulic dynamics.

Conservation Biology, Ecosystem Service Science, Sustainable Land Management: We develop integrated landscape models linking hydrological, ecological and socio-economic models to study the effects of environmental change on species and to provide management options for conserving biodiversity. Currently, we are studying the effects of sea level rise and climate change on ecosystem services and biodiversity as well as their trade-offs in Germany's coastal regions focusing on the role of uncertainties in decision making (BMBF-project RUINS). In the Graduate School Gute Küste Niedersachsen, we contribute to finding nature-based solutions for coastal protection in the face of sea level rise.

Landscape Epidemiology: We study the distribution patterns and interrelationships of ticks, their hosts and pathogens causing tick-borne diseases such as Lyme disease with a focus on abiotic and biotic controlling factors in order to assess infection risks and derive prevention and intervention strategies to reduce such risks. Currently, we are focusing on tick-borne diseases in urban areas by studying transmission foci in public green infrastructure and private gardens.



Set of environmental predictors controlling species distribution patterns (top)

Ixodes ricinus, vector tick of Lyme disease
© F-R Matuschka, Potsdam

Tidal reeds at the Elbe estuary

Publications

- Phillips HRP et al. 2019. Global distribution of earthworm diversity. Science 366: 480-485
- Dormann CF et al. 2018. Model averaging in ecology: a review of Bayesian, information-theoretic, machine-learning and other approaches. Ecological Monographs 88: 485-504
- Schibalski A, Körner K, Maier M, Jeltsch F, Schröder B. 2018. Novel model coupling approach for resilience analysis of coastal plant communities. Ecological Applications 28: 1640-1654
- Carus J, Paul M, Schröder B. 2016. Vegetation as self-adaptive coastal protection: Reduction of current velocity and morphologic plasticity of a brackish marsh pioneer. Ecology and Evolution 6: 1579-1589
- Wintle BA, Bekessy SA, Keith DA, Van Wilgen BW, Cabeza M, Schröder B, Carvalho S, Falcucci A, Maiorano L, Regan TJ, Rondinini C, Boitano L, Possingham HP. 2011. Ecological-economic optimization of biodiversity conservation under climate change. Nature Climate Change 1: 355-359

Institute of Geosystems and Bioindication (IGeo)

Prof. Dr. sc. Antje Schwalb

- Professor for Geology and Geosystems
- Director IGeo

Researcher's Career

- Chairwoman Board of Trustees, Federal Institute for Geosciences and Natural Resources (BGR)
- Member Selection Committee, Alexander von Humboldt Foundation
- Member Board of Trustees Volkswagen Foundation, Council member Universität Trier
- Member DFG Boards: Senate, Joint Committee, Review Board Member Geology/Paleontology
- Dr. sc. habil., Universität Göttingen
- BMBF Junior Group Leader, Universität Heidelberg
- Scientific Coordinator, Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences
- DFG Research Fellow and Research Associate, Universität Göttingen
- Swiss NSF Research Fellow, University of Minnesota, Minneapolis, and Visiting Scientist, U.S. Geological Survey, Denver (USA)
- Geologist, Service d'Archéologie du Canton de Neuchâtel (CH)
- Dr. sc., Université de Neuchâtel (CH)
- Dipl.-Geol., Universität Göttingen

Funding

DFG, BMBF, DAAD, State Lower Saxony

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Mission Statement

The sustainable use of our environment, and especially water resources, depends on a thorough understanding of the processes that shape and alter our habitats. Therefore, our research focuses on the interactions between climate, geobiodiversity, environmental dynamics and human impact on different time scales.

Research

Water quality assessment: Our team uses aquatic organisms such as diatoms, ostracodes and chironomids as bioindicators and hydrochemical parameters to assess human impact in both urban and remote, pristine regions.

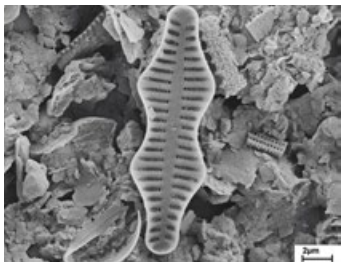
Water quality protection: We exploit bioindicators and geochemical parameters archived in lake and estuarine sediments to (1) trace human impact through time and to (2) define reference states of aquatic ecosystems and water quality that should be (re-) established.

Assessment of the regional impact of global climate change: Using lake sediments from climatically sensitive regions such as, for example, the Tibetan Plateau, Central Asia as well as Central and South America we evaluate how climate change has altered the regional hydrological cycle and water supply to landscapes and humans.

Long-term monitoring of environmental change: As member in several projects of the International Continental Scientific Drilling Program (ICDP) we have established an extensive network of interdisciplinary and international cooperation partners to recover long sediment cores from large lakes reaching back several hundred thousand years in time. This allows us to detect, for example, (1) changes in the long-term environmental evolution, (2) discover patterns of natural climate variability and frequency of climate extremes, as well as to search for (3) causes for changes in biodiversity and human activities and dispersal. Our approaches contribute to the development of concepts for environmental protection, especially under the aspects of future climate change and increasing land use. Since 2018 we coordinate the International Research Training Group "Geoecosystems in transition on the Tibetan Plateau" (TransTiP, DFG GRK 2309), a joint research and training program lead by environmental scientists and engineers based at the Universities in Braunschweig, Hannover and Jena.

Geoscientific fieldwork after sudden drying-out of lakes in the Maya-Lacandon Forest in Chiapas, southern Mexico (Photo: Liseth Pérez).

Collection of sediment cores from Lake Nam Co, Tibet Plateau (Photo: Alexandra Müller).



15,000-yr-old algae from Jeetzel river valley sediments in Lower Saxony (Photo: A. Schwarz).

Publications and Patents

- Cohuo, S., Macario-González, L., Wagner, S., Naumann, K., Echeverría-Galino, P., Pérez, L., Curtis, J., Brenner, M., Schwalb, A., 2020. Influence of late Quaternary climate on the biogeography of Neotropical aquatic species as reflected by non-marine ostracodes. Biogeosciences 17, 1,145-161. DOI: 10.5194/bg-17-145-2020
- Costa-Böddeker, S., Thuyên, L.X., Hoelzmann, P., de Stigter, H.C., van Gaever, P., Đ c Huy, H., Smol, J.P., Schwalb, A., 2020. Heavy metal pollution in a reforested mangrove ecosystem (Can Gio Biosphere Reserve, Southern Vietnam): Effects of natural and anthropogenic stressors over a thirty-year history. Science of the Total Environment 716. DOI: 10.1016/j.scitotenv.2020.137035
- Schwalb, W.E. Dean, H. Güde, S. Hanisch, S. Sobek, Wessels, M. 2013. Benthic ostracode d13C as sensor for early Holocene establishment of modern circulation patterns in Central Europe. Quaternary Science Reviews 66, 112-122. DOI: 10.1016/j.quascirev.2012.10.032
- Zhu, L., Lü, X., Wang, J., Peng, P., Kasper, T., Daut, G., Haberzettl, T., Frenzel, P. Li, Q., Yang, R., Schwalb, A., Mäusbacher, R., 2015. Climate change on the Tibetan Plateau in response to shifting atmospheric circulation since the LGM. Sci Rep 5,13318. DOI: 10.1038/srep13318

Institute of Transport, Railway Construction and Operation (IVE)

Prof. Dr.-Ing. Thomas Siefer

- Director of Institute of Transport, Railway Construction and Operation, TU Braunschweig
- Managing partner of IVE mbH
- Advisory Professor at Tongji University Shanghai
- Speaker of the scientific advisory board of the Association of German Transport Companies (VDV)

Researcher's Career

- Full Professor, TU Braunschweig
- Full Professor, Leibniz University of Hannover
- Project manager "Constructing S-Bahn Hannover", DB Netz AG
- Member of staff at Deutsche Bundesbahn/ Deutsche Bahn AG
- German "Bauassessor"
- Special on-the-job training at Deutsche Bundesbahn
- Study of Civil engineering, University of Hannover

Funding

BMVI, State Lower Saxony, EU, Industry

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Mission Statement

Efficiency and competitiveness of the railway system determines the work of IVE in the fields of research, teaching and consulting. Scientific employees of various disciplines develop special detail solutions. National and international co-operations enable processing of a wide range of subjects from the fields of transport and railway engineering.

Research

The work on research projects forms a major work field. Besides railway operational questions all other fields of transportation are contents of the research activities at the institute.
Specific fields of activity are Strategies and transport planning in passenger and freight traffic, Railway operation, rolling stock employment and technology, Track Technology, System Research and Software development.
Our projects benefit from the existing scientific knowhow within the institute and the developed software and tools. The experience gained in consulting projects and research activities is fed back into degree level training.

Operational analysis, timetabling and simulation:

- Capacity analysis of Hamburg port railways
- Concept for regional railways Braunschweig 2014+
- Operational concept for the U-Bahn München
- Concept for express-trains for the S-Bahn Hannover

Strategic Investigation:

- Microscopic feasibility study Deutschland-Takt
- Influence of the infrastructure on the reliability of the railway system (BVWP 2015)
- REPLAN - Optimization of the alignment of time supplements and buffer times

Permanent Way:

- Evaluation of the load transmission on tracks with ballast
- Model for the optimization of the length of track possessions

The following software was developed with the institute and is distributed by co-operation partners:

- Dispo – Optimised Vehicle Allocation
- Dispo-IRM – Recovery of past incident effects
- DWS – Digital Ordering of Turnouts
- Dynamis® – Driving Dynamic Calculations of any Train Configuration
- EcoTransIT World® – Ecological Transport Information Tool
- NEMO – Network Evaluation Model
- RailSys® Innovative Solutions for Railway Transport, enables a technical as well as an operational planning for railway transport.
- SOG® – Computer Aided Planning of Track Maintenance

Railway teaching facility

Track maintenance

Construction side of public transport

Publications

- Rail Transit system in China: an Overview and Perspective, Metro Report International 2017
- Handbuch für Bauingenieure 3. Auflage, Teil: Öffentlicher Nahverkehr, Eisenbahnbau und Bahnbetrieb, Springer Verlag 2018/2019
- Was läuft in Dänemark anders? Die Herausforderungen des grenzüberschreitenden Verkehrsprojekts Feste Fehmarnbeltquerung, ZEVrail 12/2018
- Ermittlung des Einflusses der Infrastruktur auf die Zuverlässigkeit des Verkehrsablaufs für den Verkehrsträger Schiene, ZEVrail 01/2019
- Machbarkeitsstudie Deutschlandtakt, Infrastruktur für eine starke Schiene, PMC Media 2020

Institute for Geomechanics and Geotechnics

Prof. Dr.-Ing. Joachim Stahlmann

Researcher's Career

- Full Professor and Head of the Institute for Geomechanics and Geotechnics, Department of Civil Engineering at the Technische Universität Braunschweig
- Functions in private enterprises: Engineer in charge, Project manager, Head of branch office, Unit manager in geotechnics and underground openings
- Dr.-Ing. at the RWTH Aachen
- Research Assistant at the Institute of Foundation Engineering, Soil Mechanics, Rock Mechanics and Water Way Construction, RWTH Aachen
- Study of Civil engineering (Dipl.-Ing.) at the Technische Universität Braunschweig

Funding

BMBF, BMWi, BMU, DFG, Industry

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Mission Statement

Geomechanics and Geotechnics, the modern terms for Soil and Rock Mechanics and Foundation Engineering, is an essential part of Civil Engineering, present in each engineering project. Due to the fact that all constructions are in interaction with the subsoil, the knowledge about the soil behavior and the soil-structure interaction is crucial. The complexity of the naturally-formed underground requires continuing research.

Research

Offshore Wind Energy: Offshore wind energy is an important factor in the field of renewable energy. Due to the lack of construction experience, intensive research is carried out in the field of horizontal and vertical bearing capacity of the foundation structures (mainly pile foundations. Furthermore, another research field came up as a consequence of the end of their operating time and the required complete removal from the ground. The development and optimization of different decommissioning systems were carried out within the project DeCoMP with large-model scale tests at our test site.

Disposal of radioactive waste: What is the most suitable host rock for deep geological disposal? Which deep repository safety level is safe enough? How could monitoring data help to study and confirm the predicted development of the repository? To answer these questions from a geo-technical point of view and in order to test the short- and long-term safety requirements, the constitutive model TUBSsalt was developed. It is capable of considering the different phases of creep and failure of rock salt. In the current WEIMOS research project, developments are constantly being made in healing and small deviatoric stresses. Furthermore, experimental studies on the behavior of flat-bedded salt are carried out.

Salt samples after triaxial extension tests

Besides the technical questions, the non-technical aspects of the cooperation between science, implementers, regulators and society should be analyzed to understand the effects of disposal options. A transdisciplinary approach may be a feasible way to do so. The IGG is part of the TRANSENS project, in which the consequences of retrieval and monitoring on the repository design will be researched in cooperation with a group of interested citizens.

Large model scale test site at IGG-TUBS

Publications

- Hinzmann, N.; Lehn, P.; Gattermann, J.: Large-Scale Model Investigation for Monopile Decommissioning of Offshore Wind Turbines – Overpressure and Vibratory Pile Extraction. paper IOWTC2020-20704, ASME 3rd International Offshore Wind Technical Conference (IOWTC2020) October 18-21 2020, Boston, USA, 2020
- Stahlmann, J.; Mintzlaff, V.; León-Vargas, P; Epkenhans, I.: Design Implications of retrievability in HLW repositories. In: da Fontoura, S.A.B., Rocca, R.J.; Pavón Mendoza, J. (eds.): Rock Mechanics for Natural Resources and Infrastructure Development - Full Papers: Proceedings of the 14th International Congress on Rock Mechanics and Rock Engineering (ISRM 2019), September 13-18, 2019, Foz do Iguassu, Brazil, 1st Edition, CRC Press, London, 2019
- Hinzmann, N.; Stein, P.; Gattermann, J.: Decommissioning of Offshore Monopiles, Occuring Problems and Alternative Solutions. Proceedings of the 37th International Conference on Ocean, Offshore and Arctic Engineering, OMAE 2018, June 17-22 2018, Madrid, Spain, V009T10A020. ASME. https://doi.org/10.1115/OMAE2018-78577, 2018
- Gährken, A.; DeVries, K. L.; Stahlmann, J.: Advanced development of the constitutive model TUBSsalt for rock salt regarding the influence of Lode angle effects. Proceedings of the 9th Conference on the Mechanical Behavior of Salt (Saltmech IX), pp. 479-496, September 12-14 2018, Hannover, 2018
- Missal, C.; Stahlmann, J.: A Relation of Anisotropic Damage and Permeability in the EDZ of Drifts in Rock Salt. Proceedings of the 9th Conference on the Mechanical Behavior of Salt (Saltmech IX), pp. 573-984, September 12-14 2018, Hannover, 2018

Institute of Steel Structures

Prof. Dr. Klaus Thiele

- Head of Institute of Steel Structures, TU Braunschweig
- Acting Head of Institute for Building Preservation

Researcher's Career

- Full Professor for Steel Structures, TU Braunschweig
- Head of Design and Construction Office at Max Bögl Stahl- und Anlagenbau GmbH & Co. KG, Neumarkt
- Dr. sc. techn. at IBK, ETH Zürich
- M.E.Sc. at Boundary Layer Wind Tunnel Laboratory, University of Western Ontario, London, Canada
- Dipl.-Ing., Civil Engineering, TH Darmstadt

Funding

DFG, AiF, DAAD, Industry

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Mission Statement

Steel plays an increasingly important role for light-weight and wide-spanning Civil Engineering Structures with advantages in economy and sustainability. Our work includes fundamental research as well as application-oriented research – also in fields connected to Steel Construction such as Wind Engineering and Building Preservation

Research

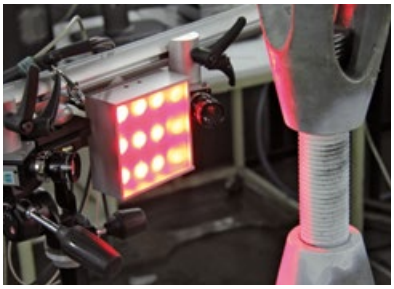
Remaining Service Life of Steel Structures: For existing bridges and crane structures, quantification of the expected remaining service life time is of great importance. Several approaches for in-situ identification of pre-crack material ageing using optical high-resolution strain field measurement and deep learning methods among others are investigated.

Additive Manufacturing using WAAM: To establish Wire and Arc Additive Manufacturing (WAAM) as a method with a stable manufacturing process and safely predictable material properties, virtual component tests as a novel approach for material and component testing is developed.

Material Properties under very high strain velocity: High speed loading explosions impose severe damage to structures. Design methods are to be developed to ensure safe evacuation of buildings after such events. The current project classifies typical construction steel due to its properties under high speed loading to predict structural robustness.

Design of silo structures: Engineering models for today's open questions for design of silo structures are developed. These questions concern e.g. the safe and economic consideration of eccentric discharging behavior and of openings in
silo shell.

Wind Engineering: For more than two decades, the Institute of Steel Structure has been dealing with the characteristics of natural wind fields and its various effects on the loading of buildings. The 340 m high antenna mast in Gartow (Germany) and the wind tunnel in the Institute serve as the main research facilities. One of the research focuses is the wind effects on bridges under construction.



Publications

- J. Müller, M. Grabowski, C. Müller, J. Hensel, J. Unglaub, H. Kloft, K. Thiele and K. Dilger, "Design and parameter identification of Wire and Arc Additively Manufactured (WAAM) steel bars for use in construction" Metals 2019, 9(7), pp. 725. DOI: 10.3390/met9070725.
- Ritter, K., Unglaub, J., Thiele, K.: Untersuchung der Mikroschädigung in Baustahl mit ESPI. Bautechnik 97 (3), 2020 , S. 180-187. DOI: 10.1002/bate.201800006.
- K. Thiele, D. Rademacher, B. Hauke, and M. Huckshold, "Verbundbrücken kurzer und mittlerer Spannweite," in Stahlbau Kalender, vol. 20, Stahlbau Kalender 2018: Verbundbau Fertigung, U. Kuhlmann, Ed., 2018, pp. 883–979. DOI: 10.1002/9783433607701.ch10.
- Scholl, N., Minuth-Hadi, F., Thiele, K., "Modelling the strain rate dependent hardening of constructional steel using semi-empirical models", Journal of Constructional Steel Research 145, pp. 414–424, 2018 DOI: 10.1016/j.jcsr.2018.02.013.
- T. Höbbel, K. Thiele, M. Clobes, "Wind turbulence parameters from three dimensional full-scale measurements at 344 m high guyed mast site Gartow 2," in Journal of Wind Engineering and Industrial Aerodynamics, pp. 341–350, 2018. DOI: 10.1016/j.jweia.2017.11.00.
- F. Gusella, M. Orlando, A. Vignoli, K. Thiele, "Flexural capacity of steel rack connections via the component method," in Open Construction and Building Technology Journal (12), pp. 90–100, 2018. DOI: 10.2174/1874836801812010090.

Institute of Geoecology – Climatology and Environmental Meteorology

Prof. Dr. Stephan Weber

- Dean of studies Geoecology/ Environmental Sciences (2013-2017)

Researcher's Career

- Full professor Climatology and Environmental Meteorology, TU Braunschweig
- Post-Doc, Applied Climatology and Landscape Ecology, University of Duisburg-Essen
- Dr. rer. nat. at the University of Duisburg-Essen
- PhD student, Applied Climatology and Landscape Ecology, University of Duisburg-Essen
- Diploma Thesis at Royal Netherlands Institute for Sea Research, Texel, Netherlands
- Study of Physical Geography and Climatology, Ruhr University Bochum

Funding
DFG, BMBF, State lower Saxony (MWK), Industry

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Mission Statement

Our group uses measurements and modelling to explore exchange processes of energy and mass between urban and non-built surfaces and the atmosphere. We study relationships between urban particle emission and meteorological influence to assess exposure variability of humans towards pollutants.

Research

Surface-atmosphere exchange and boundary layer processes: The atmospheric boundary layer is characterised by important exchange processes of energy, mass and pollutants between the surface and the atmosphere. These fluxes influence climate, the state of ecosystems or human well-being. We use the state-of-the-art eddy covariance technique to quantify exchange fluxes. The work in our group focuses on urban environments, but takes place also in natural ecosystems. Currently, we are studying exchange processes of heat, water and CO_2 between the urban atmosphere and green roofs as well as at a mountainous peatland site.

Urban Climatology: The climate of urban areas is significantly modified in comparison to non-built urban surroundings. The urban heat island is the most well known phenomenon of urban climate effects. We are interested in studying modifications of near-surface climate processes in urban environments and in analysing the relationship with urban structure and morphology. Our research addresses basic aspects of urban climatology but also looks into applied questions, e.g. benefits and urban ecosystem services of green infrastructure (cf. Figure).

Air quality and Aerosol research: Pollutants that are emitted into the atmosphere from different sources react and/or transform during atmospheric transport and residence. Due to a large number of sources especially in urban areas, the exposure towards particles is characterised by a large spatio-temporal variation. We assess particle exposure by using state-of-the-art measurement and modelling approaches to resolve particle concentration variability on the local urban scale. A current work models the transformation of particle number size distributions during atmospheric transport from roadside into the urban background.

Publications and Patents

- Heusinger J., Weber S. (2015). Comparative microclimate and dewfall measurements at an urban green roof versus bitumen roof. Building and Environment, 92: 713-723.
- von Bismarck-Osten C., Birmili W., Ketzel M., Weber S. (2015). Statistical modelling of aerosol particle number size distributions in urban and rural environments – a multi-site study. Urban Climate, 11: 51-66.
- Birmili, W., Sun, J., Weinhold, K., Merkel, M., Rasch, F., Wiedensohler, A., Bastian, S., Löschau, G., Schladitz, A., Quass, U., Kuhlbusch, T.A.J., Kaminski, H., Cyrys, J., Gu, J., Kusch, T., Flentje, H., Meinhardt, F., Schwerin, A., Bath, O., Ries, L., Gerwig, H., Wirtz, K., Weber, S. (2015). Atmospheric aerosol measurements in the German Ultrafine Aerosol Network (GUAN) - Part III: Black Carbon mass and particle number concentrations 2009-2014, Gefahrstoffe – Reinhaltung der Luft 11/12, 479-488
- Ruths M., von Bismarck-Osten C., Weber S. (2014). Measuring and modelling the local-scale spatio-temporal variation of urban particle number size distributions and black carbon. Atmospheric Environment, 96: 37-49
- Hussein T., Mølgaard B., Hannuniemi H., Martikainen J., Järvi L., Wegner T., Ripamonti G., Weber S., Vesala T., Hämeri K. (2014). Finger-Prints of Urban Particle Number Size Distribution in Helsinki – Finland: Local versus Regional Characteristics. Boreal Environment Research, 19: 1-20

Braunschweig Pavement Engineering Centre

Prof. Dr. Michael P. Wistuba

- Full Professor of Pavement Engineering, TU Braunschweig

Researcher's Career

- Head of Braunschweig Pavement Engineering Centre, TU Braunschweig
- Board member of the accredited testing laboratory for road-building materials according to the German guidelines RAP-Stra, Braunschweig
- Steering group member of the European Asphalt Technology Association (EATA)
- Scientific board member of Deutsches Asphaltinstitut (DAI)
- Scientific board member of the Swiss Expert Association for Road and Transport Engineering (VSS)
- Board member of Christian Doppler Laboratory for performance based optimization of flexible road pavements, TU Wien, 2003-2008
- Post-Doc research associate at Ecole polytechnique fédérale de Lausanne (EPFL, Switzerland), 2002-2003
- Ph.D. in Civil Engineering, TU Wien, 2002
- Research Associate at TU Wien, 1988-2008
- Diploma in Civil Engineering, TU Wien, 1989

Funding

EU, BMVBS, BASt, AiF, FFG, DAAD, Lower Saxony, Industry

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Mission Statement

The major requirements of modern road pavements are safety, functionality and sustainability. Our research work focuses on these requirements, emphasizing the increase in durability of asphalt pavements by means of structural optimization for making the design, selection of materials and construction, rehabilitation & recycling techniques as fully perfect and effective as possible.

Research

Laboratory testing of road building materials: We run a well-equipped laboratory for testing asphalt materials, in particular for identifying the characteristics of the individual components (aggregate and bitumen) as well as of the composed mixtures. We use the latest test methods and are developing new performance-based methods. Thus, new recipes can be optimized, and asphalt quality can be assured.

Modeling behavior of road materials and pavement structures: With help of the results from laboratory testing and by means of computer simulation of road pavement behavior under controlled climate conditions and under repeated loading, we predict short- and long-term performance of road materials and pavement structures. Our objective is to support the development and optimization of new road building materials and new methods for pavement design and road construction, rehabilitation & recycling techniques, considering the actual growth in heavy vehicle traffic, new trends in the automobile and tire industries, the effects of climate, as well as the changing availability of bitumen and the strong need for re-using reclaimed asphalts.

Developing tools for systematic pavement management: We are developing methods for pavement condition assessment and evaluation, as well as for systematic road maintenance. A major research focus is dedicated to improving the performance prediction functions within Pavement Management Systems (PMS) by considering the individual properties of the actual pavement materials and structures.

Publications

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- Poulikakos L., Cannone Falchetto A., Wistuba M., Hofko B., Porot L. and Di Benedetto H. (Editors) 2019. RILEM CMB Symposium: Chemo Mechanical Characterization of Bituminous Materials. RILEM Book Series, Springer International Publishing.
- Büchner, J., Wistuba, M.P., Cannone Falchetto, A., Riccardi, C. & Alisov, A. 2018. A new Binder-Fast-Characterization-Test using DSR and its Application for Rejuvenating Reclaimed Asphalt Binder. Journal of Testing and Evaluation (2020) 48(1):20180893, doi.org/ 10.1520/JTE20180893, ASTM International Journal.
- Schrader, J., Wistuba, M. P., Remmler, T. & Wang, D. 2019. On Low Temperature Binder Testing using DSR 4mm Geometry. Materials and Structures (2019) 52:113, doi.org/10.1617/s11527-019-1412-3, Springer.
- Wistuba, M. P., Büchner, J. and Hilmer, T. 2019. On the way to a new asphalt performance specification system. Proc., 17th Colloquium on Asphalt, Bitumen and Pavements, Nov. 29th, 2019, Bled, Slovenia.

Institute for Building Materials, Solid Construction and Fire Protection
Department of Organic and Wood-based Construction Materials

Prof. Dr. Libo Yan

- Assistant Professor of Department of Organic and Wood-based Construction Materials, iBMB, TU Braunschweig
- Junior Research Group Leader

Researcher's Career

- Assistant professor of Department of Organic and Wood-based Construction Materials at Institute of Building Materials Concrete Construction and Fire Protection (iBMB) at Technical University of Braunschweig
- PhD in Civil Engineering, University of Auckland, New Zealand
- Master of Science in Structural Engineering from Cardiff University, United Kingdom
- Bachelor of Engineering in Civil Engineering from Chongqing University, China
- Recipient of several international/national awards, such as Best PhD thesis Award from International Institute of FRP for Construction, Vice-Chancellor's Prize for Best Doctoral Thesis (2014) from the University of Auckland, Chinese Government Award for Outstanding Self-financed Student Abroad from China Scholarship Council (2014)

Funding

DFG, BMEL, BMBF

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Mission Statement

We are devoted to developing an designing future environmentally-friendly construction and building materials and structures with lower carbon footprint from construction and building demolition, forestry and agricultural wastes to promote the development of circular and bio-economy.

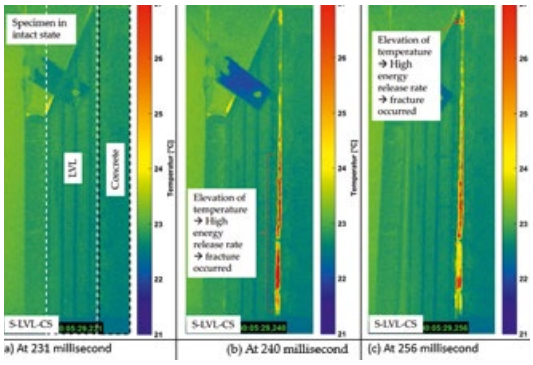
Research

Application of Construction, Forestry, and Agricultural Wastes in Infrastructure: Our group is one of the leading German institutes to utilize agricultural waste, i.e. plant-based natural fibres and their reinforced polymer composites, for infrastructure application. Our research covers material characterization, structural design and numerical simulation of natural fibre reinforced composite materials and the application of these materials to replace synthetic fibre reinforced composite materials. Currently we are also focusing on reuse and recycle of construction and building demolition wastes.

Design and Modeling of Hybrid Structures in Infrastructure: We design, model and characterize hybrid structures combining Fibre Reinforced Polymer (FRP) composite materials with conventional construction and building materials such as steel, concrete and timber to be light-weight and environmentally-friendly structures with high performance.

Crashworthiness Design of Composite Structures for Automotive Engineering: We develop, design and model crashworthy structures with lightweight and high strength composite materials for automotive engineering application. Currently we are using composite materials such as glass, basalt and flax FRP composites.

Ageing Investigation of Construction and Building Materials: We focus on the durability and ageing investigation of conventional and novel construction and building materials such as natural fibre, natural fibre reinforced polymer and natural fibre reinforced cementitious composites, concrete and recycled aggregate concrete. Currently we are studying the long-term durability of natural fibre and their fibre reinforced polymer and cementitious composites subjected to various accelerated environmental weathering conditions.



Publications

- Fu, Q.; Yan L.B.*; Ning, T.; Wang, B.; Kasal, B. Behavior of adhesively bonded engineered wood – Wood chip concrete composite decks: Experimental and analytical studies. Construction and Building Materials 2020; 247, 118578
- Fu, Q.; Yan L.B*; Ning, T.; Wang, B.; Kasal, B. Interfacial bond behavior between wood chip concrete and engineered timber glued by various adhesives. Construction and Building Materials 2020; 238, 117743
- Gao, C.; Huang, L.; Yan, L.B.*; Jin, R.; Chen, H. Mechanical properties of recycled aggregate concrete modified by nanoparticles. Construction and Building Materials 2020; 241, 118030
- Bachtiar, E. V.; Kurkowiak, K.; Yan, L.B.*; Kasal, B. and Kolb, T. Thermal stability, fire performance, and mechanical properties of natural fibre fabric-reinforced polymer composites with different fire retardants. Polymers, 11(4), 699
- Gao, C.; Huang, L.; Yan, L.B.*; Jin, R.; Kasal, B. Strength and ductility improvement of recycled aggregate concrete by polyester FRP-PVC tube confinement. Composites Part B: Engineering 2019; 162, 178-197

Institute of Building Materials, Concrete Construction and Fire Safety (iBMB)

Prof. Dr.-Ing. Jochen Zehfuß

Researcher's Career

- Full Professor for Fire Safety at Institute of Building Materials, Concrete Construction and Fire Safety (iBMB), TU Braunschweig
- Director of Fire Research Center (ZeBra)
- successful acquisition Fire Research Center (ZeBra) with large-scale caolrimeter Advanced Fire Lab (ca. 18 Mio €)
- Member of the board of directors of Civil Engineering Material Testing Intitute (MPA) Braunschweig
- Convenor of DIN standard committee for Fire Safety Engineering
- PhD at TU Braunschweig, Department of Civil Engineering
- Study of Civil Engineering at TU Braunschweig

Funding

DFG, BMBF, BMWi, AiF, Industry

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Mission Statement

The focus of our work is the development of fire-safe buildings. Therefore, we combine experimental research as well as numerical modelling in the field of structural fire engineering and fire dynamics.

Research

Fire dynamics: We investigate experimentally the pyrolysis, fire propagation and development of pollutants during real fires. The experimental results will be used for further development and validation of numerical models for fire propagation and evacuation. In the newly established Center for Fire Research (ZeBra), interdisciplinary research work is carried out on the development of resource-efficient buildings and optimized innovative products with regard to fire safety.

Fire behavior of renewable building materials: Lightweight construction and usage of renewable materials ensure sustainable buildings. With regard to the fire protection lightweight constructions rapidly heat up, renewable materials are combustible. We examine suitable constructions and protective materials to achieve the protection objectives of sustainability as well as fire safety.

Fire behavior of façade systems: A rapid fire propagation through façades can make a fire uncontrollable. Combustible substances in the façade system have to be protected through appropriate measures. The above-mentioned measures are researched through experimental and numerical examinations.

Natural fires and safety concepts for fire safety design: Examination of the influencing parameters and development of natural fires and their modelling as well as development of a safety concept comprising the design approach is a research area.

High-temperature behavior of concrete elements: The loss of strength of high-performance concrete and ultra-high-performance concrete at higher temperatures is progressing faster than normal concrete and the tendency of spalling increases. We perform basic studies on thermal and thermomechanical behavior of high- and ultra-high-performance concrete. Also, the material behavior during the cooling phase of fire, which has not been widely studied, is the subject of research at iBMB.

Publications

- Richter, E.; Zehfuß, J.: The influence of imperfections on the load-bearing capacity of reinforced concrete cantilever columns exposed to fire. In: Fire Safety Journal (2021)
- McNamee, R.; Zehfuss, J.; Bartlett, A.; Heidari, M.; Robert, F.; Bisby, L.: Enclosure Fire Dynamics with a Combustible Ceiling. In: Fire and Materials (2020).
- Zehfuß, J.; Robert, F.; Spille, J.; Razafiniato, R. N.: Evaluation of Eurocode 2 approaches for thermal conductivity of concrete in case of fire. In: Civil Engineering Design (2020).
- Lyzwa, J.; Zehfuß, J.: Ableitung von thermischen Materialkennwerten für Beton unter Naturbrandbeanspruchung anhand von experimentellen Untersuchungen. In: Beton- und Stahlbetonbau (2020).
- Souza, R.; Andreini, M.; La Mendola, S.; Zehfuß, J.; Knaust, C.: Probabilistic thermo-mechanical finite element analysis for the fire resistance of reinforced concrete structures. In: Fire Safety Journal (2019).
- Brunkhorst, S.; Pfennig, S.; Zehfuss, J.; Mensinger, M.: Influence of Elevated Temperatures on the composite joint of a Composite Beam in Fire. In: Journal Fire Technology (2019).
- Zehfuß, J.; Northe, C.; Riese, O.: An investigation of the fire behavior of ETICS facades with polystyrene under fire loads of different size and location. In: Fire and Materials (2018).
- Zehfuß, J.; Hosser, D.: A parametric natural fire model for the structural fire design of multi-storey buildings. In: Fire Safety Journal 42 (2007), 115–126.

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Mechanical Engineering

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Chair of Entrepreneurship

Prof. Dr. Reza Asghari

- Director of Entrepreneurship Center
- CEO Academic Ventures GmbH & CO KG

Researcher's Career

- Regular professorship of joint chair for Entrepreneurship at Technische Universität Braunschweig and Ostfalia University, Braunschweig/Wolfenbüttel
- Endowed Professorship Entrepreneurship and Business Creation at Technische Universität Braunschweig and Ostfalia University, Braunschweig/Wolfenbüttel
- Professor for business administration, internet economy and e-business at Ostfalia University, Wolfenbüttel
- Research assistant at the Institute for Economics, Braunschweig
- Study of Business Administration Computer Science, Braunschweig

Funding

BMWI, State Lower Saxony,
Local Gorvernments, Private Sector

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Mission Statement

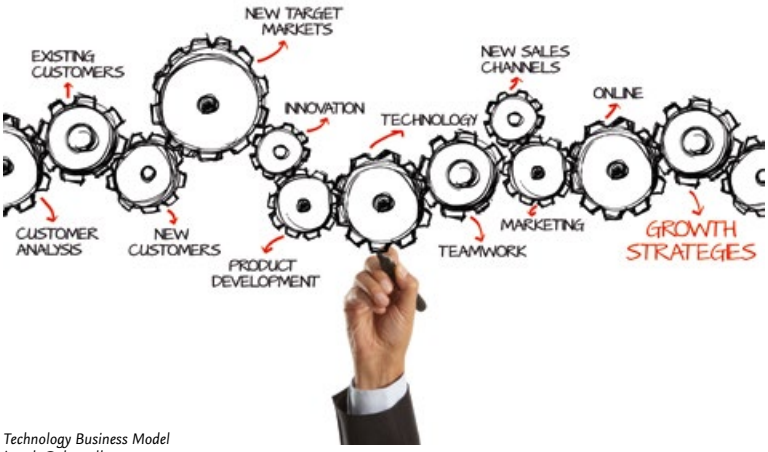
Developing and implementing an entrepreneurial mindset. Development of skills and methods to conceptualize and implement innovative business models. Linking the research results with knowledge application through disruptive start-ups

Research

Technology Entrepreneurship: The process of commercialization of research results runs through several protracted stages in which the technology has to accommodate itself to customer requirements.
We analyze and develop methods to transfer the technology knowledge into innovative products and services.

Institutional Analysis of Entrepreneurship: The entrepreneurship process needs an appropriate institutional framework which enables the individuals to implement their creative ideas fluently into the market. Entrepreneurial mindset, entrepreneurship governance, availability of venture capital and tax rules belong to the main institutional determinants.

Entrepreneurial University: In the context of a knowledge driven economy we analyze the role and function of universities and research centers in the process of creative destruction. Holistic concepts which empower universities to breed innovative spin-offs are in the focus of our research work. Appropriate entrepreneurship education plays a key role for entrepreneurial universities. University entrepreneurship rules contribute to accelerate the entrepreneurship transformation.
Green Entrepreneurship: We take those university spin-offs under focus which contribute to energy saving, recycling technologies and environment protection. We analyze the business model requirements for Green Start-ups and research on specific requirements with respect to customer segment and price models.



Technology Business Model
istock © kemalbas

Publications

- Asghari, R. Political Entrepreneurship, in: Handbuch Entrepreneurship, Günter Faltin (Hrsg.), Springer Verlag, 2016
- Asghari, R., Erol, O. The role of universities in fostering knowledge-intensive start-ups, International Conference on Industrial Management 2015, Singapore
- Asghari, R., Wilgeroth, D. Crowd Funding, How German Start-ups evaluate Crowd-Funding, An Empirical Research, 2015
- Asghari, A., Gedeon, S. Significance and Impact of Internet on the Entrepreneurial Process: E-Entrepreneurship and Completely Digital Entrepreneurship In: Kakouris, A. - Proceedings of the 5th European Conference on Innovation and Entrepreneurship ECIE 2010, Athens (Greece), 2010
- Asghari, R., Becks, M. Konventionen unbedingt brechen: Bestimmungsfaktoren nachhaltiger Unternehmensgründung. In: economag, Wissenschaftsmagazin für Betriebs- und Volkswirtschaftslehre. 07/2010

Maria-Goeppert-Mayer Professorship for "Gender, Technology and Mobility"

Prof. Dr.-Ing. Corinna Bath

Researcher's Career

- Maria-Goeppert-Mayer Professor for "Gender, Technology and Mobility" at the Institute for Flight Guidance TUBS and at the Ostfalia University for Applied Sciences
- Chair of the doctoral program "Gendered Configurations of Humans and Machines" with Prof. Dr. Bettina Wahrig
- Guest Professor at TU Berlin (2012) and TU Graz (2016)
- Postdoctoral Researcher in the DFG doctoral research program "Gender as a Category of Knowledge" at HU Berlin
- Dr.-Ing. University of Bremen, Computer Science
- Research fellow at the IAS-STS Graz and the University of Lancaster
- Research projects and teaching at German and Austrian universities
- Study of mathematics, computer science and political science at FU Berlin and CAU Kiel

Funding

VolkswagenStiftung, DFG, MWK, BMBF

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Mission Statement

Located in mechanical engineering, "Gender, Technology and Mobility" research critically analyses implicit power structures in technological development processes and scientific knowledge production and aims to establish responsible research and design practices. In this context, we focus on gender and its entanglement with other categories of social inequality such as age, ability, race and class.

Research

Our research at the intersection of engineering and gender studies uncovers, questions and aims to counteract social inequalities, discrimination and exclusions in engineering research and design practices. In this respect, we particularly take a stand for those who are marginalized, overseen or affected by a certain technology. We do not only aim to make their perspectives visible, but involve them actively in the research and development process. In this way, our research contributes to social sustainability and justice in engineering.

"Gendered Configurations of Humans and Machines" (1/2017–3/2021)
In this doctoral program, 15 PhD students at 12 institutes of 3 universities investigate the relationships between the production of technology and the (re)production of gender by asking how machine-human configurations arise, how they support inequality, injustice and (dis-) empowerment, and how an alternative might be created.

"Human Demands of Sustainable Aviation" (10/2019–4/2021)
This project is a part of the Cluster of Excellence SE2A "Sustainable and energy-efficient aviation". Based on a Feminist Science & Technology Studies perspective and using methods from Participatory Design research, it aims to democratize technological research and development by integrating passengers' and airport residents' demands into the Cluster's knowledge base.

"Towards a Response-able Culture of Objectivity: Corona Discourses as Situated Knowledges" (3/2021–9/2022)
This research project investigates how public science discourses about Sars-CoV 2 support shifts in knowledge politics towards a new culture of objectivity. It aims at facilitating a "response-able" culture of objectivity accompanied by an innovative science communication approach as key results.

"Sociotechnical practices of objectivation. An empirical examination of AI-based health apps for diagnosis" (7/2021-6/2024 with Prof. Samerski, HS Emden)
This project empirically focusses on AI-based diagnostic apps in order to create a better understanding of the sociotechnical production of objective knowledge in the field of health. We will analyze the construction of technical and data infrastructures, the processes of modeling, formalization and classification of medical knowledge, new practices of health knowledge, and their social impact from an STS and gender studies perspective.

Publications

- Paul, B./Bath, C./Wenk, S. (Eds.) (2020): Geschlechterwissen in und zwischen den Disziplinen. transcript.
- Buchmüller, S./Bath,C. (2018): To whom does the driver's seat belong in the future? In: Proceedings of the 4th Conference on Gender & IT, 165-174, https://dl.acm.org/citation.cfm?id=3196839.3196866.
- Bath, C./Meißner, H./Trinkaus, S./Völker, S. (Eds.) (2017): Verantwortung und Un/Verfügbarkeit. Impulse und Zugänge eines (neo)materialistischen Feminismus. Westfälisches Dampfboot.
- Ernst, W./Bath, C./Vehviläinen, M. (Eds.) (2017): Political Objects. Prescriptions, Injustices and Promises of Material Agents. Special issue of the International Journal Gender, Science and Technology 9 (2).
- Bath, C./Both, G./Lucht, P./Mauß, B./Palm, K. (Eds.) (2017): rebootING. Handbuch Gender-Lehre in den Ingenieurwissenschaften. LIT-Verlag.
- Bath, C. (2014): Diffractive Design. In: Marsden, N./Kempf, U. (Eds.): GENDER-UseIT. HCI, Usability und UX unter Gendergesichtspunkten. De Gruyter, Oldenbourg, 27-36.
- Bath, C. (2013): Searching for methodology. Feminist technology design in computer science. In: Ernst, W./ Horwath, I. (Eds.): Gender in Science and Technology. Interdisciplinary Approaches, transcript, Bielefeld, 57–78.
- Bath, C. (2009): De-Gendering informatischer Artefakte. Grundlagen einer kritisch-feministischen Technikgestaltung. Dissertation. Bremen. URN: http://nbn-resolving.de/urn:nbn:de:gbv:46-00102741-12.

Institute of Mechanics and Adaptronics

Prof. Dr.-Ing. Markus Böl

Researcher's Career

- Head of Institute of Mechanics and Adaptronics
- Full Professor for Solid Mechanics at the TU Braunschweig
- Temporary head of the Institute of Solid Mechanics at the TU Braunschweig
- Postdoc research at the Stanford University
- Assistant professor for Polymer Mechanics, Biomechanics, and Numerical Mechanics at the TU Braunschweig
- Postdoc research at the Stanford University
- Postdoc research at the TU Braunschweig
- Dr.-Ing. at the Ruhr University of Bochum
- Research Assistant at the Chair of Numerical Mechanics and Simulation Technique, Ruhr University of Bochum
- Study of civil engineering, degree Dipl.-Ing. Technical University of Dortmund

Funding
DFG, State Lower Saxony, Industry

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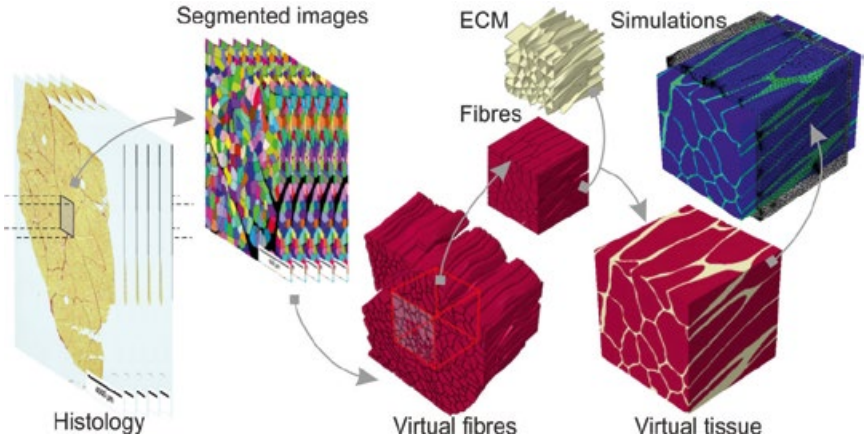
Mission Statement

Based on novel multi-scale experimental techniques used at various levels from micro to macro scale we develop capable multi-scale/multi-field numerical models for the description of different partly living materials.

Research

Multi-scale/multi-field modelling: For most biological materials it is essential to consider beside different length scales also different fields, like temperature, electrical potentials, or chemical variables. For example, in the contraction process of smooth muscle cells, different fields such as an electrical potential and various chemical variables such as calcium are involved. To describe the contraction process of such muscles in an adequate way, these fields (multi-field) have to be considered at different length scales (multi-scale).

Multi-scale/multi-field experiments: The numerical description of biological materials such as skeletal muscles, smooth muscles, or various soft tissues need the knowledge of their structural behaviour at different length scale and under different states, e.g. during growth processes or under passive and active conditions. Therefore, novel and advanced experimental techniques are indispensable for measuring the mechanical characteristics at all required length scales.



Homogenisation Techniques: An essential point in the framework of multi-scale/multi-field modelling is knowledge about the transfer of information between the different length scales for various fields. Therefore, the development of adequate homogenisation techniques is necessary.

Growth modelling: One special feature of biological, living materials is their ability to grow. Growth phenomena are of special interest, since during growth various processes take place. Here we focus on volume growth and remodelling effects, as well as their influence on the mechanical behaviour at different length scales.

Publications

- R. Kuravi, K. Leichsenring, M. Böl, A. E. Ehret, 3D finite element models from serial section histology of skeletal muscle tissue - The role of micro-architecture on mechanical behavior, Journal of the Mechanical Behavior of Biomedical Materials, 113, 104109, 2021
- J. Liu, M. Helbig, J.-P. Majschak, M. Böl, Whey protein gel - experimental testing and modelling of wire cutting, Journal of Food Engineering, 292, 110324, 2021
- M. Bauer, E. Morales-Orcajo, L. Klemm, R. Seydewitz, V. Fiebach, T. Siebert, M. Böl, Biomechanical and microstructural characterisation of the porcine stomach wall: Location- and layer-dependent investigations, Acta Biomaterialia, 102, 83-99, 2020
- M. Böl, R. Seydewitz, K. Leichsenring, F. Sewerin, A phenomenological model for the inelastic stress-strain response of a potato tuber, Journal of the Mechanics and Physics of Solids, 137, 103870, 2020
- L. Klemm, R. Seydewitz, M. Borsdorf, T. Siebert, M. Böl, On a coupled electro-chemomechanical model of gastric smooth muscle contraction, Acta Biomaterialia, 109, 163-181, 2020

Institute of Microtechnology

Jun.-Prof. Dr. Iordania Constantinou

Researcher's Career

- Junior Professor, Institute of Microtechnology, TU Braunschweig
- PostDoc, Zentrum für Molekulare Biologie der Universität Heidelberg
- PostDoc, Materials Science and Engineering, North Carolina State University
- PhD, Materials Science and Engineering, University of Florida
- BSc, Mechanical Engineering, Cyprus University of Technology

Funding

VolkswagenStiftung, AiF, State Lower Saxony, Carl-Zeiss-Stiftung

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Mission Statement

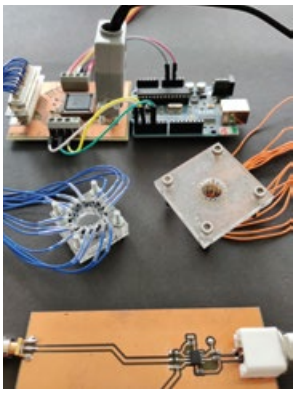
Our interdisciplinary research focuses on the development of miniaturized platforms for applications in the life sciences. Such platforms include micro- and nanosensors, microfluidics and organs-on-chip.

Research

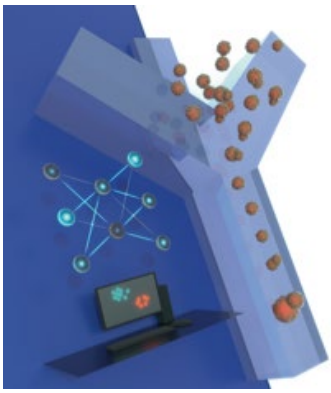
Microfluidic systems allow for the manipulation of small amounts of fluid flowing through microchannels. Microfluidics enable precise control over the microenvironment as well as over processes such as transport, mixing, and separation of fluids. We design and develop microfluidic platforms used in biological applications. Examples of our research projects include a microfluidic imaging flow cytometer and microfluidic systems for cascade biocatalysis on-chip.

Organ-on-chip platforms are advanced microfluidic cell culture devices designed to create microenvironments that closely resemble *in vivo* conditions. Such devices offer a biomimetic alternative to traditional static cell cultures and animal experiments. Our research focuses on the development of advanced organ-on-chip platforms and their use for the investigation of biological phenomena such as Lyme disease dissemination through the vascular endothelium and the effects of traumatic brain injury on the intestinal epithelium.

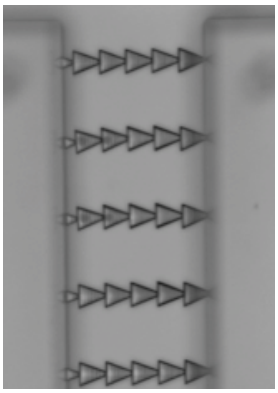
Nano-/microsensors based on various sensing principles can be integrated into organ-on-chip and other miniaturized platforms. We develop novel miniaturized electrical and optical sensors for applications such as tissue characterization, process monitoring, and cell/particle counting. Current research projects focus on the development of electrical sensors for spatially resolved tissue imaging on organ-on-chip platforms. One explored approach involves the development of a miniaturized electrical impedance tomographer.



Miniaturized electrical impedance tomographers



Microfluidics for single cell analysis



Microfabricated diode structures for oriented neuronal reconstruction

Publications

- Schwarz, M., Jendrusch, M., Constantinou, I. (2020) Spatially resolved electrical impedance methods for cell and particle characterization. Electrophoresis, 41:65–80.
- Constantinou, I., Jendrusch, M., Aspert, T., Görlitz, F., Schulze, A., Charvin, G., Knop, M. (2019) Self-Learning Microfluidic Platform for Single-Cell Imaging and Classification in Flow. Micromachines, 10:311.
- Knop, M., Theer, P., Constantinou, I., Schulze, A., Jendrusch, M., Goerlitz, F. (2018) Method for image-based flow cytometry and cell sorting using subcellular co-localization of proteins inside cells as a sorting parameter. Patent pending, WO2018215624A1.
- Constantinou, I., Yi, X., Shewmon, N.T., Klump, E.D., Peng, C., Garakyaraghi, S., Lo, C. K., Reynolds, J. R., Castellano, F. N., So, F. (2017) Effect of Polymer-Fullerene Interaction on the Dielectric Properties of the Blend. Adv. Energy Mater, 1601947.
- Constantinou, I., Lai, T.-H., Zhao, D., Klump, E. D., Deininger, J. J., Lo, C. K., Reynolds, J. R., So, F. (2015) High Efficiency Air-Processed Dithienogermole-Based Polymer Solar Cells. ACS Appl. Mater. Interfaces, 7(8):4826.

Institute of Microtechnology

Prof. Dr. Andreas Dietzel

- Director Institute of Microtechnology
- Member of the Board, Center of Pharmaceutical Engineering (PVZ)

Researcher's Career

- Dean of the Mechanical Engineering Faculty at TU Braunschweig D (2019-2021)
- Full Professor for Microtechnology, TU Braunschweig-D
- Full Professor for Micro- and Nano- Scale Engineering, TU Eindhoven-NL
- Program manager for Flexible Systems Technology,TNO Eindhoven-NL
- Project manager for "Base development 3rd generation inertial sensors", Robert Bosch GmbH, Reutlingen-D
- Department head at IBM Storage Division in Mainz-D, researcher at IBM Research Laboratory in Rüschlikon-CH, and specialist at IBM Semiconductor Division in Böblingen-D
- Dr. rer. nat. at U Göttingen, Institute of Medical Physics and Biophysics
- Dipl.-Phys. at U Göttingen

Funding

DFG, BMBF, BMWi, Volkswagen Foundation, DAAD, Industry

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Mission Statement

Based on research into micro- and nanostructuring processes using a broad spectrum of state-of-the-art clean room manufacturing methods and ultra-short pulse laser structuring, complemented by novel design approaches, unique microsystems for research in the fields of mechatronics and life sciences/biomedical engineering are created.

Research

Micro-sensors and micro-actuators

Typical application fields include micro -sensors for metrology, aeronautics and biomedicine, as well as micro-mechanical grippers. Optical and piezoresistive sensing schemes play a major role. We are bridging the gap between pure research and prototype applications.

Lab-on-a-Chip

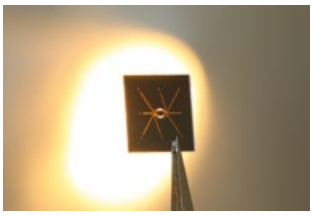
Our research comprises investigation of materials, processes and methods for the realization of micro-fluidic components and for the development of entire lab-on-a-chip systems. Novel microsystem technologies, sensor principles, fluid manipulation schemes and methods of process engineering and tissue cultivation are pursued. Our research is supported by computational fluid dynamics simulations and the experimental characterization of flow fields using micro particle image velocimetry. Our focus is on analyzing and manipulating droplets and particles and cells in microscopic environments.

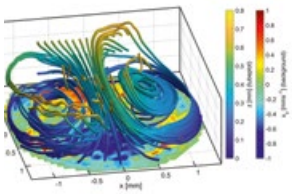
Sensors-in-Foil

Flexible and stretchable sensors-in-foil allow new areas of application because they adapt to non-flat surfaces of larger systems or parts of the human body. Challenges lie in the fabrication of ultra-thin sensors or sensor arrays, and in the integration of silicon subsystems. Systems for use in aerospace, robotics, life sciences and biomedicine are explored.

Femtosecond-Laser-Structuring

Ultra-short-pulse lasers offer new options for micro production. They allow selective removal of otherwise difficult to structure sensor layers without deteriorating thermal effects. Laser Induced Forward Transfer (LIFT) method can write functional structures. Two-photon structuring allows 3D material modification in the volume of otherwise transparent materials on even sub-micron scales for entirely new lab-on-chip and organ-on-chip systems as well as integrated optics.





Publications

- P. Erfle, J. Riewe, H. Bunjes, A. Dietzel, Goodbye fouling: a unique coaxial lamination mixer (CLM) enabled by two-photon polymerization for the stable production of monodisperse drug carrier nanoparticles, Lab on Chip ,21, 2178-2193, 2021
- T. Lorenz, S. Bojko, H. Bunjes, A. Dietzel, An inert 3D emulsification device for individual precipitation and concentration of amorphous drug nanoparticles, Lab on a Chip 18, 627-638, 2018
- K. Mattern, N. Beißner, S. Reichl, A. Dietzel, DynaMiTES – A dynamic cell culture platform for in vitro drug testing PART 1 – Engineering of microfluidic system and technical simulations, European Journal of Pharmaceutics and Biopharmaceutics, 126, pp. 159-165, 2018
- A. Dietzel (Ed), Microsystems for Pharmatechnology - Manipulation of Fluids, Particles, Droplets, and Cells, ISBN 978-3-319-26918-4, Springer New York 2016
- E. Koch, A. Dietzel, Skin attachable flexible sensor array for respiratory monitoring, Sensors and Actuators A Physical 250, 138-144; 2016
- I. Petousis, E. Homburg, R. J. S. Derks, A. Dietzel, Transient behaviour of magnetic micro-bead chains rotating in a fluid by external fields, Lab on a Chip, 1(12), 1746-1751, 2007
- More than 20 granted patents

Institute of Joining and Welding (ifs)

Prof. Dr.-Ing. Klaus Dilger

- CEO of the Open Hybrid LabFactory
- Member of the working group "Klebtechnik" (adhesive bonding technology) of Deutsches Institut für Bautechnik (DIBt – German institute for structural engineering)
- Chairman of Clausthaler Zentrum für Materialtechnik (CZM – Clausthal center for material technology)
- Member of the "Braunschweigische Wissenschaftliche Gesellschaft", Academy of Science, Lower Saxony

Researcher's Career

- Director of the Institut für Füge- und Schweißtechnik (Institute of Joining and Welding) of the TU Braunschweig.
- Appointed Professor for Adhesive Bonding Technology at the RWTH Aachen
- Manager of NRW TC-Kleben GmbH
- Research assistant at the Institute of Joining Technology, TU Munich
- Study of mechanical engineering at the TU Munich

Funding

DFG, BMBF, EU, State Lower Saxony, Industry

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Mission Statement

Joining of different parts and different materials is essential for modern products and a modern production. Especially in the field of lightweight design the joining technique is of special importance. The ifs incorporates relevant knowledge into the education of Bachelor's and Master's Degree students and is one of the leading research institutes in this field.

Research

Adhesive Bonding: The research in this field focuses on the bonding process and the properties of bonded parts. Here the whole process chain is a core research item. Bonded parts can be characterized comprehensively. Numerical simulation is used to predict the behavior of bonded parts under complex conditions.

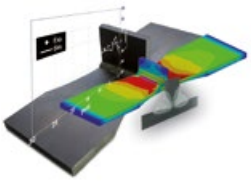
Composite Technologies: Main research subjects are: Pre-forming; binder activation; surface activation of fiber composites; joining and failure behavior of sandwich structures; quick process-integrated fixation and handling of pliable textiles.

Strength and Component Behaviour: The whole range from small samples to complete parts can be tested under various loads. Reliable determination and prognosis of residual stresses in components are used to improve the fatigue properties.

High-Pressure Die Casting: Welding and adhesive bonding of aluminum die casted parts; investigations into the service life of die casting molds; energy balance of die-casting processes are investigated in this research field.

Beam Technology: Electron and laser beam welding - among others – is used to weld duplex materials, aluminum die casted parts, nickel-based materials. Laser beam welding under vacuum is investigated, lasers are also being used for different surface preparations.

The institute is a member of the Open Hybrid LabFactory as well as the Battery LabFactory. In addition, the long-time research activities in the field of joining technologies for aluminum die casting components are concentrated in the light metal center Soltau founded in 2014.

Publications and Patents

- Fischer F, Kreling S, Jäschke P, Frauenhofer M, Kracht D, Dilger K. Laser surface pre-treatment of CFRP for adhesive bonding in consideration of the absorption behaviour. Journal of Adhesion 2012, 88 (4-6), pp. 350-363.
- Dilger K, Kreling S. Adhesive bonding techniques for advanced high-strength steels (AHSS). In: Shome M, Tumuluru M, editors. Welding and Joining of Advanced High Strength Steels (AHSS). Cambridge, UK: Woodhead Publishing; 2015. p. 167-79.
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- DE 000004436701 A1 – Machine-readable optical coding for transfer of information
- DE 10 2007 006 702 B4 2015.10.01 – Method for the evaluation of the preform quality for fibre-reinforced parts

Institute of Machine Tools and Production Technology (IWF)

Prof. Dr.-Ing. Klaus Dröder

- Director of Institute of Machine Tools and Production Technology (IWF)
- Founding Director of the Open Hybrid LabFactory e.V.
- Board member of the Automotive Research Centre Niedersachsen (NFF)
- Member of the Academic Associations for Production Technology (WGP) and Assembly, Handling and Industrial Robotics (MHI)
- Member of the Battery LabFactory Braunschweig (BLB)

Researcher's Career

- Full professor for Production Technology and Process Automation, TU Braunschweig
- Head of "Vehicle Research", R&D, Volkswagen AG
- Director of the Automotive Research Centre Niedersachsen (NFF) in Braunschweig
- Head of "Manufacturing technology and Production concepts", R&D, Volkswagen AG
- Dr.-Ing. at Institute of Metal Forming and Forming Machines, Leibniz Universität Hannover
- Studies in Mechanical Engineering at TU Braunschweig and Leibniz Universität Hannover

Funding

BMBF, BMWi, DFG, State of Lower Saxony, EFRE, Industry

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Mission Statement

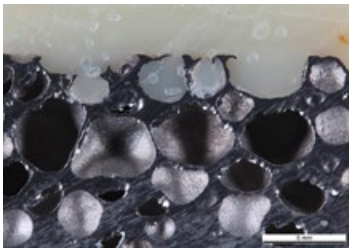
Besides the thorough knowledge of technology, the demand for high flexibility with rising requirements on quality and productivity is a major driver for innovation and our research. With the aim to achieve cost-efficient, convertible factories and production, we cooperate with leading national and international universities and companies to explore future production technology.

Research

Production Automation of Manufacturing Processes: Due to globalization and increasing mass customization, the demand for flexible and robust production technologies is growing rapidly. We develop novel solutions in process automation for hybrid multifunctional construction and battery production, robot-based additive manufacturing technologies and sensor-based adaptive assembly processes supported by machine-learning strategies. Our strengths lie in conceptual design, system and process modelling, automation-oriented process design, control and algorithm development, technical equipment evaluation and didactics for automation and assembly concepts.

Hybrid Lightweight Technology and Integrated Manufacturing: The development and application of lightweight technologies is an important factor for a sustainable use of materials and resources in automotive engineering, aerospace or civil engineering. In the field of hybrid lightweight technologies, we examine multi-material (hybrid) structures and their integrated manufacturing. Further, we focus on intelligent and functionalized tooling and mold technologies in order to implement new manufacturing strategies for function-integrated lightweight components. Our focus is on the manufacturing processes, process integration and development of virtual and digital methods along the process chain to ensure and improve the product quality.

Manufacturing Technologies: Today's production brings new challenges for machining. Our research in the field of machining technology focuses on complex system technology including process simulation, control and analysis as well as the investigation of dynamic and thermal machine behavior. If required, intelligent and sensory machine components are developed and assembled. After all, we are one of the few institutes dealing with processing of wood and composite materials. w



Publications

- Gabriel, Felix; Römer, Martin; Bobka, Paul; Dröder, Klaus. Model-based grasp planning for energy-efficient vacuum-based handling. In: CIRP Annals, 2021.
- Bobka, Paul; Gabriel, Felix; Dröder, Klaus. Fast and precise pick and place stacking of limp fuel cell components supported by artificial neural networks. In: CIRP Annals, pp.1-4, 2020.
- Hürkamp, Andre; Lorenz, Ralf; Behrens, Bernd-Arno; Dröder, Klaus. Computational Manufacturing for Multi-Material Lightweight Parts. In: Procedia CIRP, pp. 102-107, 2019.
- Leithoff, Ruben; Fröhlich, Arian; Dröder, Klaus. Investigation of the Influence of Deposition Accuracy of Electrodes on the Electrochemical Properties of Lithium-Ion Batteries In: Energy Technology, 2019.
- Dröder, Klaus; Hoffmeister, Hans-Werner; Albergt, Max. Development of a new drilling tool for machining of CFRP-metal-composites. In: Euspen's 19th International Conference & Exhibition, pp.374-375, 2019.

Institute of Internal Combustion Engines (ivb)

Prof. Dr.-Ing. Peter Eilts

Researcher's Career

- Dipl.-Ing. (MSc) at University of Hannover in 1984
- Dr.-Ing. (PhD) at University of Hannover in 1990
- 1991 to 2007 Engine Development at MAN B&W Diesel in Augsburg in several positions. Last position: Head of Thermodynamics and Injection System Development.
- From 2007 Head of the Institute of Internal Combustion Engines at Technical University of Braunschweig
- Focus on Engine Thermodynamics, Supercharging, Combustion, Emissions

Funding

FVV (BMWi), BMBF, Industry

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Mission Statement

The internal combustion engine is the backbone of our mobility and can be expected to continue playing this role for some time to come, though the electric drive will become a serious competitor in some applications. Our mission is to continue developing it to increased efficiency and improved environmental friendliness.

Research

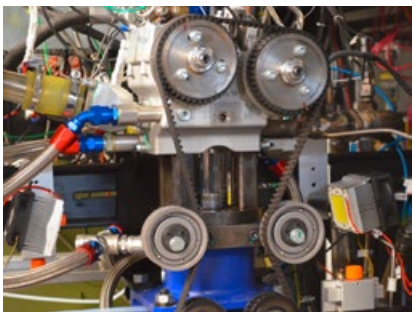
The research objectives of ivb are the development and research of combustion processes for conventional and alternative fuels, of gas exchange, charging and exhaust aftertreatment systems. Engines are investigated in connection with the vehicle-system to optimize the thermal vehicle management. Operating strategies for hybrid vehicles are investigated with focus on the reduction of emissions and fuel consumption.

- Optimization of exhaust emissions
- Alternative fuels (e.g. hydrogen)
- Energy and thermal management
- High pressure charging of vehicle engines
- Combustion process optimization for DI-Otto- and Diesel-engines

Research facilities

The ivb owns a comprehensive test area and keeps licences for current software tools that are used for engine development. The institute runs 16 modern test beds, some of them capable of hardware-in-the-loop tests, for engines up to 440 kW and 1,500 Nm. Engine components can be tested on additional component test beds. The test area is completed with a laser-optic laboratory with a pressure chamber and a gas testing laboratory for exhaust after treatment systems. A broad range of measurement systems for exhaust emissions is available. The institute holds up-to-date soft- and hardware for operating development engine ECUs (engine control unit) and some free programmable ECUs. The measuring results are supported by the use of simulation software for the engine working process and 3D-CFD.

- Engine test beds for stationary and processor-controlled instationary engine operation
- Climate chamber test bed (down to -25 °C)
- Gas testing laboratory for exhaust gas aftertreatment systems
- High-pressure-high-temperature injection chamber
- Optical measurement systems
- Measurement systems for combustion chamber pressure indication
- Comprehensive equipment for exhaust gas measurement
- Injection Analyzer
- Flow-analysis test bench for flow rate and swirl measurements on cylinder heads



Publications

- Betz, M. and Eilts, P., "Optimization of the Exhaust Aftertreatment System of a Heavy Duty Engine by means of Variable Valve Timing", SAE Technical Paper 2019-24-0143, 2019
- Pauls, A., Todt, A. and Eilts, P., "Untersuchung der Gemischbildung von Ottomotoren mit kleinem Bohrungsdurchmesser", MTZ 80. Jahrgang 04, S. 72-78, 2019
- Frerichs, J. and Eilts, P., "Development of a Physically/Chemically Based Approach for 2-Stage Ignition Delay Calculation in Medium Speed Dual-Fuel Engines", SAE Technical Paper 2019-24-0068, 2019
- Eilts, P. and Klare, L., "Investigations on the Determination of the Service Methane Number of LNG", SAE Technical Paper 2018-01-1143, 2018, doi.org/10.4271/2018-01-1143
- Meier, C., Rehbein, M.C., Scholl, S. and Eilts, P., "Mixtures of Ammonia and Organic Solvents as Alternative Fuel for Internal Combustion Engines", Energy Fuels Bd. 33 (2019), Nr.10, Seiten 10331-10342.

Institute of Aircraft Design and Lightweight Structures

Prof. Dr. Ali Elham

- Member of board of mass analysis panel of Luftfahrttechnisches Handbuch
- Founding member of Excellence Cluster Sustainable and Energy Efficient Aviation
- Member of Aeronautic Research Center Niedersachsen
- Coordinator of European project Robust and Sustainable by Design Ultra-High Aspect Ratio Wing and Airframe

Researcher's Career

- Professor and Chair holder of Aircraft Conceptual Design at TU Braunschweig
- Lecturer/Postdoc at Delft University of Technology, Netherlands
- PhD from Delft University of Technology, Netherlands
- M.Sc. in Aerospace Engineering, Moscow State Aviation Technological University, Russia
- B.Sc. in Aerospace Engineering from Sharif University of Technology, Iran

Funding
DFG, EU, BMWi, Industry

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Mission Statement

The need for sustainable and energy efficient aviation pushes the aviation industries toward the design of the next generation of transport aircraft, with dramatic reduction in energy consumption, emissions and noise. Based on Flightpath 2050, the airplanes flying in 2050 should have a 75% CO_2 reduction per passenger-kilometer. To achieve this goal, new technologies and novel aircraft concepts need to be developed. Electric or hybrid electric aircraft, active flow control technologies, active load alleviation technologies, bionic airframes and novel aircraft configurations such as blended wing body are examples of the solutions suggested to achieve the mentioned goals for the design of future aircraft.
The chair of aircraft conceptual design was established in 2017 at TU Braunschweig, to develop ideas, knowledge, methodologies and tools to support the design of the future aircraft.

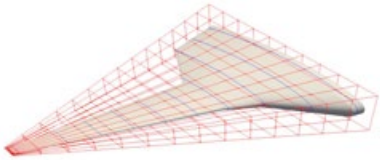
Research

Aircraft Conceptual Design; including developing new design tools and methods; design of different classes of aircraft including aircraft with novel configurations as well as novel airframe and energy network technologies, such as hybrid electric aircraft. In addition to that, my chair is actively involved in design of electric vertical take-off and landing vehicles for urban air mobility.

Multidisciplinary Design Optimization (MDO); including developing various MDO frameworks, developing new numerical optimization algorithms, sensitivity analysis methods such as adjoint and coupled-adjoint methods, surrogate modelling, and application of both gradient based and gradient free optimization methods in various engineering problems such as aircraft design, automotive design, wind energy and advanced structural design.

Topology Optimization; my chair is active is developing and applying novel topology optimization methods to both structural and multi-physics problems. Topology optimization of stiffened composite structures, and topology optimization of micro heat exchangers are example of research activities in this field.

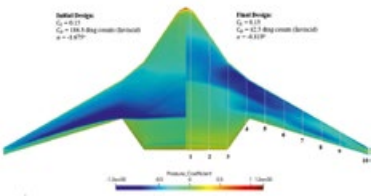
High-fidelity aerodynamic, structural, and aerostructural analysis and optimization; experienced in application of high-fidelity CFD as well as FEM methods for aerodynamic, structural and coupled aerostructural analysis and optimization.



Aircraft Geometry Parametrization

Design optimization of advanced composite structures; including developing advanced methods and tools for design optimization of tow steered composite structures.

The abovementioned research is done in close collaboration with various universities, research centers as well as industries across the world, such as TU Delft (Netherlands), Stanford University and University of South Carolina (USA), Volkswagen AG (Germany), Imperial College London and University of Strathclyde (UK), IRT Saint Exupery (France).



Aircraft aerodynamic shape optimization

Publications

- Ghasemi, A.; Elham, A. A Novel Topology Optimization Approach for Flow Power Loss Minimization Across Fin Arrays. Energies 2020, 13, 1987.
- Mahulja, S., Larsen, G.C., Elham, A., Engineering an optimal wind farm using surrogate models, Wind Energy, Volume 21, Issue 12, December 2018, Pages 1296-1308
- Alba, C. Elham, A., German, B., Veldhuis, L.L.M., A Surrogate-Based Multi-Disciplinary Design Optimization Framework Exploiting Wing-Propeller Interaction,Aerospace Science and Technology, Volume 78, 2018, Pages 721-733
- Elham, A., and van Tooren, M.J.L., Multi-fidelity wing aerostructural optimization using a trust region filter-SQP method, Structural and Multidisciplinary Optimization, Vol. 55, 2017, pp. 1773-1786.
- van den Kieboom, K., Elham, A., Concurrent Wing and High-Lift System Aerostructural Optimization, Structural and Multidisciplinary Optimization, 57, 947-963, 2018

Institute of Mobile Machines and Commercial Vehicles

Prof. Dr. Ludger Frerichs

Researcher's Career

- Full professor and director of the Institute of Mobile Machines and Commercial Vehicles at the Technische Universität Braunschweig
- Director Product Development, STILL GmbH, Hamburg
- Head of Advanced Engineering (last position), CLAAS Selbstfahrende Erntemaschinen GmbH, Harsewinkel
- Part time lectureships "Agricultural Engineering", Institute of Automotive Engineering, RWTH Aachen University
- Research Assistant at the Institute of Agricultural Engineering, University of Hohenheim
- Study mechanical engineering at the Technische Universität Braunschweig
- Study mechanical engineering at the University of Applied Science Osnabruck

Funding

DFG, EU, BMBF, BMWI, Lower Saxony, DBU, BLE, VDMA, AIF, DAAD, Industry

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Mission Statement

The mission and objective of the Institute of Mobile Machines and Commercial Vehicles is to lay the methodical and technical foundation for the next generation of mobile systems regarding processes, machinery and procedures. The research and teaching areas of the institute correspond the following five thematic groups: Processes in Mobile Machines, Powertrain Systems, Mobile Hydraulics, Automation and Robot Systems as well as Procedures and Systems. We follow a systemic approach to the holistic, transdisciplinary design of our work

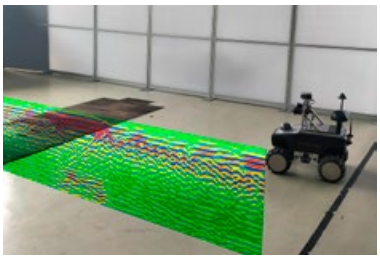
Research

For the investigation of **Processes in Mobile Machines**, the focus is on research into new process technologies and the investigation of process tool interactions with natural materials like soil or plants. For basic research, the Discrete Element Method (DEM) is applied to simulate processes in detail and to investigate the influence of system and design parameters.

In the area of **Powertrain Systems**, innovative topologies and drive technologies including mechanical, electrical and hydraulic drives are under investigation including the evaluation of possible applications. Thereby system-oriented operating strategies play a crucial role, due to the fact that powertrain systems in mobile machines and often in commercial vehicles have to power the traction and working functions.

Mobile Hydraulics is an important research field and deals with hydraulic circuits, hybrid and networked systems as well as with hydraulic fluids. Research topics are for example energy harvesting in closed hydraulic circuits, integration of traction and working hydraulics and bio-based fluids.

The **Automation and Robot Systems** group deals in particular with issues relating to perception, digitization and automation of typically cooperative acting machines in rough outdoor or indoor environments. For our work, we use innovative methods of artificial intelligence such as knowledge-based systems and algorithms.



The overarching area of **Procedures and Systems** deals with holistic system concepts using future-oriented machines, trucks and fleets regarding the determination of requirements, definition of evaluation criteria, feasibility studies and the evaluation of efficiency. The applied methods in all research topics comprise analysis, conception, modeling, simulation, testing and evaluation under laboratory and field conditions.

Publications and Patents

- Kalácska, Á.; De Baets, P.; Fauconnier, D.; Schramm, F.; Frerichs, L.; Sukumaran, J.: Abrasive wear behaviour of 27MnB5 steel used in agricultural tines, Wear Journal, Volumes 442–443, 2020, Article 203107. https://doi.org/10.1016/j.wear.2019.203107
- Ritters, K.; Winkelhahn, P.; Frerichs, L.; Kriebel, B.: Determining Saving Potentials in a Tractor Drivetrain using a Simulation Model and Measured Operating Data, 75. LAND.TECHNIK AgEng2017, Tagungsband, S. 297-302, VDI Verlag GmbH, ISBN 978-3-18-092300-0
- Schattenberg, J.; Schramm, F.; Frerichs, L.: Entwicklungsszenarien einer automatisierten Pflanzenproduktion, Journal für Kulturpflanzen, 71 (4). S. 101–107, 2019, ISSN 1867-0911. https://doi.org/10.5073/JfK.2019.04.05
- Frerichs, L.; Hanke, S.; Steinhaus; S. and Trösken, L.: EKoTech - A Holistic Approach to Reduce CO_2 Emissions of Agricultural Machinery in Process Chains, SAE Technical Paper 2017-01-1929, 2017. https://doi.org/10.4271/2017-01-1929.
- Frerichs, L.; Thielke, L.: New concepts of energy supply for sustainable agricultural systems, Landtechnik 70(4), 2015, 167-176. https://doi.org/10.15150/lt.2015.2672

Institute of Jet Propulsion and Turbomachinery (IFAS)

Prof. Dr.-Ing. Jens Friedrichs

Researcher's Career

- Member of AG Turbo Program Management
- Spokesperson EXC 2163 SE²A – Sustainable and Energy Efficient Aviation
- Dean of the faculty of Mechanical Engineering
- Member SATA (Subsonic Aerodynamic Testing Association)
- Member of scientific comittee "Compressors Users International Forum"
- TU Braunschweig, Full Professor, Director Institute of Jet Propulsion and Turbomachinery
- Several positions in jet engine industry, focused on engine maintenance and repair
- Dr.-Ing. TU Braunschweig, Faculty of Mechanical Engineering
- Research assistant at TU Braunschweig, Pfleiderer-Institute
- Dipl.-Ing. TU Braunschweig, Mechanical Engineering

Funding

DFG, BMBF, AIF, European Industry

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Mission Statement

Turbomachinery and its main components are the focus of IFAS. The understanding and description of fundamental physical effects define the basis for new methods and technologies. At IFAS this is done not only to support new designs but also do improve components and full systems during maintenance and repair.

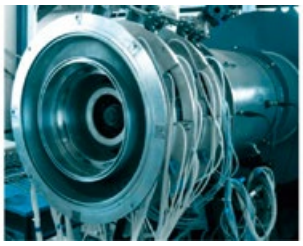
Research

Jet propulsion: The field of jet engines and propulsion focuses on the design and operational behaviour of the overall system as well as the associated components. One area of focus is the development of design recommendations for future engines using advanced design and calculation methods. The research at component level also forms an important focus area. Great significance is given to the wear diagnostics and development of repair techniques for the engine.

New engine concepts and their integration into the aircraft can be examined in a one of a kind fan test rig. For this purpose, a 40 x 8 x 12m test facility has been built, in which future propulsor concepts will be investigated.

The Institute uses a modern test engine IAE V2500-A1 (A320 family), which allows research on engine and component wear mechanisms as well as maintenance, diagnostics and condition monitoring. With the help of mathematical models and worn out engine components, specific wear mechanisms are identified and described. Through this, specific maintenance measures can be defined, by which existing aircraft can operate more efficiently in the future.

Turbomachinery: The field of turbomachinery covers especially research on centrifugal and axial pumps, low-pressure axial fans and adaptive turbomachinery seals. For the investigation of pumps, test rigs with a diameter of up to 500 mm are available. In these the performance of all pumps up to 170 kW can by analyzed using a wide range of instrumentation also within the rotating reference frame. In addition, adaptive seals and especially brush seals in steam turbines for sealing high pressure differences are examined at the institute. For this purpose, the brush seals are supplied and operated with live steam under realistic conditions in the heat and power station. Subsequently, the analysis of sealing behavior can be carried out at the specifically constructed measuring and testing facility at the Institute.



Publications

- Goeing, J.; Seehausen, H.; Vladislav, P.; Lueck, S.; Seume, J. R.; Friedrichs, J.: Influence of combined compressor and turbine deterioration on the overall performance of a jet engine using RANS simulation and Pseudo Bond Graph approach. GPPS/Journal; 22 December 2020; Journal of the Global Power and Propulsion Society¸https://doi.org/10.33737/jgpps/131109
- Giesecke, D.; Friedrichs, J.: Aerodynamics and Loss Accounting of a Low Pressure Ratio Fan for an Over-Wing Mounted Engine Fundamentals of High Lift for Future Civil Aircraft pp 299-314; Springer Verlag; online 18.10.2020
- Harjes, L.; Bode, C.; Grubert, J.; Frantzheld, P.; Koch, P.; Friedrichs, J.: Investigation of jet engine intake distortions caused by crosswind conditions GPPS/Journal; 14.Mai 2020; Journal of the Global Power and Propulsion Society
- Schur, F.; Friedrichs, J.: Operational Performance and Locally Resolved Outflow of Brush Seals AJK-Fluids-2019-4877, San Francisco, CA, USA
- Kellersmann, A.; Reitz, G.; Friedrichs, J. Deterioration Effects of Coupled Blisk Blades Journal of the Global Power and Propulsion Society, 2: 465-476, 2018

Institute for Particle Technology – Nanomaterials

Prof. Dr. Georg Garnweitner

Researcher's Career

- Full Professor for Nanomaterials, TU Braunschweig
- Junior Professor for Nanoparticles and Nanocomposites, TU Braunschweig
- Postdoc at Max Planck Institute of Colloids and Interfaces, Potsdam
- Dr. rer. nat. at University of Potsdam and Max Planck Institute of Colloids and Interfaces, Potsdam
- Study of Technical Chemistry, Vienna University of Technology, Austria

Funding

DFG, BMBF, BMWI, AIF, State Lower Saxony, Industry

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Mission Statement

The Institute for Particle Technology strives for excellence in research and teaching in selected fields of mechanical process engineering and particle technology. The particle-particle interactions and the control of interfaces thereby play a key role and are investigated in great detail.

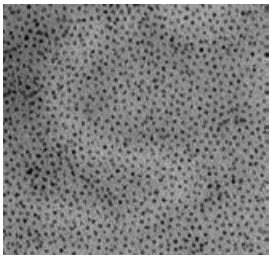
Research

The branch "Nanomaterials" investigates the fabrication, stabilization and application of nanoparticles and nanostructures.

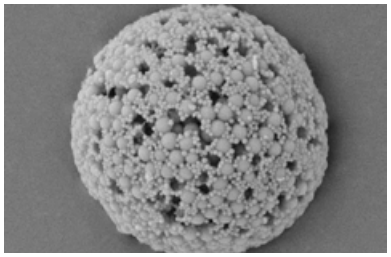
Nanoparticle synthesis: We have strong expertise in the field of "bottom-up" synthesis, with a focus on the nonaqueous synthesis in organic solvents. Via this method, the preparation of small nanoparticles (2-20 nm in size) with narrow size distribution and high sample homogeneity and crystallinity is possible. Due to their high stability and diversity of properties, we concentrate on the synthesis of inorganic materials, in particular metal oxides and quantum dots. Through a thorough understanding of formation mechanisms and process interrelations, we achieve the synthesis of complex metal oxide nanostructures with high homogeneity even at pilot plant scale.

Surface modification and functionalization: In addition to the synthesis, the colloidal stabilization and functionalization of nanoparticles is a crucial issue for applications and thus is investigated in detail. Due to their very large specific surface area, nanoparticles are prone to agglomeration, but they can be stabilized by coverage with organic molecules, for example. This also allows one to influence many other properties, such as the chemical behavior, catalytic acitivity, or optical properties. We study in detail the adsorption and exchange of organic molecules at the particle surface and develop strategies for a rational tailoring of the nanoparticle surface chemistry.

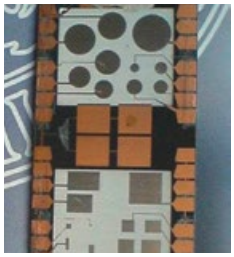
Applications of tailored nanomaterials: Nanomaterials with defined structural and chemical properties are further processed for novel applications. Our main interests thereby include the fields of polymer nanocomposites with optimized mechanical and functional properties, hierarchical and self-assembled structures from nanoparticle building blocks, nanoparticulate and nanocomposite thin films, nanostructured materials for electrochemical energy storage as well as magnetic nanomaterials for selective separation, purification and drug delivery.



ZrO_2 nanocrystals



porous spray dried aggregate of SiO_2 nanoparticles



thin-film capacitors fabricated from ZrO_2 nanocrystals

Publications

- G. Garnweitner & D. Xue (2020): Crystal Engineering for Electrochemical Applications, CrystEngComm, 22, 1498-1499.
- M. Barasinski & G. Garnweitner (2020): Restricted and Unrestricted Migration Mechanisms of Silica Nanoparticles in Agarose Gels and Their Utilization for the Separation of Binary Mixtures, J. Phys. Chem. C, 124, 5157-5166.
- T. Preller, S. Knickmeier, D. Menzel, B. Temel & G. Garnweitner (2020): Exchange Bias in FePt-FePt3 Thin Films by Controlled Phase Transition of Blended Nanoparticle Building Blocks, Langmuir, 36, 2093-2101.
- J. C. Porsiel, B. Temel, A. Schirmacher, E. Buhr & G. Garnweitner (2019): Dimensional characterization of cadmium selenide nanocrystals via indirect Fourier transform evaluation of small-angle X-ray scattering data, Nano Research, 12, 2849-2857.
- L. Kleinfeldt, J. Gädke, R. Biedendieck, R. Krull & G. Garnweitner (2019): Spray-Dried Hierarchical Aggregates of Iron Oxide Nanoparticles and Their Functionalization for Downstream Processing in Biotechnology, ACS Omega, 4, 16300-16308.

Institute of Flight Guidance (IFF)

Prof. Dr.-Ing. Peter Hecker

- Managing Director of the Institute of Flight Guidance (IFF)
- Member of the SESAR JU Administrative Board representing the Scientific Community
- Member and chairman of the Clean Sky Scientific Committee
- Member of the Board of Directors of the "Association for Scientific Development of ATM in Europe" (ASDA)
- Member of the Board of Directors of the Aeronautics Research Centre Niedersachsen (NFL)
- Member of the Board of Directors of the Braunschweig Research Airport e.V.
- Member of the Scientific Advisory Board of the "German Institute of Navigation" (DGON)

Researcher's Career

- Full Professor for Flight Guidance, TU Braunschweig
- Head of the Department "Pilot Assistance", DLR Institute of Flight Guidance
- Dr.-Ing. at TU Braunschweig
- Research Scientist, DLR Institute of Flight Guidance
- Dipl.-Ing., Electrical Engineering, TU Braunschweig

Funding

EC, National Government (BMWi, BMBF), DFG, Industry

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Mission Statement

The discipline of flight guidance addresses principles and technical means to support the human in guiding aircraft safely gate to gate. Subjects of research are functions, systems and operations for assisting the aircrew, the air traffic controller or other stakeholders involved in the air transportation system. The objective of research is to enable a safe, efficient and environmentally friendly flight.

Research

Air Traffic Management:

- Assistance Systems (Cockpit, Ground)
- Air Traffic Guidance (Ground, Air)
- Airline Operations and Cabin Management

Navigation:

- Localisation (Algorithms, Sensors, Filters)
- Data fusion und Processing
- Airborne Metrology and Platforms

Flight Guidance Systems and Flight Mechanics:

- Flight Control and Flight Mechanics
- Flight Safety and Certification
- Flight Guidance Systems

Airborne Meteorology and Measurement Technique:

- Airborne Meteorology
- Atmospheric Research
- Airborne Measurement Techniques

More than 50 staff members with professional background in aerospace, electrical engineering, meteorology and computer science are working in project teams in order to face this challenge. Our interdisciplinary teams develop and apply tools and solutions, comprising, for example, on-board avionics and cockpit assistant systems as well as weather data, positioning and navigation, ground based systems for air traffic control, airports or airlines.

Moreover, measuring methods for aviation applications are developed, applied and validated. The institute has an outstanding infrastructure including research aircraft, flight simulators and unmanned aerial systems; these are used for research and in the scope of student education. The institute is a member of the Aeronautics Research Centre Niedersachsen (NFL).

Publications

- Feuerle, T.; Steen, M.; Hecker, P.: New Concept for Wake-Vortex Hazard Mitigation Using Onboard Measurement Equipment, in Journal of Aircraft, 2014
- Krüger, T.; Nowak, S.; Hecker, P.: Towards Autonomous Navigation with Unmanned Ground Vehicles Using LiDAR, in The Institute of Navigation, Proceedings of the ION ITM 2015, Dana Point, USA, pp. 778-788, January 2015
- Rauskolb, F.; Berger,K.; Lipski, C.; Magnor, M.; Cornelsen,K.; Effertz, J.; Form, T.; Graefe, F.; Ohl, S.; Schumacher , W.; Wille, J.; Hecker, P.; Nothdurft, T.; Doering, M.; Homeier, K.; Morgenroth, J.; Wolf, L.; Basarke, C.; Berger, C.; Gülke, T.; Klose, F.; Rumpe, B.: An Autonomously Driving Vehicle for Urban Environments, Journal of Field Robotics 25, 9, 674-724, 2008
- Schönhals, S.; Steen, M.; Hecker, P.: Towards wake vortex safety and capacity increase: the integrated fusion approach and its demands on prediction models and detection sensors; Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering 227, 1, 199-208, 2013
- Schönhals, S.; Steen, M.; Hecker, P.: Wake Vortex prediction and detection utilising advanced fusion filter technologies; The Aeronautical Journal, Vol. 115, no. 1166, Royal Aeronautical Society, 2011

Institute of Machine Tools and Production Technology (IWF)

Prof. Dr.-Ing. Christoph Herrmann

- Dr.-Ing. at TU Braunschweig
- Chair of Sustainable Manufacturing & Life Cycle Engineering

Researcher's Career

- Co-director of IWF, Institute of Machine Tools and Production Technology
- Member of the institute management at the Fraunhofer Institute for Surface Engineering and Thin Films IST Braunschweig
- Full professor for Sustainable Manufacturing & Life Cycle Engineering
- Co-director of Joint German-Australian Research Group "Sustainable Manufacturing and Life Cycle Engineering"
- Member of the International Academy for Production Engineering (CIRP)
- Scientific director of NFF (Automotive Research Center Niedersachsen)
- Scientific director of KERP Center of Excellence Environment & Electronics, Vienna Austria
- Associate Professor for Product- and Life-Cycle-Management at TU Braunschweig

Funding

Diverse (inter)national funding, e.g. AiF, BMBF, BMEL, BMUB, BMWi, DAAD, DBU, DFG, EU, Industry, etc.

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Mission Statement

Sustainability in manufacturing aims for cost-efficient products and processes with minimal environmental impact over the entire life cycle. Within our research we strive for technologies which minimize the use of resources as well as methods and tools to support the life cycle-oriented design of systems and to educate sustainable system thinking.

Research

Sustainable production technologies: Our research focuses on production technologies maximizing energy and resource efficiency. We investigate alternative cutting fluids towards the vision of a mineral oil free factory.

Integrated Computational Production and Life Cycle Engineering: We combine complementary modelling and simulation paradigms to analyse and assess complex dynamic systems on process, process chain, factory or even life cycle level. Using multi-scale approaches we aim for a deep understanding of product-process interdependencies and leverages to minimize cost and the use of material and energy.

Cyber-Physical Production Systems and Factories of the Future: We develop solutions addressing the increasing convergence of industrial production with digital technologies. This includes the dynamic integration of innovative data gathering and analytics with model based control and decision support for different stakeholders. We recognize the potentials of urban factories.

Circular Economy and Industrial Symbiosis: By analysing products and processes through the entire life cycle we are able to optimize products for disassembly, develop new recycling systems and substitute non-renewable resource and investigate strategies to improve eco-efficiency.

Smart Production of Sustainable Vehicles and Batteries: Within the Open Hybrid LabFactory our research focuses on life cycle engineering of function integrated structures for applications in today and future vehicles. With our research towards 'green batteries' with minimal environmental impact we contribute to research activities of the Battery LabFactory Braunschweig.

"Die Lernfabrik" and Engineering Education: Our learning factory provides a unique infrastructure to disseminate our findings as well as inspire new ideas. Innovative teaching methods like game-based learning help students and professionals to acquire a deeper understanding of sustainability in engineering and corresponding concepts, methods and tools.

Publications

- Melo, Sofia Pinheiro; Barke, Alexander; Cerdas, Felipe; Thies, Christian; Mennenga, Mark; Spengler, Thomas Stefan; Herrmann, Christoph. Sustainability Assessment and Engineering of Emerging Aircraft Technologies – Challenges, Methods and Tools, in: Sustainability, MDPI, Basel, 2020, vol. 12, pp. 5663.
- Suvarna, Manu; Bueth, Lennart; Hejny, Johannes; Mennenga, Mark; Li, Jie; Ng, Yen Ting; Herrmann, Christoph; Wang, Xiaonan. Smart Manufacturing for Smart Cities – Overview, Insights, and Future Directions, in: Advanced Intelligent Systems, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2020, Vol. 2, pp. 1-19.
- Herrmann, Christoph; Juraschek, Max; Burggräf, Peter; Kara, Sami. Urban production: State of the art and future trends for urban factories, In: CIRP Annals - Manufcturing Technology, Elsevier B.V., Amsterdam, 2020, vol. 69/2, pp. 764-787.
- Thiede, Sebastian; Turetskyy, Artem; Kwade, Arno; Kara, Sami; Herrmann, Christoph; Data mining in battery production chains towards multi-criterial quality prediction. In: CIRP Annals - Manufacturing Technology, Elsevier B.V., Amsterdam, 2019, Vol. 68, Issue 1, pp. 463-466.
- Schulze, Christine; Thiede, Sebastian; Thiede, Bastian; Kurle, Denis; Blume, Stefan; Herrmann, Christoph Cooling tower management in manufacturing companies: A cyber-physical system approach. In: Journal of Cleaner Production , Elsevier B.V., Amsterdam, 2019, Vol. 211, pp. 428-441.

Institute of Aircraft Design and Lightweight Structures (IFL)

Prof. Dr.-Ing. Peter Horst

Researcher's Career

- Oceanography, University Hamburg, 1975-1978
- Mech. Engg., special field of Aeronautics, 1978-1984, TU Braunschweig
- PhD: TU Braunschweig 1990 in Mech. Engg.
- 1984-1990, Research Assistant, Inst. f. Flugzeugbau und Leichtbau, TU Braunschweig
- 1990-1998, Airbus Deutschland, last position: Head of "Structure, Repair, Engineering"
- 1998-present: Universityprofessor of "Aircraft Design and Lightweight Structures" and Head of the Institute of Aircraft Design and Lightweight Structures, TU Braunschweig

Funding

DFG, EU, BMWi, Industry

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Mission Statement

In aerospace applications as well as many other technical areas ecologically and environmentally efficient and therefore light solutions are needed. This may only be achieved by taking into account multidisciplinary aspects and sophisticated methods. The institute provides both in many fields.

Research

The different groups of the institute working in aerospace science cover five main subjects, namely, Conceptual Design of Aircraft, Numerical Methods/Multiphysics, Damage Mechanics, New Building Blocks and Experiments.

Multiphysics (headed by Dr. M. Haupt) are dealing with subjects like fluid-structure-interaction, thermomechanical and electromagnetic interactions. An in-house code named ifls is used to couple the different codes used to find solutions in several areas like structures, aerodynamics etc.

Damage Mechanics cover both metallic as well as composite materials and structures. In all cases experimental and theoretical approaches are followed. Due to the large difference in scale, simulation models, specimens and testing tools have to be versatile.

New Building Blocks are searched for by methods of structural optimization, again ranging from complete aircraft to particular panels. This work is often performed in conjunction with other scientists from subjects such as production, for example, in order to find methods for economically and ecologically efficient structures.

Aircraft Conceptual Design (headed by Dr. W. Heinze) is an inherently multi-disciplinary optimization problem, taking into account many disciplines. A solution may only be found by an extensive computer code. The in-house code PrADO has been developed in recent decades. Special attention has been paid to unconventional concepts (such as blended wing body aircraft), green aircraft or aircraft using extremely high lift.

As already visible in the above mentioned areas, experimental data and validation by experiments play a crucial role in the work done at the institute. The institute therefore has a broad experimental basis, which allows for testing complete aircraft parts like sailplane wings etc. down to microcracking in small composite specimens.

Publications and Patents

- Sommerwerk, H., Luplow, T., Horst, P., Numerical Simulation and Validation of Electro-Impulse De-Icing on a Leading Edge Structure, Theoretical and Applied Fracture Mechanics, Vol 105, pp. 1-8; 10.1016/j.tafmec.2019.102392, 2020
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- Adam, T.J., Horst, P., Fatigue Damage and Fatigue Limits of a GFRP Angle-Ply Laminate tested under Very High Cycle Fatigue Loading, International Journal of Fatigue, online February 2017, Vol. 99, pp. 202-214, doi.org/10.1016/j.ijfatigue.2017.01.045
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- Schmitz, A., Horst, P., Bending deformation limits of corrugated unidirectionally reinforced composites. Composite Structures, 2014, 107:103-111

Institute for Surface Technology (IOT) – Plasma Chemistry and Polymers

Prof. Dr. Claus-Peter Klages

Researcher's Career

- 1975-1979, PhD study in physical-organic chemistry, Inst. f. Org. Chemie, University Hamburg
- Sept. 1976, Attendance: Charles Coulson Theoretical Chemistry Summer School, Oxford
- 1975-1976, Sholarship, Fonds der Chemischen Industrie
- 1977-1979, Sci. Ass., Org. Chem., Univ. Hamburg
- 1979-1990, Scientist, Philips Research Laboratories, Hamburg
- 1990-today, Department Head, Fraunhofer Institute for Surface Technology and Thin Films (IST); since 2003 as secondary employment
- 1999-2003, Deputy Director of Fraunhofer IST
- 1993-1996, Visiting Professor, Physics Dept., University of Lanzhou, Lanzhou, PR China
- 1998-2000, Consultant Professor, Shanghai University, Shanghai, PR China
- 1998, Habilitation (Thin Film and Surface Technology), TU Braunschweig
- Appointment as private lecturer
- 2003, Appointment as Professor, Institute for Surface Technology, TU Braunschweig
- Since 2018, Continuation of research as retired professor

Funding
DFG, BMBF, BMU, Industry

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Mission Statement

Plasma-chemical processes based on atmospheric-pressure gas discharges facilitate tailoring of physico-chemical surface properties. Polymers are of particular interest, both as substrates as well as thin film materials. The chemical characterization of plasma-modified surfaces is still presenting substantial challenges.

Research

Studies of plasma-surface interaction: Plasma-chemical processes in non-equilibrium gas discharges can nowadays be modeled in great detail, thanks to the exact knowledge of a large number of elementary gas-phase reactions. The interaction of plasmas with surfaces, on the other hand, especially plasma-chemical reactions with polymers, and the deposition of thin films by plasma-assisted chemical vapor deposition are much less well understood. The chemical nature of polymer surfaces after contact with a plasma is often largely unknown. The focus of the group is on atmospheric-pressure discharges. In order to reduce the complexity of plasma-surface interactions, single-filament dielectric barrier discharges and flowing post-discharges are studied.

FTIR-ATR and IRRAS: Using Fourier-transform infrared spectroscopy in the attenuated-total-reflection mode or as infrared reflexion-absorption spectroscopy, surfaces of dielectrics or metals can be studied with high sensitivity during or after their contact with reactive species generated in atmospheric-pressure gas discharges. In this way chemical changes of surfaces upon plasma contact may be studied at an early stage and chemical gas-phase derivatization reactions may be applied to explore the presence of functional groups qualitatively and quantitatively.

Combinatorial studies of plasma-chemical surface modification processes: While combinatorial methods are established in chemistry and biochemistry, they are relatively rare in studies of plasma-based surface coating or modifications processes.
At the IOT, novel combinatorial methods are being studied within several DFG-funded projects, utilizing feeding of plasma reactors with gas streams carrying a transversal gradient of gaseous species to obtain continuous thin films or micro-spot arrays with a gradient of chemical composition and physico-chemical properties. In a recently started project, an orthogonal gradient of electrical power density dissipated in the discharge will also be employed to attain 2D libraries of plasma-modified surfaces (see figure).

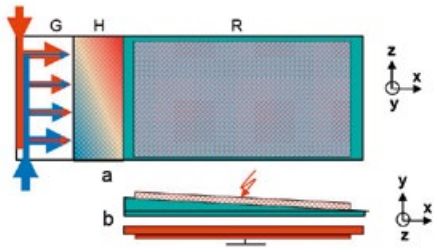

Figure: Schematic of an atmospheric-pressure plasma reactor employing orthogonal gradients of gas composition and power density

Publications

- D. Loffhagen, M. M. Becker, A. K. Czerny, C.-P. Klages, Modeling of atmospheric-pressure dielectric barrier discharges in argon with small admixtures of tetramethylsilane; Plasma Chem. Plasma Process. 2021, 41, 289.
- L. Bröcker, G. S. Perlick, C.-P. Klages, Evidence of ionic film deposition from single- filament dielectric barrier discharges in Ar–HMDSO mixtures; Plasma Process. Polym. 2020, 17, 2000129.
- C.-P. Klages, A. Martinovs, L. Bröcker, D. Loffhagen, Does the energy transfer from Ar(1s) atoms to N2 lead to dissociation? Plasma Process. Polym. 2020, 17, 2000070.
- C.-P. Klages, V. Raev, D. Murugan, V. V. R. Sai, Argon-water DBD pretreatment and vapor-phase silanization of silica: Comparison with wet-chemical processes; Plasma Process. Polym. 2020, 17, 1900265.
- Z. Khosravi, S. Kotula, A. Lippitz, W. E. S. Unger, C.-P. Klages, IR- and NEXAFS-spectroscopic characterization of plasma-nitrogenated polyolefin surfaces; Plasma Process. Polym. 2018, 15, 1700066.

Thermal Science Laboratory (IfT)

Prof. Dr.-Ing. Jürgen Köhler

Researcher's Career

- Full Professor for Thermodynamics at Braunschweig University of Technology
- Lead Author of a RTOC/UNEP working group
- German Environmental Award 2007 of the German Environmental Foundation (DBU)
- Visiting Scientist at the Department of Mechanical Engineering of the Massachusetts Institute of Technology (MIT), USA
- Self-employed consultant engineer. Consulting work in the field of thermal sciences, air conditioning, and refrigeration
- Head of the R&D department of a manufacturer of mobile refrigeration and air conditioning systems
- Habilitation in the field of thermodynamics from Darmstadt University of Technology
- Doctoral research work and graduation (Dr.-Ing.) from Darmstadt University of Technology
- Mechanical engineering study and graduation (Dipl.-Ing.) from Darmstadt University of Technology

Funding
DFG, BMBF, BMWi, DBU, EU, Lower Saxony, Industry

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Mission Statement

Understanding thermal energy conversion, storage, transport and interaction from the molecular to the system level is the key for developing and improving energy efficient thermal systems.

Research

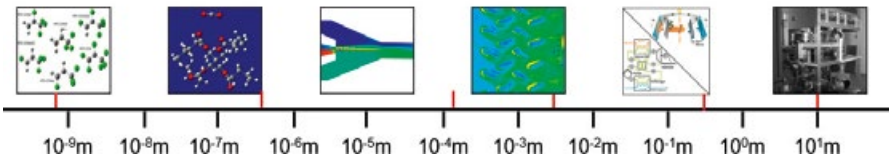
Molecular Thermodynamics (Priv.-Doz. Dr.-Ing. Gabriele Raabe): The research of the group "Molecular Thermodynamics" is generally aimed at a systematic development of both simulation algorithms and molecular models for a wide range of applications of molecular simulation studies. Current research topics of the group are "refrigerants", "pharmaceutical systems" or "molecules at interfaces". Thereby, molecular simulation methods are employed for the prediction of thermophysical properties, and for gaining a molecular level insight into systems to allow for an identification of relevant molecular interaction patterns. A further research focus of the group is the development of the underlying molecular models (force fields) for simulations studies.

Dynamic System Simulation (Dr.-Ing. Wilhelm Tegethoff): High performance analysis, optimization and control of thermal systems, such as automotive thermal management systems, fuel cell systems, power plants or industrial processes. Working on international standards for the interoperability of different languages and simulators.

Refrigeration Components and Systems (Dr.-Ing. Nicholas Lemke): Experimental investigation of refrigeration components (compressor, heat exchanger, expansion device, accumulator, ...) and systems (mobile HVAC, household, residential heat supply, ...). Design and layout of test rigs. Development of complex control strategies. System analysis (measurement and simulation).

Thermal Heat Engines with Waste Heat Recovery (ORC): The good old steam engine cycle recently experienced a revival by being used for waste heat recovery in industrial and internal combustion engine processes. New approaches are used, for example to determine thermophysical properties of new working fluids and improve energy efficiency of the transient behavior of the whole cycle.

Fuel Cells, Batteries, Photovoltaic and Thermoelectric Systems: Fluxes of matter, heat and electricity can occur parallel, interact, and affect together energy conversion and storage. This is investigated with a special focus on system integration, transient behavior, and energy efficiency.



Publications

- Tang, T.; Heinke, S.; Thüring, A.; Tegethoff, W.; Koehler, J.: Freeze start drive cycle simulation of a fuel cell powertrain with a two-phase stack model and exergy analysis for thermal management improvement. Applied Thermal Engineering, Volume 130, 5 February 2018, Pages 637–659
- Brandau, N.; Heinke, S.; Koehler, J.: Analysis of mass exchangers based on dimensionless numbers. International Journal of Heat and Mass Transfer, Volume 99, August 2016, Pages 261-267,
- Schulze, C.; Raabe, G.; Tegethoff, W.; Köhler, J.: Transient evaluation of a city bus air conditioning system with R-445A as drop-in – From the molecules to the system, International Journal of Thermal Sciences Volume 96, Pages 355-361, October 2015
- G. Raabe, Molecular Simulation Studies on Thermophysical Properties – with Application to Working Fluids, Springer Nature, ISBN 978-981-10-3545-6 (2017).
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- Junior, C.; Chen, G.; Köhler, J.: Modeling of a new recuperative thermoelectric cycle for a tumble dryer, International Journal of Heat and Mass Transfer, Volume 55, Issues 5-6, pp. 1536-1543, 2012

Institute of Energy and Process Systems Engineering

Prof. Dr.-Ing. Ulrike Krewer

- Head of Institute of Energy and Process Systems Engineering
- Director, Battery Labfactory Braunschweig
- Director, Energy Research Hub EFK-BS
- Steering committee member, Center of Pharmaceutical Engineering
- Board member, International Max Planck Research School for Advanced Methods in Process and Systems Engineering

Researcher's Career

- Full professor for Energy and Process Systems Engineering, TU Braunschweig
- Junior-Professor for Portable Energy Systems, University of Magdeburg
- Head of Otto Hahn research group, Max Planck Institute for Dynamics of Complex Technical Systems
- Senior Engineer, Energy Research Center, Samsung SDI, South Korea
- Ph.D. degree in Process and Systems Engineering, University of Magdeburg
- Research assistant, Max Planck Institute for Dynamics of Complex Technical Systems
- Studies of Chemical Engineering, University of Erlangen-Nuremberg

Funding

DFG, BMBF, BMWI, AIF, Lower Saxony, Industry

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Mission Statement

Shaping the way we will produce or store energy in the future is one of the main fields of work of the institute. We are also passionate about modelling and analysing complex systems, such as fuel cells, batteries, dynamic power plants and pharmaceutical production processes.

Research

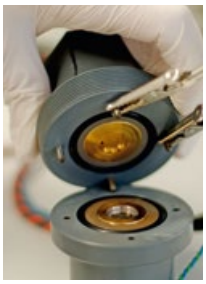
The Institute of Energy and Process Systems Engineering (InES) conducts research on various established electrochemical systems, such as Li-Ion batteries and DMFCs, as well as next generation cells, such as Zn-air batteries and alkaline fuel cells. Research also covers power-to-ammonia, combustion-based power plants and pharmaceutical processes.
Analysis and optimisation of all these systems is conducted using models on various scales, from surface models based on kinetic Monte Carlo to system models, system analysis tools as well as experiments.

Li-ion batteries: The main aim of research is on one hand optimisation of battery performance by investigating innovative materials, cell geometries and influences of the production process. On the other hand, the mechanisms of degradation in lithium-ion cells are examined in order to extend battery life times and to avoid unexpected thermal runaway of lithium-ion cells. InES is a member of the Battery LabFactory Braunschweig (BLB) which allows manufacturing of custom-made lithium-ion cells.

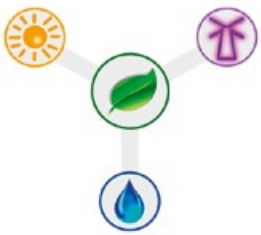
Next-generation batteries exhibit high theoretical energy densities. We investigate with our research the extent to which environment impacts the operation of metal-air cells. Our research work also includes the simulation of processes which occur inside Li-S and all-solid-state batteries with the aim of understanding and optimising the design and operation of electrodes and cells, including also experimental work to validate and calibrate the models applied.

Alkaline fuel cells/Microbial fuel cells: The use of non-acidic fuel cells opens up the possibility of using a large variety of Pt-free catalysts. Our research focuses on improving and optimising performance. Therefore, we investigate factors limiting performance, such as reaction kinetics, ionic conductivity of catalyst layers, diffusivity of reactants through the catalyst layer etc., by simulation and experiment.

Pharmaceutical Process Engineering:
We use process systems engineering tools (modelling, optimisation and control) to design novel, cost-effective, and intensified continuous processes to produce poorly soluble drugs. Innovative Uncertainty Analysis concepts help to identify critical parameters and to account for model-related variability within the process design phase. InES is member of the Center of Pharmaceutical Engineering (PVZ).



Battery



Power to X

Publications

- Schröder, D., Laue, V. and Krewer, U., Numerical simulation of gas-diffusion-electrodes with moving gas–liquid interface: A study on pulse-current operation and electrode flooding. Computers & Chemical Engineering, 84, pp.217-225, 2016.
- Torchio, M., Wolff, N.A., Raimondo, D.M., Magni, L., Krewer, U., Gopaluni, R.B., Paulson, J.A. and Braatz, R.D., 2015, July. Real-time model predictive control for the optimal charging of a lithium-ion battery. In American Control Conference (ACC), 2015 (pp. 4536-4541). IEEE.
- Jenssen, D., Berger, O., and Krewer, U., Anode flooding characteristics as design boundary for a hydrogen supply system for automotive polymer electrolyte membrane fuel cells. Journal of Power Sources, 298, pp 249-258, 2015.
- Khadke, P.S., Krewer, U., Performance Losses at H_2/O_2 Alkaline Membrane Fuel Cell, Electrochemistry Communications, Volume 51, pp. 117-120, 2015.
- Weinzierl, C., Krewer, U., Model based Analysis of Water Management in Alkaline Direct Methanol Fuel Cells, Journal of Power Sources, 268, pp. 911-921, 2014.

Institute of Automotive Engineering (IAE)

Prof. Dr. Ferit Küçükay

- Since 1997 Director of the Institute of Automotive Engineering (IAE), TU Braunschweig
- Since 2007 Board member of "Automotive Research Centre Niedersachsen" (NFF)

Researcher's Career

- 1985–1997 BMW: Manager "Chassis Advanced Development" and Managing Director "Powertrain, Transmission Development"
- 1986 "Habilitation" (post-doctoral lecturing qualification, mechanics), TU München
- 1981 Ph.D., mechanical enginneering, TU München
- 1977 Dipl-Ing., mechanical engineering, TU München

Funding

DFG, BMBF, BMWi, BMVI, BMBF, VDA, FAT, Industry

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Mission Statement

Based on the 3D Methodology, the research focuses on the synthesis and optimal design as well as the representative testing of drivetrains and propulsion systems, including operating strategies. Besides the acoustics and vibration behaviour of vehicles, the subjective comfort characteristics and driving safety are taken into account. Besides the acoustics and vibration behaviour of vehicles, the subjective comfort characteristics and driving safety are taken into account.

Research

Powertrain and transmission

- HEV, BEV, REEV, FCEV drivetrain concepts, synthesis and testing
- AT, DCT, CVT, MT transmission concepts and synthesis, testing
- Component concepts, testing
- Benchmarking (drivetrains, transmissions, components)

Drivetrain integration and calibration

- Automated drivetrain calibration (test bench supported and virtual) *
- Objectification: drive dynamics and comfort, including switching and starting quality *
- Prototype conception, construction and testing

Requirements and test management

- Systematization of the customer requirements, markets, legislators and manufacturers (focus on load spectra, drive functions)
- Generation of representative load collectives and loads as well as creation of representative test specifications

Operating and energy management

- Operating strategy (drive) with regard to comfort, safety, energy consumption
- Thermal management (complete vehicle, drivetrain units) with regard to comfort and energy consumption
- Measurement, simulation and optimization of vehicle efficiency (complete vehicle, units and components)

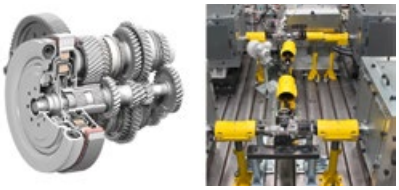
Vibrations and acoustics (full vehicle, modules, components)

- Overall vehicle acoustics, drivetrain vibrations, gear rattle
- Psychoacoustics and acoustic objectification
- NVH: causes and measures

Cross sectional competencies

- 3D Methodology, requirements engineering
- Objectification of subjective characteristics
- Measurement and simulation

3D Data Acquisition and Representative Testing



Transmission Concept Design and Testing on the Modular 4WD Drivetrain Test Rig

Publications and Patents

- Werra, M.; Sturm, A.; Küçükay, F.: Optimal and prototype dimensioning of 48V Po+P4 hybrid drivetrains, Automotive and Engine Technology 5:173-186, Springer, 2020
- Scheikh Elard, F.; Gürbüz, H.; Schulz, J.; Küçükay, F.: Einfluss von Torsionsspreizfedern auf die Effizienz und Dynamik von ölgekühlten Mehrscheibenkupplungen, Automobiltechnische Zeitschrift – ATZ, 06/2020
- Werra, M.; Ringleb, A.; Sieg, C.; Küçükay, F.: CO2-Analyse und Auslegung von 48-V-Hybridantrieben, ATZ extra: Hybridantriebe und 48-V-Bordnetz - Performance, Komfort, Sicherheit, Springer Vieweg Verlag, 2020
- Li, L.; Chen, H.; Küçükay, F.: Systematic Synthesis of Dedicated Hybrid Transmission, Automotive Innovation Volume 2 Issue 3, Springer Verlag, 2019
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Institute for Particle Technology (iPAT)

Prof. Dr.-Ing. Arno Kwade

- Managing Director of the Institute for Particle Technology (iPAT)
- Scientific Director, Battery LabFactory Braunschweig (BLB)
- Speaker of the Executive Board, Center of Pharmaceutical Engineering (PVZ)
- Division Head Fraunhofer Project Center for Energy Storage and Systems (ZESS)

Researcher's Career

- Member of National Academy of Science and Engineering (acatech)
- Vice Chairman Advisory Board Battery Research Germany (BMBF)
- Chairman of the ProcessNet and EFCE working parties "Comminution and classification"
- Full Professor for Mechanical Process Engineering/Particle Technology
- Managing Director, Betonwerke Emsland GmbH und Co. KG, Nordhorn
- General Manager, Schwedes+Schulze Schüttguttechnik, Braunschweig
- Research Associate, Institute of Mechanical Process Engineering, TU Braunschweig
- Study of Mechanical Engineering, TU Braunschweig and University of Waterloo, Canada

Funding

DFG, BMBF, AiF, State Lower Saxony, BMWi, EU, DBU, ZIM, industry

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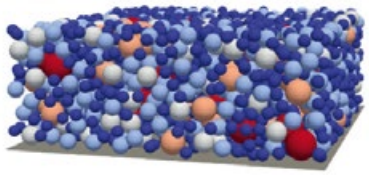
Mission Statement

The properties of particle based products depend not only on the particle properties in the formulation, but also essentially on the production process. Therefore, it is our endeavour to adapt particle properties as well as process and formulation parameters in such a way that such products can be produced very efficiently and sustainably as well as with innovative functions.

Research



Our research focuses on the generation, tailoring, formulation and processing of micro- and nanoparticles. We develop and investigate sustainable processes as well as formulations to produce innovative and customized products, especially battery electrodes and drug products. To accomplish this, our research focuses on the influence of material and process parameters on the disperse and structural properties, especially on micro scale, and how these properties determine the application properties. This enables us to determine process-structure-property relationships and to predict product properties. Furthermore, these mechanistic or empiric models are complemented by Computational Fluid Dynamics (CFD) and Discrete Element Method (DEM) simulations, so that we are able to describe particle based processes and predict product properties based on sophisticated model parameter calibration. Basically, our research covers the following three areas:

Battery Process Engineering: Based on a pilot line to produce lithium battery electrodes, we focus on the knowledge based process and battery development as well as the model development with the objective, to increase among others energy density, fast charging capability and cycle stability of lithium-ion, lithium-sulfur and solid state battery cells. Special attention lies on innovative sustainable, continuous and integrated processes for circular production of current and future battery electrodes as well as battery recycling.

Pharma- and Bioparticle Technology: We develop and investigate effective and individualized drug dosage forms and their production from milling of API down to final granulation, especially by continuous and micronized processes. Moreover, based on our mechanical process knowledge we intensify biotechnological processes. In both fields we use in-house developed experimental and numerical methods like nanoindentation and DEM-simulations.

Powder and Slurry Processes: With our basic, but also product orientated research on innovative size reduction processes for various materials, especially in the micro- and nanometer size range, we enable the production of fine products with distinct properties. Moreover, in the field of bulk solids handling we investigate the flow and storage behaviour of complex powders like fibres and the particle conditioning of metal powders and concrete for additive manufacturing.

Publications

- Kwade, A., Haselrieder, W., Leithoff, R., Modlinger, A., Dietrich, F., Droeder, K. (2018) Current status and challenges for automotive battery production technologies. Nature Energy 3, 290-300.
- Hanisch, C., Loellhoeffel, T., Diekmann, J., Markley, K. J., Haselrieder, W., Kwade, A. (2015) Recycling of lithium-ion batteries: A novel method to separate coating and foil of electrodes. Journal of Cleaner Production 108, 301-311
- Bitterlich, A., Laabs, C., Krautstrunk, I., Dengler, M., Juhnke, M., Grandeury, A., Bunjes, H., Kwade, A. (2015) Process parameter dependent growth phenomena of naproxen nanosuspension manufactured by wet media milling. European Journal of Pharmaceutics and Biopharmaceutics 92, 171-179
- Combarros, M., Feise, H. J., Zetzener, H., Kwade, A. (2014) Segregation of particulate solids: Experiments and DEM simulations. Particuology 12(1), 25-32
- Burmeister, C. F., Kwade, A. (2013) Process engineering with planetary ball mills. Chemical Society Reviews 42, 7660-7667.
- Kwade, A. (1999) Wet comminution in stirred media mills — research and its practical application. Powder Technology 105(1-3), 14-20.

Institute for Acoustics

Prof. Dr.-Ing.
Sabine Christine Langer

- Professor for Acoustics

Researcher's Career

- University Professor for Acoustics (W3), TU Braunschweig
- Deputy Professorship Mechanics, TU Braunschweig
- Deputy Professorship Solid Mechanics, Technical University Clausthal
- Assistent Professor (W1) Wave Propagation and Building Acoustics
- Dr.-Ing. TU Braunschweig
- Research Assistant, Institute of Applied Mechanics, TU Braunschweig
- Study of Civil Engineering, degree Dipl.-Ing. TU Braunschweig

Funding
BMBF, DFG, DAAD, industry

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Mission Statement

We devote our research to the science of sound & silence and are dedicated to acoustics for people. Paving the way for calm, smooth and smart designs – this is the aim of our institute. Novel technologies require the development and fundamental study of acoustic effects, reliable models and innovative approaches to create a quiet environment.

Research

Sound has various facets and manifold ways with which it appears to us in our daily life. Sound is the necessary basis for speech-based communication. In the form of music, sound can generate various emotions. Conversely, unwanted sound (noise) can be inconvenient, disturbing and even harmful. This appears more often in societies with an increased degree of technology use and urbanization.

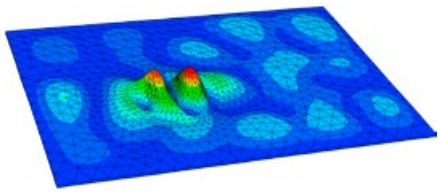
The field of Technical Acoustics in engineering deals especially with questions that arise from the necessity of noise mitigation. Which solutions appear to be silent? How can low-noise products be accomplished at the stage of product design? Which noise reduction measures are possible, desirable?

The Institute for Acoustics aims for scientific proven answers to these questions within three InALABs : Acoustic Engineering, Computational Acoustics, Models & Systems.

In the **InALAB Acoustic Engineering** we pursue the intrinsic acoustic design in early product development phases. One of our research focuses is the integration of acoustic functions into new products and systems. The main aim is a low-noise design with noise-reduction measures such as smart structural modifications and innovative passive damping measures. By means of acoustic models, efficient simulations and experiments, an optimal acoustic design can be achieved.

In the **InALAB Computational Acoustics** we investigate wave-resolving numerical methods for vibroacoustic models and develop our in-house research code elPaSo (ELementary PArallel SOlver). Providing robust solutions of coupled air- and structure-borne sound domains is our main purpose. Key topics are the quantification of sensitivities, model order reduction techniques, hybrid methods and a sustainable code development.

In the **InALab Models & Systems** we provide descriptions for acoustic systems by means of adequate and robust modeling techniques. Herein, one focus is the application of machine-learning algorithms to infer models from observed data. Another focus in the context of acoustic system modeling is the field of noise assessment, as it allows for a model corroboration and provides indication for improving systems with the goal of a quieter future.



Publications

- S. Rothe, C. Blech, H. Watschke, T. Vietor, S. C. Langer: https://www.mdpi.com/1996-1944/14/1/168, Material Parameter Identification for Acoustic Simulation of Additively Manufactured Structures. Materials, Volume 14(1), 168, 2021.
- S. Kuschmitz, T. P. Ring, H. Watschke, S. C. Langer, T. Vietor: https://www.mdpi.com/1996-1944/14/7/1747, Additive Manufacturing of Porous Sound Absorbers – A Machine-Learning Approach. Materials, Volume 14(1747), 2021.
- G. Felix Greco, L. Bertsch, T.P. Ring, S.C. Langer: https://doi.org/10.1007/s13272-021-00515-9, Sound quality assessment of a medium-range aircraft with enhanced fan-noise shielding design. CEAS Aeronaut Journal, 2021.
- C. Blech, C. K. Appel, R. Ewert, J. W. Delfs, S. C. Langer: https://doi.org/10.1016/j.jsv.2019.114960, Numerical prediction of passenger cabin noise due to jet noise by an ultra-high-bypass ratio engine. Journal of Sound and Vibration, Volume 464 (1), 2020.
- T. P. Ring, S.C. Langer: https://www.mdpi.com/1996-1944/12/20/3397/, Design, Experimental and Numerical Characterization of 3D-Printed Porous Absorbers. Materials, Volume 12(20), 2019.

Institute of Dynamics and Vibrations

Prof. Dr.-Ing. Georg-Peter Ostermeyer

- Steering board member of Eurobrake, International Friction Forum, Celle Drilling
- Advisory board member of Asia Brake, SAE Brake Colloqium
- Organizer of German-Polish Workshop on Dynamical Systems

Researcher's Career

- Full Professor for Dynamics and Vibrations, TU Braunschweig
- Speaker of SFB 605
- Full Professor for Mechanics, Interfacial and Friction Physics, TU Berlin
- Research engineer in vehicle technology, Volkswagen AG, Wolfsburg
- Assistant Professor at TU Braunschweig
- Habilitation, venia legendi for Mechanics (TU Braunschweig)
- PhD-thesis on unilateral constraints in Mechanics (Dr.-Ing.,TU Braunschweig)
- First state examination for teaching in Physics and Mathematics (TU Braunschweig)
- Diploma in Mathematics (TU Berlin)

Funding

DFG, BMWi, DAAD, Lower Saxony, Volkswagen Foundation, Industry

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Mission Statement

Our mission is problem-oriented solving of dynamical problems in mechanical and electromechanical systems by identification, modeling, simulation, measurement and control. Our motivation in research is the generation of transdisciplinary system competence. The institute has a strong background in tribology, measurement and innovative simulation techniques.

Research

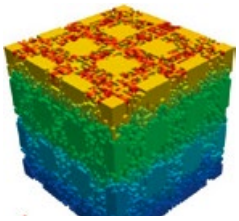
Modeling and Simulation: For a description of mechanical, electronic, electromechanical systems (multi physics) classical methods (Lagrange-Hamilton method) and discrete methods (FEM, BEM, MKS, CA, DEM) are used and developed. With tailored models and appropriate simulation techniques, we generate solutions to optimize dynamical systems.

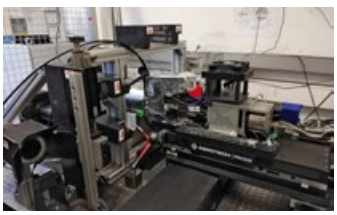
Friction, Wear and Emissions: Friction is a highly dynamic process, which is effected by a wide range of influencing factors. We develop new insights into the elementary mechanisms of friction and wear towards the better description and control of the dissipation processes between two bodies in frictional contact and the resulting wear debris and emission dynamics. With respect to its significance for friction-induced vibrations, one major application is the technical brake system and the investigation of NVH-phenomena.

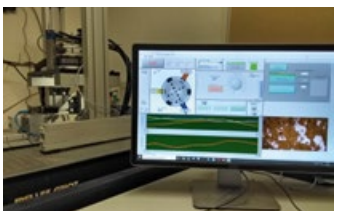
Lubricated Contacts (PD Dr.-Ing. M. Müller): The interaction of flow and structural dynamics are investigated with novel modeling techniques and measurements. Special focus is on systems under starved lubrication and the transition from boundary lubrication to mixed lubrication.

Vibrations and NVH: Properties of dynamical systems such as mode shapes, frequency spectra, sound pressure level or power density spectra, are analyzed by measurement. By simulation with appropriate models and sensitivity studies vibrations and acoustics could be controlled at an early stage. With respect to its significance for friction induced vibrations, one major application is the technical brake system.

Drill String and Reservoir Dynamics: We consider and investigate the complex matter of drill string and reservoir dynamics using multiscale techniques as well as adaptive problem-specific model complexity with a flexible, modular model setup, even for Real-Time applications.







Publications

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- Merlis, J.H., Ostermeyer, G.-P.: Simulating and Evaluating Synchronized Vibrations in Macroscopic Tribological Contacts, TECHNISCHE MECHANIK, Tech. Mech., Vol. 39, Is. 3, (2019), 282–297
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- Ostermeyer, G.-P.: Eigenschaften der Reibpaarungen im Bremsprozess, In B.Bremer, K.H.Bill, Hrsg. Bremsenhandbuch S.593–610, Springer Vieweg 2017
- Ostermeyer, G.-P.: On tangential friction induced vibrations in brake systems. SAE Int. J. Passeng. Cars – Mech.Syst. 1(1): 1251–1257, 2008
- Ostermeyer, G.-P.: On the dynamics of the friction coefficient, 280. WE-Haereus Seminar, Ilmenau 2002, Wear 254 (2003) 852–858

Institute of Fluid Mechanics

Prof. Dr.-Ing. Rolf Radespiel

- CEO, Aeronautics Research Centre, Niedersachsen
- Co-Coordinator, DFG Cluster of Excellence "Sustainable and Energy-Efficient Aviation"
- Co-Coordinator, DFG Collaborative Research Centre SFB TRR-40 "Rocket Propulsion"
- President OSTIV

Researcher's Career

- Full Professor for Fluid Mechanics, TU Braunschweig
- Head of High-Speed Aircraft Branch, Institute of Aerodynamics and Flow Technologies, DLR
- Technology Engineer, Daimler-Benz Aerospace Airbus GmbH
- Head Aerothermodynamics Branch, Institute of Design Aerodynamics, DLR
- Visiting Scientist, NASA Langley Research Center
- Research Scientist, Institute of Design Aerodynamics, DLR
- Doctor of Engineering, TU Braunschweig
- Studies of Mechanical Engineering, TU Braunschweig

Funding
DFG, BMBF, BMWi, State Lower Saxony, EU, DLR, Industry

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Mission Statement

Fluid mechanical processes govern the performance of industrial goods, noise emissions, power consumption and energy conversion. Our work combines fundamental research in fluid mechanics theory, experiments and numerical simulation with advanced application areas in aerospace, automotive and energy technologies.

Research

Aerodynamics of Aircraft: Flow simulation of complex aerodynamic processes is the key to improved design. Our research addresses new high-fidelity physical models of turbulence and boundary-layer transition to enhance future flow simulations of aircraft and space vehicles. We aim at improving performance parameters of aircraft by providing new design options to enhance lift and to reduce drag.

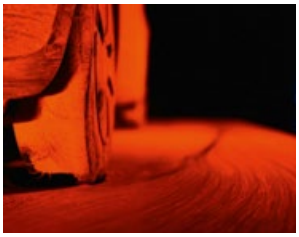
Measurement and Manipulation of Flows: We develop and utilize new methods for active and passive control of flows. The goals are to effectively control turbulent separations for high lift or low drag. The research group focuses on generating high-quality experimental datasets for airfoils, aircraft components, automotive geometries and generic configurations.

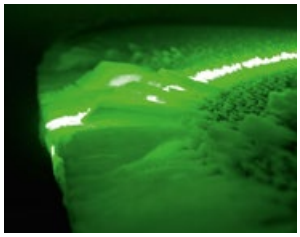
Physics of Laminar Wing and Fuselage: The Junior Research Group of EXC SE^{2}A focuses on radical concepts of hybrid laminar flow control by suction for future transport aircraft.

Flow Physics of Load Reduction: The Junior Research Group of EXC SE^{2}A develops active control techniques to alleviate dynamic loads on transport aircraft wings caused by gusts and unsteady flight maneuvers.

Multiphase Flows and Icing: Multiphase flows and icing are relevant for aircraft, automotive and wind turbine performance. Our research group operates a unique wind tunnel facility where dynamical interactions of flow, super-cooled droplets and ice crystals with technical surfaces can be measured. New numerical simulations reveal physical insight into complex processes.

Flow Modelling and Control: Closed-loop flow control has great potential in providing future flow processes with adaptivity, robustness and optimum performance. Therefore we develop tools for flow state estimation and suited algorithms for closed-loop flow control applications. We address key challenges of turbulence control from the inherent nonlinearity of actuation mechanism to noise in experiments.





Publications

- R. Radespiel, M. Burnazzi, M. Casper, P. Scholz: Active flow control for high lift with steady blowing, The Aeronautical Journal, Vol. 120, pp. 171-200, 2016.
- R. Cecora, R. Radespiel, B. Eisfeld, A. Probst: Differential Reynolds-Stress Modeling for Aeronautics, AIAA Journal, Vol. 53, pp.739-755, 2015.
- X. Gong, S. Bansmer: 3-D ice shape measurements using mid-infrared laser scanning, Opt. Express, vol. 23, pp. 4908-4926, 2015
- F. Munoz, D. Heitmann, R. Radespiel: Instability Modes in Boundary Layers of an Inclined Cone at Mach 6. Journal of Spacecraft and Rockets, Vol. 51, pp. 442-454, 2014.

Institute for Materials

Prof. Dr. Joachim Rösler

Researcher's Career

- Since 1996: Full Professor for Materials, Technical University Braunschweig
- 1991-1996: Project Leader, Group Leader, Department Head, Asea Brown Boveri AG, Baden, Switzerland
- 1990-1991: Project Leader, Max-Planck-Institute for Metals Research, Stuttgart
- 1988-1990: Assistant Research Engineer, Materials Department, University of California, Santa Barbara, USA
- PhD at Max-Planck-Institute for Metals Research, Stuttgart
- Study of Material Science/ Metal Science at Friedrich-Alexander University Erlangen-Nürnberg/ University Stuttgart

Funding

DFG, BMWi, EU, State of Lower Saxony, Industry

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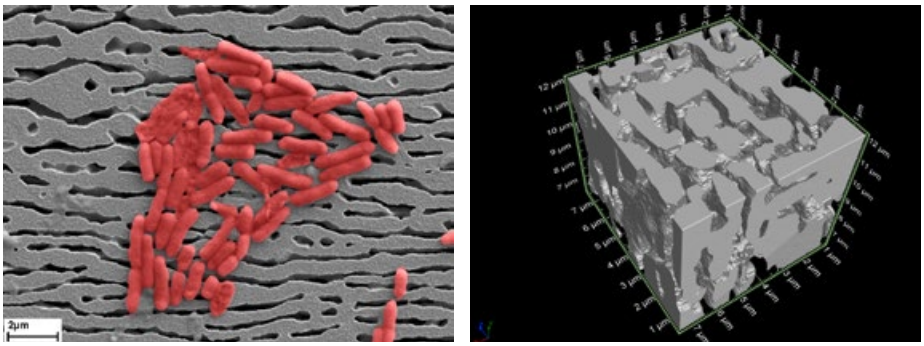
Mission Statement

The focus of our research is on metallic materials. Our goal is to develop high temperature materials with unprecedented properties, investigate new materials using modern methods and understand failure and fracture of modern engineering materials.

Research

Nanoporous Superalloy Membranes and Porous Materials: Based on the well-known rafting process in superalloys we invented a technique to produce metallic membranes with extremely fine and homogenous porosity on the nanoscale. Current research focuses on manufacturing processes using single crystalline and polycrystalline superalloys, development of superalloys tailored for this application, understanding the mechanical behavior of these novel porous materials. Other porous metallic materials, such as porous aluminum, are investigated with respect to their microstructure-property relationship and tailored for functional applications such as noise attenuation.



Examples of nanoporous superalloy membranes. The ability to filtrate bacteria (here: pseudomonas) is shown on the left. The 3D-microstructure obtained by FIB-tomography of another membrane material is shown on the right.

High Temperature and High Performance Materials: Superalloys are developed for high temperature applications, e.g. turbine discs. Furthermore, we have invented Co-Re alloys for applications beyond the temperature capability of superalloys. Due to complete miscibility of Co and Re and a steadily increasing melting temperature with Re-addition, the character of these alloys can be tuned almost at will between that of conventional Co-alloys and high melting point refractory metals. Currently investigated alloys exhibit melting temperatures in excess of 1,500°C. Alloy development concepts are derived from in-depth studies of microstructure-property relationships. Furthermore, titanium alloys are investigated and developed, especially with a focus on biomedical applications.

Thermal Barrier Coatings: The micromechanics and failure mechanisms of thermal barrier coatings are studied with particular emphasis on the role of creep processes. Finite element simulation is used to analyze the stress state in the coating system and model crack-paths during thermo-mechanical loading. Furthermore, novel thermal barrier coating systems are developed for applications other than in gas turbines, e.g. rocket engines.

Publications

- T. Fiedler, J. Rösler and M. Bäker, A New Metallic Thermal Barrier Coating System for Rocket Engines: Failure Mechanisms and Design Guidelines", J Therm Spray Tech, 28, 1402 (2019).
- J. Rösler and C. Voelter, Nanoporous Superalloy Membranes: A Review, Adv. Eng. Mater., 20, 1701011 (2018).
- J. Tychsen, N. Lippitz and J. Rösler, Modification of Porous Aluminum by Cold Rolling for Low-Noise Trailing Edge Applications, Metals, 8, 598 (2018).
- J. Rösler, D. Mukherji, T. Baranski, Co-Re-Based Alloys: A New Class of High Temperature Materials?, Adv. Eng. Mater., 9, 876 (2007).
- J. Rösler, H. Harders, M. Bäker, Mechanical Behaviour of Engineering Materials, Springer Verlag (2007).

Institute of Mechanics and Adaptronics

Prof. Dr.-Ing. Michael Sinapius

- DFG Research Group 2021: “Acting principles of nano-scaled matrix additives for composite structures”
- DFG Research Group 3022: “Ultrasonic Monitoring of Fibre Metal Laminates Using Integrated Sensors”

Researcher’s Career

- Full Professor for Adaptive Systems, TU Braunschweig
- Member of the Directorate of the Institute of Composite Structures and Adaptive Systems, DLR
- Full Professor for Adaptive Lightweight Design, University of Magdeburg
- Deputy Director of the Institute of Composite Structures and Adaptive Systems, DLR
- Visiting Scientist, NASA Langley Research Center
- Research Scientist, Institute of Aeroelasticity, DLR
- Doctor of Engineering, RWTH Aachen
- Studies of Mechanical Engineering, University of Kassel

Funding

DFG, BMBF, EU, HGF, Industry

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Mission Statement

Our vision is a new school of lightweight construction through

- structure compliant integration of functions from material through to component level
- adaptivity on environmental conditions and alternating requirements
- self-regulating production processes
- simultaneously securing robustness and fault tolerance.

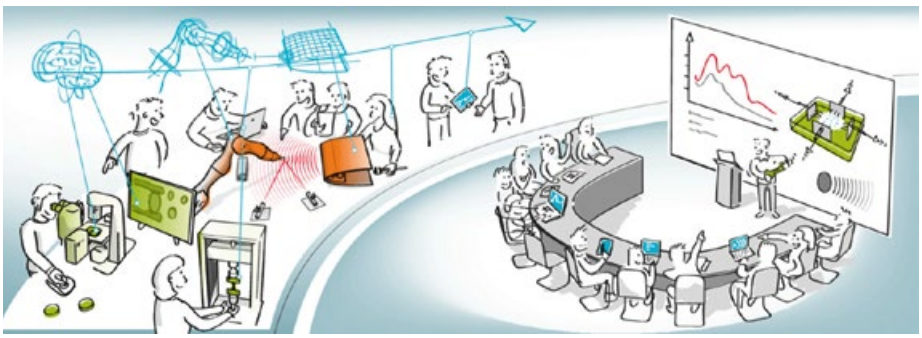
Research

Adaptronics is an interdisciplinary science of engineering. This specific field deals with the research and development of adaptive components and constructions in mechanical engineering. Adaptronics includes an integration of new functions in carrying components through the combination of conventional construction materials with active material systems.

The aim of Adaptronics, also called smart structures technology, is active influence of the elasto-mechanical behavior of technical structures in mechanical engineering. Adaptronics solutions are characterized by special measures on function integration. This means they have at their disposal a structure compliant integration of sensory-actuator-like characteristics and/or components. Targets of Adaptronics are in particular:

- vibration reduction,
- noise reduction,
- shape control and
- structural health monitoring.

We are currently focusing our research on four fields:
4D-printing Lab: Combination of Automated fibre placement (AFP) and 3D printing; Sensor – actuator printing; 4D Printing;
Smart Composite Design Lab: morphing structures; Pressure-Actuated Cellular Structures;
Smart Composite Manufacturing Lab: Sensor integrated adhesive Bondlines; Fibre Reinforced Nanocomposites; Cure Monitoring
Structural Dynamics Lab: Structural Health Monitoring; ANN based Condition Monitoring; Sensor Integration
Adaptive Machine Elements Lab: Shape variable foil bearings; ANN based condition monitoring; Adaptive/ active friction control
Ice Protection Lab: Ice detection; Thermo-mechanical de-icing; Ice adhesion



Publications

- Sinapius, M.: Adaptronics – Smart Structures and Materials, Springer, ISBN 978-3-662-61399-3 (2020)
- Sinapius, M. Adaptronik – Prinzipe – Funktionswerkstoffe – Funktionselemente - Zielfelder mit Forschungsbeispielen, Springer, ISBN 978-3-662-55884-3 (2018)
- Lammering, R., Gabbert, U., Sinapius, M., Schuster, T., Wierach, P. (Eds.): Lamb-Wave Based Structural Health Monitoring in Polymer Composites, Springer, ISBN 978-3-319-49714-3
- Wiedemann, M., Sinapius, M. (Eds.): Adaptive, Tolerant and Efficient Composite Structures. ResearchTopics in Aerospace. Springer. ISBN 978-3-642-29189-0) (2012)
- more than 200 scientific papers in peer-reviewed Journals

Institute for Biochemical Engineering (ibvt)

Prof. Dr.-Ing. Antje C. Spiess

Researcher's Career

- Full Professor for Biochemical Engineering, TU Braunschweig
- Full Professor for Enzyme Process Technology, RWTH Aachen University
- Habilitation, Faculty of Mechanical Engineering, RWTH Aachen University
- Scientific Assistant at the Chair for Biochemical Engineering, RWTH Aachen University
- Ph.D. at Technical University Hamburg-Harburg, Department of Chemical Engineering
- Studies of Chemical Engineering, Technical University Hamburg-Harburg

Funding

DFG, NRW, MWK

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Mission Statement

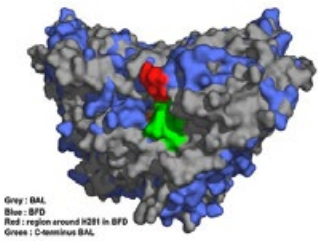
We apply and develop bioreactors, classical and systems biotechnological analytics, and modelling methods in a structured way using model-based experimental analysis in order to rationally develop tailored biocatalysts and sustainable integrated bioprocesses.

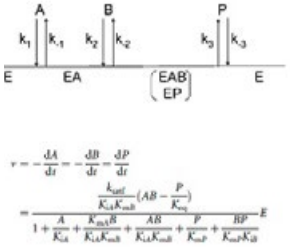
Research

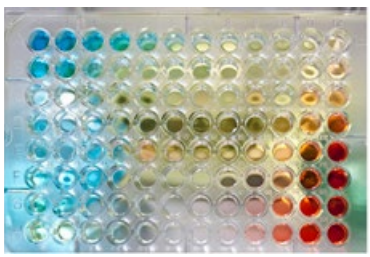
Analytics for bioprocesses: We apply, develop and validate analytics for the monitoring and control of bioprocesses, either spectrometric (photometry, CLSM, DLR) or chromatographic methods (GPC-MALLS, HPAED-PAD), in order to supply modelling with reliable quantitative data (e.g. Grosch et al. 2016). In particular, we have been successful in quantifying mass transport in enzyme immobilizates and in demonstrating that reaction and transport processes are orthogonal (e.g. Zavrel et al. 2010).

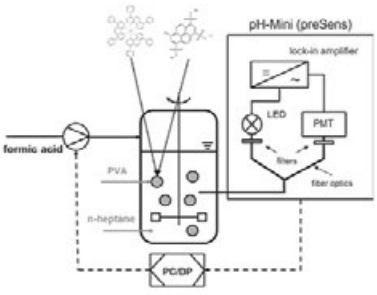
Model-based experimental analysis: We use a structured iterative approach to generation and validation of mathematical models for various kinds of bioprocesses, including advanced methods for analysis of identifiability, for experimental design (DOX and OED), as well as for parameter estimation (e.g. Zavrel et al. 2010). Mechanistic kinetic models attained through this rigorous approach can be applied both on a microscale to relate catalyst structure and function and on a macroscale to predict bioreactor performance (e.g. Begemann and Spiess 2015).

Bioreactor design and control: We develop new reactor concepts and control strategies for intensified bioprocesses, also using non-conventional, non-aqueous reaction media (see Engel et al. 2010). Besides reduced process times and simplified downstream-processing, new reaction trajectories can be further exploited (see Wiese et al. 2013).









Publications

- Grosch, J.-H., Sieben, M., Lattermann, C., Kauffmann, K., Büchs, J., & Spieß, A. C. (2016). Enzyme activity deviates due to spatial and temporal temperature profiles in commercial microtiter plate readers. Biotechnology Journal, 11(4), 519-529. http://doi.org/10.1002/biot.201500422
- Begemann, J., & Spiess, A. C. (2015). Dual lifetime referencing enables pH-control for oxidoreductions in hydrogel-stabilized biphasic reaction systems. Biotechnology Journal, 10(11), 1822-1829. http://doi.org/10.1002/biot.201500198
- Wiese, S., Spiess, A. C., & Richtering, W. (2013). Microgel-stabilized smart emulsions for biocatalysis. Angewandte Chemie - International Edition, 52(2), 576-579. http://doi.org/10.1002/anie.201206931
- Engel, P., Mladenov, R., Wulfhorst, H., Jäger, G., & Spiess, A. C. (2010). Point by point analysis: how ionic liquid affects the enzymatic hydrolysis of native and modified cellulose. Green Chemistry, 12(11), 1959-1966. http://doi.org/10.1039/c0gc00135j
- Zavrel, M., Michalik, C., Schwendt, T., Schmidt, T., Ansorge-Schumacher, M., Janzen, C., ... Spiess, A. C. (2010). Systematic determination of intrinsic reaction parameters in enzyme immobilizates. Chemical Engineering Science, 65(8), 2491-2499. http://doi.org/10.1016/j.ces.2009.12.026

Institute for Engineering Design

Prof. Dr.-Ing. Thomas Vietor

Researcher's Career

- Leader of the research area "Design and Simulation" in the Forschungscampus "Open Hybrid Lab Factory" OHLF e.V.
- Leader of the research area "Flexible Vehicle Concepts" at NFF
- Leader of the Institute for Engineering Design
- University (Full) Professor for Engineering Design at TU Braunschweig
- Leader of a vehicle concepts department and different positions in Vehicle Development in the automotive industry
- Dr.-Ing at the University of Siegen
- Research Assistant at the Institute of Mechanics and Control Engineering, University of Siegen
- Student of mechanical engineering at University of Siegen. Degree: Dipl.-Ing.

Funding
AiF, BMBF, BMWI, DAAD, DFG, EU, industry, Lower Saxony

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Mission Statement

We develop approaches, methods and computer-aided tools ranging from elementary approaches to transferring methods into industry in order to support the process from an idea to a product. Knowledge of various technical systems coupled with interdisciplinary cooperation at the Automotive Research Centre Niedersachsen (NFF), the Battery LabFactory Braunschweig (BLB) and the Open Hybrid LabFactory e.V. (OHLF e.V.) serve to initiate innovative approaches.

Research

Optimization: Novel methods for the structural optimization of composite and hybrid parts are developed to enable a well-founded component design in early development phases. The research focuses mainly on topology and shape optimization approaches with a strong link to industrial applications. In addition to optimization algorithms, specific manufacturing constraints are a core topic.

Additive manufacturing: The research focus is on developing methods and tools in order to ensure a goal-oriented utilization of new design potentials provided by additive manufacturing in general and of multi-material designs in particular. In addition to such methods and tools for supporting the product development in conceptual, embodiment and detail design, new design principles are investigated in experiments.

Design Methodology & Systems Engineering: The research focus is on the development of methods and tools for product planning and design, including technical and organizational constraints. In particular, approaches of (model-based) systems engineering are developed, which enable a model-based description of the system to be developed in the different phases of the development process and from different views (requirements, variance, structure, etc.). For this purpose, standardised modelling languages are adapted and extended in a solution-oriented way to relate the product information/models of the different disciplines involved. In addition to these methods and tools, strategies for the implementation of these and other new development methods in existing development organizations are being researched.

Vehicle Concepts: The research focus is on the integration of alternative vehicle systems into the vehicle package, the development and evaluation of adapted vehicle concepts for current and future mobility concepts as well as the manufacturing of vehicle structures.

Energy storage systems: The research focus is on the developing of strategies, methods and tools for supporting the development process of energy storage systems as well as their transfer to practical applications. In particular, the description and modeling of holistic systems (systems engineering) and their use across all life phases (cycle management) focused upon.

Publications

- Falkenberg, P.; Türck, E.; Vietor, T. (2018): Cost and Weight Optimization of Hybrid Parts Using a Multi-material Topology Optimization Approach. In: Schumacher, A., Vietor, T., Fiebig, S., Bletzinger K.-U., Maute, K. (Ed.): Advances in Structural and Multidisciplinary Optimization. Proceedings of the 12th World Congress of Structural and Multidisciplinary Optimization (WCSMO12). Springer International Publishing, ISBN 978-3-319-67988-4, pp. 1418–1424.
- Watschke, H.; Hilbig, K.; Vietor, T. (2019): Design and Characterization of Electrically Conductive Structures Additively Manufactured by Material Extrusion. In: Applied Sciences 9 (4), p. 779. doi: 10.3390/app9040779.
- Huth, T., Inkermann, D. and Vietor, T. (2018), "Model-based Process Engineering – An approach to integrated product system and process modelling", paper presented at EMEASEC 2018 / TdSE 2018, 5.–7.11.2018, Berlin.
- Bavendiek, A.-K., Huth, T., Inkermann, D., Paulsen, H., Vietor, T. and Kauffeld, S. (2018), "Collaborative Design: Linking Methods, Communication Tools and Compentencies to Processes", in Marjanović, D., Štorga, M., Škec, S., Bojčetić, N. and Pavković, N. (Eds.), Proceedings of the DESIGN 2018 15th International Design Conference, May, 21-24, 2018, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia; The Design Society, Glasgow, UK, pp. 149–160.
- Uerlich, R.; Ambikakumari, K.; Bokelmann, T.; Vietor, T. (2019): Finite element analysis considering packaging efficiency of innovative battery pack designs, International Journal of Crashworthiness. https://doi.org/10.1080/13588265.2019.1632545.

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Institute for Geophysics and extraterrestrial Physics

Prof. Dr. Jürgen Blum

Researcher's Career

Education:

- Study of physics, Gießen University (1981–1983)
- Study of physics and astronomy, Heidelberg University (1983–1987)
- Diploma in physics (1987), Heidelberg University
- Dissertation in physics (Dr. rer. nat.) (1990), Heidelberg University
- Habilitation (1999), Faculty for Physics and Astronomy, Jena University

Occupations:

- Max Planck Institute for Nuclear Physics and TU Munich (1987–1992)
- Max Planck Research Group "Dust in Star-Forming Regions" Jena (1992–1996)
- Astrophysical Institute, University of Jena (1997–1999)
- Department of Astronomy, University of Florida and Naval Research Laboratory, Washington, D.C. (1999–2000)
- Astrophysical Institute, University of Jena (2000–2003)
- Institute for Geophysics und extraterrestrial Physics, TU Braunschweig (since 2003)

Funding

DFG, BMWi, BMBF, ESA

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Mission Statement

State-of-the-art laboratory astrophysics on cosmic dust, planet formation and small bodies in the Solar System

Research

Dust particles are ubiquitous in space and are, due to their large surface area per unit mass, important ingredients for the energy transport and chemistry in space as well as for the formation of planets. Our focus lies on the physical interactions of these particles, e.g., by mutual collisions, with the ambient rarefied gas, or with radiation. To investigate these processes, we perform experiments in the laboratory and under microgravity conditions on all available platforms, from the drop tower to the International Space Station. In our own laboratory, we operate three mini-drop-towers to conduct zero-gravity experiments on low-velocity collisions under space conditions (vacuum, low temperatures) and an electromagnetic linear stage. Moreover, we also have a powder gun for high-velocity impacts up to about 1 km/s. Besides many small experimental setups for the study of dust clouds or planetary regolith, we also run the international Comet Physics Laboratory (CoPhyLab) in which we study the physical processes above and beneath the surface of a comet nucleus when it approaches the Sun. All our experimental activities are accompanied by theoretical or numerical studies of the governing processes.

Laboratory astrophysics: Simulation of cosmic processes in the laboratory; dust agglomeration; fabrication and characterization of protoplanetary and cometary analog materials; nano and micro particles; ice experiments; collisional processes.

Cosmic dust: morphological, optical, electrostatic, aerodynamic, mechanical and collisional properties of cosmic dust; characterization of cosmic dust by in-situ measurements; dust collection in the upper atmosphere (stratosphere and mesosphere); collection of cosmic dust in space experiments.

Formation of planetary systems: Initial phase of dust growth in young planetary systems; properties of protoplanetary dust aggregates; collisional evolution of dust in young planetary systems; properties of macroscopic bodies in young planetary systems; physical properties of planetesimals and cometesimals; protoplanetary and debris disks.

Minor bodies in the solar system: Experimental simulation of regolith formation; thermal, optical and mechanical properties of regolith; density and porosity of primitive bodies in the solar system; collisions among ring particles and structure formation in Saturn's rings; cometary physics.

Low-gravity experiments: Experiments on dust aggregation, regolith formation, Brownian motion and rotation, granular media, photophoresis and thermophoresis; particle traps under microgravity conditions; utilization of drop tower, parabolic flights, suborbital flights, sounding rockets, and space shuttle/ISS; construction of an autonomous model aircraft for parabolic flights and lab-based mini drop towers and guided rails.

Publications

- J. Blum, G. Wurm, The Growth Mechanisms of Macroscopic Bodies in Protoplanetary Disks, Annual Review of Astronomy and Astrophysics 46, 21-56, 2008.
- B. Gundlach, J. Blum, A new method to determine the grain size of planetary regolith, Icarus 223, 479-492, 2013.
- B. Gundlach, J. Blum, The stickiness of micrometer-sized water-ice particles, Astrophysical Journal 798:34, 2015.
- J. Blum, B. Gundlach, M. Krause, M. Fulle, A. Johansen, J. Agarwal, I. von Borstel, X. Shi, X. Hu, M. S. Bentley, F. Capaccioni, L. Colangeli, V. Della Corte, N. Fougère, S. F. Green, S. Ivanovski, T. Mannel, S. Merouane, A. Migliorini, A. Rotundi, R. Schmied, C. Snodgrass, Evidence for the formation of comet 67P/Churyumov-Gerasimenko through gravitational instability of a pebble cloud, MNRAS 469, S755 S773, 2017.
- B. Gundlach, M. Fulle, J. Blum, On the activity of comets: understanding the gas and dust emission from comet 67/Churyumov-Gerasimenko's south-pole region during perihelion, MNRAS 493, 3690-3715, 2020.

Institute for Theoretical Physics

Prof. Dr. Wolfram Brenig

- Former Dean of the Fakultät für Elektrotechnik, Informationstechnik, Physik
- TUBS-Coordinator of the trilocal NTH Graduate School “Contacts in Nano Systems”
- Manging Director of the TUBS Institute of Theoretical Physics (rotational 2-year terms)

Researcher’s Career

- Full Professor for Theoretical Physics, Technische Universität Braunschweig
- Professor for Theoretical Physics (stand in), RWTH Aachen
- Professor for Theoretical Physics (stand in), University Bayreuth
- Habilitation in Theoretical Physics, University of Cologne
- Postdoc, University of California, Santa Barbara, USA
- Postdoc, Max-Planck-Institute for Solid State Research Stuttgart
- Dr. rer. nat., Max-Planck-Institute for Solid State Research and Technical University Munich
- Study of Physics (Diploma), Technical University Munich

Funding
DFG, NSF, EU, State Lower Saxony

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Mission Statement

Cutting-edge research on emergent properties, novel orders, exotic excitations, and collective dynamics, as part of the global quest for quantum many body phenomena in condensed matter and strongly correlated electron systems.

Research

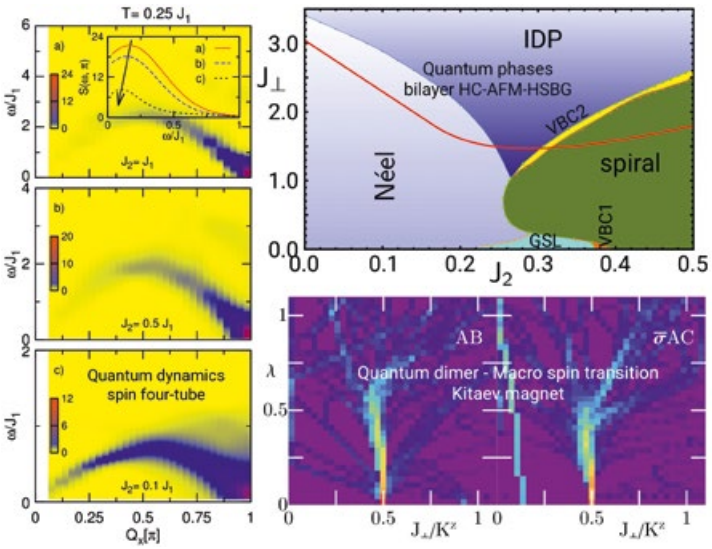
Quantum spin systems: Highly entangled magnetic matter, with and without magnetic frustration, focusing on emergent topological phases, exotic quantum orders, spin liquids, fractional elementary excitations, quantum criticality, field-induced collective states, disorder and carrier doping.

Transport properties of quantum magnets, i.e. spin- and heat-transport, focusing on intrinsic dissipation and thermalization, off-diagonal response functions, the role of defects and phonons, as well as manipulation by external electromagnetic fields.

Development & application of new computational methods: High-order series expansions for quantum-magnets using CUT-algorithms, quantum typicality and exact diagonalization calculations of transport coefficients in quantum magnets, quantum Monte-Carlo studies of static and dynamic properties of clean and disordered spin systems.

Correlated electron materials: Low-dimensional systems, transition-metal compounds, matter with strong spin-orbit coupling, high-temperature superconductors, as well as molecular and organic magnets.

Theory of spectroscopies: Optical, Raman, electronic, neutron scattering and magnetic resonance.



Publications

- Richard Hentrich, Anja U. B. Wolter, Xenophon Zotos, Wolfram Brenig, Domenic Nowak, Anna Isaeva, Thomas Doert, Arnab Banerjee, Paula Lampen-Kelley, David G. Mandrus, Stephen E. Nagler, Jennifer Sears, Young-June Kim, Bernd Büchner, Christian Hess, Large field-induced gap of Kitaev-Heisenberg paramagnons in α-RuCl3, Phys. Rev. Lett. 120, 117204 (2018).
- R. Steinigeweg, J. Herbrych, X. Zotos, and W. Brenig, Heat conductivity of the Heisenberg spin-1/2 ladder: From weak to strong breaking of integrability, Phys. Rev. Lett. 116, 017202 (2016).
- R. Steinigeweg, J. Gemmer, and W. Brenig, Spin-Current Autocorrelations from Single Pure-State Propagation, Phys. Rev. Lett. 112, 120601 (2014).
- W. Brenig and A. L. Chernyshev, Highly Dispersive Scattering from Defects in Noncollinear Magnets, Phys. Rev. Lett. 110, 157203 (2013).
- R. Steinigeweg and W. Brenig, Spin transport in the XXZ chain at finite temperature and momentum, Phys. Rev. Lett. 107, 250602 (2011).

Institute of Computer and Communication Engineering – Research Group Embedded System Design Automation

Prof. Dr.-Ing. Rolf Ernst

- Head of Institute of Computer and Communications Engineering (IDA)
- DFG Liaison Officer TU Braunschweig
- Deputy Speaker Center TUBS.digital

Researcher's Career

- Full Professor at TU Braunschweig
- Member of Technical Staff at Bell Laboratories, Allentown, USA
- Ph.D. in Electrical Engineering (w. honors), Univ. Erlangen-Nürnberg (D. Seitzer)
- Diploma in Computer Science, Univ. Erlangen-Nürnberg

Funding

DFG, BMBF, BMWi, EU, Industry (Europe, US, Japan, China)

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IDA INSTITUTE OF COMPUTER AND NETWORK ENGINEERING

Mission Statement

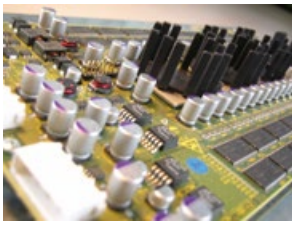
Develop embedded hardware/software architectures and design methods for dependable and efficient intelligent systems and their responsible application in technology and society.

Research

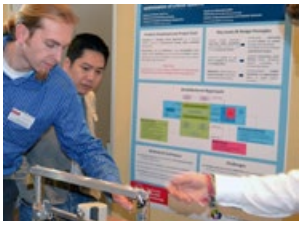
The research group is internationally known as a pioneer in embedded systems design. Embedded systems are a generic term for all computers that control "things" and make them "smart", from a household device to a modern car or aircraft with 100+ computers to large systems, such as in the smart city or smart grid. A smart phone contains embedded computers for sensing or wireless communication. Since the microcontrollers of the 80s, embedded computing has gone a long way to the networked high-performance manycore-computers implementing intelligent systems today. They shape the hot research topics of cyber-physical systems and the Internet-of-Things. However, high-performance embedded computing platforms expose a complex and highly dynamic behavior that must be mastered for a controllable and reliable implementation of a growing number and size of applications. Interest shifts from individual hardware/software components to end-to-end behavior, such as from the appearance of an object on the road to a driving maneuver. Traditional design methods targeting mostly static behavior of computers and applications are no longer sufficient. New mechanisms are needed to guarantee predictable end-to-end behavior of dynamic systems under real-time and safety constraints in all critical applications. Current projects cover:

- programming paradigms and related mechanisms that preserve critical behavior under dynamics, change, and errors [1]
- embedded platform self-awareness for self-reflection and self-management [2, 3]
- timing analysis for transient system overload [4]
- dynamic network control for mixed criticality systems [5]

Work includes basic research into formal models, methods, and architectures, as well as challenging prototype designs in collaboration with academic partners and industry. Project groups are typically large consisting of 3+ Post Docs, Ph.D. candidates, in addition to undergraduate students. Main areas of application are automotive, avionics and smart buildings.



FlexWAFE Re-configurable high-performance hardware accelerator



Self protecting distributed control demonstrator (CCC)

Research prototype for software defined vehicle network (TSN)

Publications

- Gemlau, K. B., Köhler, L., Ernst, R., & Quinton, S. System-Level Logical Execution Time: Augmenting the Logical Execution Time Paradigm for Distributed Real-Time Automotive Software. ACM Transactions on Cyber-Physical Systems, accepted Feb. 2020, https://doi.org/10.1145/3381847
- Möstl, M., Schlatow, J., Ernst, R., Dutt, N., Nassar, A., Rahmani, A., ... & Herkersdorf, A. (2018). Platform-centric self-awareness as a key enabler for controlling changes in CPS. Proceedings of the IEEE, 106(9), 1543-1567.
- Rambo, E. A., Kadeed, T., Ernst, R., Seo, M., Kurdahi, F., Donyanavard, B., ... & Yi, S. (2019, October). The information processing factory: a paradigm for life cycle management of dependable systems. In 2019 International Conference on Hardware/Software Codesign and System Synthesis (CODES+ ISSS) (pp. 1-10). IEEE.
- Köhler, L., & Ernst, R. (2019, April). Improving a compositional timing analysis framework for weakly-hard real-time systems. In 2019 IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS) (pp. 228-240). IEEE.
- Kostrzewa, A., Tobuschat, S., Ernst, R., & Saidi, S. (2016, August). Safe and dynamic traffic rate control for networks-on-chips. In 2016 Tenth IEEE/ACM International Symposium on Networks-on-Chip (NOCS) (pp. 1-8). IEEE.

Institute for Communications Technology (IfN) – Department Signal Processing and Machine Learning

Prof. Dr.-Ing. Tim Fingscheidt

- Signal Processing & Machine Learning

Researcher's Career

- 2019 + 2020, CVPR Workshop Best Paper Award
- 2017 + 2020, ITG Prize of VDE (co-author)
- 2014, IHK Technology Transfer Award
- 2011–2017, Elected member of IEEE Speech and Language Processing Technical Committee
- Since 2006, Full Professor at Technische Universität Braunschweig
- 2005–2006, Competence field manager at Siemens Corporate Technology, Munich
- 2004, IEEE Senior member
- 2002, ITG Prize of VDE
- 1999–2005, R&D team leader at Siemens Communications, Mobile Phones, Munich
- 1999, Advancement Prize of the Vodafone Mobile Communications Foundation
- 1998–1999, PostDoc at AT&T Labs (Shannon Labs), Florham Park, N.J., USA
- 1993–1998, Scientific Research Assistant at RWTH Aachen, PhD with distinction, Borchers medal
- 1987–1993, Student of Electrical Engineering at RWTH Aachen, Dipl.-Ing. with distinction, Springorum Prize

Funding

DFG, BMBF, BMWi, BMVI, industry

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Mission Statement

Machine Learning and Signal Processing are core elements of our research today in computer vision, speech and audio processing, data transmission, autonomous systems. Specific research fields are environment perception funtions for autonomous driving, speech enhancement, speech and emotion recognition, predictive maintenance, production technology, smartphones, hearing aids.

Research

Speech: Mobile speech communication is typically disturbed by background noise and acoustic echoes, requiring speech enhancement algorithms. Automatic speech recognition, on the other hand, has become omnipresent through Siri, Google Home, and Amazon Echo. We perform internationally leading research in a wide range of speech technology methods, many of them being employed world-wide in smartphone solutions. The team pioneered data-driven speech enhancement, today employing modern deep neural networks (DNN) throughout the entire processing chain. We secured top ranks in several international benchmarks. In speech technology, we work in DFG/BMBWi projects or cooperate with international smartphone and hearing aid industry.

Vision: The team performs internationally award-winning research in environment perception based on cameras (computer vision) and LiDAR. In the fields of object classification, semantic segmentation and depth estimation, we are most interested in robust methods, adversarial attacks and defenses, domain adaptation, learned image and video compression, corner case detection, and depth estimation from mono vision. We are cooperating with many other universities and industry in the four (of five) major national AI projects AI Platform Concept, AI Validation, AI Delta Learning, and AI Data Tooling, each with budgets up to 20 M€. The overall goal is to make autonomous driving possible.

Machine Learning in Predictive Maintenance and Production Technology: Much of our research in vision and audio is about deep learning and prediction. We are involved in various projects in predictive maintenance and production technology, most often based on camera sensors, microphones, or any other sensor input. Thanks to GPU support, our training algorithms run efficiently and allow fast development and prototyping.

TU Braunschweig Deep Learning Lab (TUBS.dll): Initially funded as a BMBF project, we established the TU Braunschweig Deep Learning lab as a think tank for machine learning solutions on sensor data (speech, vision, ...). To students, it provides once a year an exclusive and competetive environment to gain hands-on experience with modern machine learning frameworks and to aim for winning a certain Challenge as a team. To industry, the TUBS.dll has become an attractive opportunity for sponsors get to contact to young experts, and to fund research projects on machine learning tasks with the department. TUBS.dll hosts a large amount of GPU capacity to meet the needs of modern machine learning teaching and research.

Publications and Patents

- S. Receveur, R. Weiss, T. Fingscheidt, Turbo Automatic Speech Recognition, IEEE/ACM Transactions on Audio, Speech, and Language Processing, vol. 24, no. 5, pp. 846-862, May 2016
- J.-A. Bolte, M. Kamp, A. Breuer, S. Homoceanu, P. Schlicht, F. Hüger, D. Lipinski, and T. Fingscheidt, Unsupervised Domain Adaptation to Improve Image Segmentation Quality Both in the Source and Target Domain, in Proc. of CVPR-Workshops, Long Beach, CA, USA, Jun. 2019, pp. 1404-1413 (Best Paper Award)
- A. Bär, M. Klingner, S. Varghese, F. Hüger, P. Schlicht, and T. Fingscheidt, Robust Semantic Segmentation by Redundant Networks With a Layer-Specific Loss Contribution and Majority Vote, in Proc. of CVPR-Workshops, Seattle, WA, USA, Jun. 2020, pp. 1348-1358 (Best Paper Award)
- M. Klingner, J.-A. Termöhlen, J. Mikolajczyk, and T. Fingscheidt, Self-Supervised Monocular Depth Estimation: Solving the Dynamic Object Problem by Semantic Guidance, in Proc. of ECCV, virtual conference, Aug. 2020, pp. 582-600.
- M. Strake, B. Defraene, K. Fluyt, W. Tirry, and T. Fingscheidt, INTERSPEECH 2020 Deep Noise Suppression Challenge: A Fully Convolutional Recurrent Network (FCRN) for Joint Dereverberation and Denoising, in Proc. of INTERSPEECH, Shanghai, China, Oct. 2020, pp. 2467-2471. (2nd rank, after Amazon)
- 9 patents granted.

Institute for Electrical Machines – Traction and Drives (IMAB)

Prof. Dr.-Ing. Markus Henke

Researcher's Career

- Full Professor for Electrical Drives at TU Braunschweig
- Leader of the research area "Electromobility" at NFF
- Head of the Institute for Electrical Machines; Traction and Drives, TU Braunschweig
- Professor for Electrical Drives and Mechatronics at Ostfalia, Wolfsburg
- Head of the Electrical Drives Department at Volkswagen Group Research, Wolfsburg
- Dr.-Ing. at the University of Paderborn
- Research Assistant at the Institute of Power Electronics and Electrical Drives, University of Paderborn
- Study of electrical engineering, degree Dipl.-Ing. University of Paderborn

Funding

DFG, BMBF, BMWi, DBU, Lower Saxony, Industry

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Mission Statement

We work on new designs for electrical motors, linear actuators and power electronics to realize high performance drives with maximum energy efficiency. With a strong background in electromagnetic motor design, engineering design, power electronics and testing, prototype drive systems are realized, analyzed and enhanced.

Research

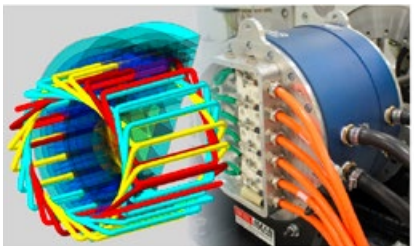
Innovative Electrical Machines for Automotive Applications: In cooperation with scientific and industrial partners (especially in NFF) we design, build and optimize electrical drives for automotive powertrains and for ancillary components. The main design targets are energy efficiency, power density and and noise reduction, which are pursued by implementing new electromagnetic materials, innovative machine topologies and optimized cooling systems.

Design and Control of High Speed Electrical Drives:
The main advantage of high speed drives is the possibility to reduce weight and size, especially in automotive applications.The technology is characterized by excitation with high mechanical frequencies, which effect the rotor dynamics and the design of mechanical structures and bearings.

Power Electronics for High Performance Motor Control: We work on operation of electrical drive systems with maximum energy efficiency. Here we use fast switching SiC and GaN semiconductors to reduce loss in power electronics and to enhance switching frequency and power density of converter systems.

Contactless Power Transfer: Contactless power transfer via inductive charging technology is an important feature of battery electric vehicles (busses and cars). We have been doing research for many years on the design of electromagnetic coupling and power conversion and have built up several types of charging systems in different power range.

Flywheel energy storage systems: In smart grids and in industrial applications flywheel systems are used to compensate energy fluctuations. Motor / Generator devices in combination with superconductive bearings support this technology. At IMAB we work on new innovative approaches to optimize these systems.



Design and Test of High Efficient Electrical Drives

Publications

- C. Bode, W.-R. Canders, M. Henke: "A new analytical approach to determine slotting based eddy current losses in permanent magnets of PMSM taking into account axial and circumferential segmentation", Int. Journal for Computation and Mathematics in Electrical and Electronic Engineering, 2015
- C. Bode, H. Schillingmann, M. Henke: "A Free-Piston PM Linear Generator in Vernier Topology using quasi-Halbach-Excitation", Int. Conf. on Electrical Machines ICEM 2014
- N. Domann, W.-R. Canders, M. Henke: "Design Process and Topology Comparison for a High Performance PM-Machine for Sustainable Traction Drive Technology" in Eighth Int. Conference and Exhibition on Ecological Vehicles and Renewable Energies (EVER), Monacco, 2013
- M. Cai, M. Henke, W.-R. Canders: "An Improved Method for Design of Symmetrical Multiphase Winding with Optimal Space Harmonics Spectrum", Int. Conf. on Electrical Machines and Systems, ICEMS 2014, Hangzhou
- N. Langmaack, G. Tareilus, M. Henke: "High Temperature and High CMR Gate Driver Circuit for Wide-Band-Gap Power Semiconductors", IEEE Int. Conf. on Power Electronics and Drive Systems, PEDS 2015

Institute of Geophysics and Extraterrestrial Physics

Prof. Dr. Andreas Hördt

Researcher's Career

- Full Professor of Applied Geophysics, TU Braunschweig.
- Temporary professor of Applied Geophysics, Institute of Geology, Universität Bonn.
- Assistant professor, Universität zu Köln.
- Postdoc, Universität zu Köln.
- Dr. rer nat., Universität zu Köln
- Dipl. geophysics, Universität zu Köln

Funding

DFG, MWK, EU, Industry

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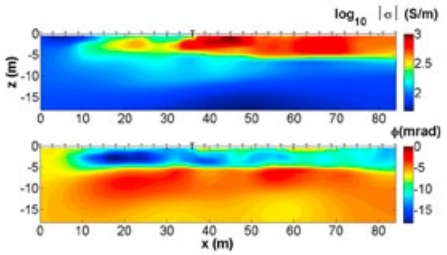
Mission Statement

We advance electrical and magnetic methods in the field of Applied Geophysics. Our aim is an improved investigation of the subsurface of the Earth, with a variety of applications in geosciences, such as groundwater research, exploration for resources, environmental sciences, permafrost and tectonics.

Research

Spectral induced polarization: measures the complex, frequency-dependent impedance of the subsurface. The aim is to estimate hydraulic parameters, important for many applications in groundwater research. We study the method in the laboratory, at the field scale, and theoretically by developing models to understand the relationships between hydraulic and electric properties.

Spectral induced polarization measurements in the field



Electrical image of the subsurface

Capacitive resistivity: determines the electrical impedance of the subsurface without direct contact to the ground. In the frequency range between 100 Hz and 100 kHz, the electrical permittivity of water ice displays a characteristic frequency dependence. We exploit this information for terrestrial permafrost studies, and potentially during space missions for the investigation of small planetary bodies.

Three-component borehole magnetometry: We measure Earth's magnetic field in boreholes. Whereas conventional methods determine only the total field, we are able to measure all three components. This requires an extremely precise determination of the sensor orientation, for which we use fiber optic gyros and sophisticated software. From the data, we can determine the rock magnetization which is important for plate tectonics and ore exploration.

Publications and Patents

- Mudler, J., Hördt, A., Przyklenk, A., Fiandaca, A., Maurya, P.K. and Hauck, C., 2019. Two-dimensional inversion of wideband spectral data from the capacitively-coupled resistivity method - first applications in periglacial environments. The Cryosphere, 13, 2439-2456.
- Hördt, A., Bairlein, K., Bücker, M., and Stebner, H., 2017. Geometrical constraints for membrane polarization, Near-surface Geophysics 15, 579-592.
- Ehmann, S., A. Hördt, M. Leven, and C.Virgil, 2015. Paleomagnetic inclination and declination from three-component borehole magnetometer data—New insights from logging in the Louisville seamounts J. Geophys. Res. Solid Earth, 120, doi:10.1002/2014JB011531.
- Bücker, M., and Hördt, A., 2013. Analytical modelling of membrane polarization with explicit parameterization of pore radii and the electrical double layer, Geoph. J. Int., doi: 10.1093/gji/ggt136.
- Hördt, A., Blaschek, R., Kemna, A., Zisser, N., 2007, Hydraulic conductivity estimation from induced polarisation data on the Field Scale – The Krauthausen case history, J. Appl. Geoph., 62, 33-46.

Institute of Communications Technology (IfN) –

Department of Information Theory and Communication Systems

Prof. Dr.-Ing. Eduard Axel Jorswieck

- Managing Director of Institute of Communications Technology
- IEEE Fellow
- Editor-in-Chief Springer EURASIP Journal on Wireless Communications and Networking

Researcher's Career

- Full Professor for "Communications" at TU Braunschweig
- Full Professor for "Communications Theory" at Technische Universität Dresden
- Assistant Professor at Signal Processing group at KTH Stockholm
- Postdoctoral Fellow at Signal Processing group at KTH Stockholm
- Research Associate at Fraunhofer Institute for Telecommunications, Berlin
- Ph.D. received from TU Berlin under supervision of Prof. Dr. Dr. Holger Boche
- Research Assistant at Fraunhofer Institute for Telecommunications, Berlin
- Diploma in Computer Engineering, Technische Universität Berlin

Funding

DFG, BMBF, BMWi, EU, Industry

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Mission Statement

State-of-the-art and cutting-edge mathematical methods and tools are applied to systematically model, analyse and design modern communication systems, including cellular beyond 5G and 6G, wireless local and body area networks, molecular communications, and information-theoretic secure communications.

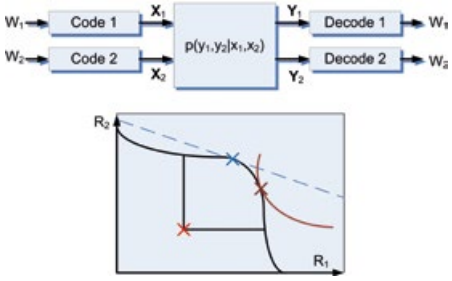
Research

The research in the department of information theory and communication systems spans the whole cycle from fundamental information-theoretic research to system design and implementation on demonstrating platforms. The group performs research in the following three main areas:

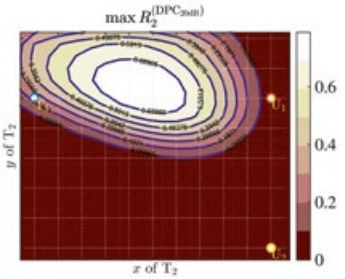
Cellular Communications Systems: Analysis and design of beyond 5G and 6G wireless communications, massive MIMO, mmWave, full duplex, dense heterogeneous interference networks. System architecture from PHY, MAC to network layer including network slicing, network function virtualization, scheduling, resource allocation, power control, beamforming, channel coding. Multimedia broadcast technologies in 5G and beyond. Novel technologies for higher reliability and coverage: multi-connectivity, relay-assisted communications, reconfigurable intelligent surfaces, optimization and reliability theory-based resource allocation.

Wireless Local and Body Area Networks: Fundamental understanding of communications theoretic principles for massive multiple access in WiFi networks, resource allocation, power control, multi-user multi-armed bandits. Distributed non-convex optimization and game theoretic approaches. Statistical signal processing in wireless sensor networks, molecular and massive machine type communications.

Physical Layer and Information-Theoretic Security: Alternative scalable and infrastructure-less approaches for securing internet of things (IoT), optical multi-mode fiber and multi-hop networks: confidentiality by wiretap coding, secret key generation, authentication, differential privacy, anonymity, jamming attacks. Information-theoretic channel models include compound and arbitrarily varying wiretap and multi-user channels.



Information-theoretic model of interference channel and achievable rate region with efficient operating points.



Heterogeneous 5G/6G wireless network with modern coexisting radio technologies."

Publications

- E. Jorswieck, E. Larsson and D. Danev, "Complete Characterization of the Pareto Boundary for the MISO Interference Channel", IEEE Trans. on Signal Processing, vol. 56, no. 10, pp. 5292-5296, Oct. 2008.
- E. Björnson and E. Jorswieck, "Optimal Resource Allocation in Coordinated Multi-Cell Systems", Foundations and Trends in Communications and Information Theory, vol. 9, no. 2-3, January 2013, pp. 113-381.
- A. Zappone and E. Jorswieck, "Energy Efficiency in Wireless Networks via Fractional Programming Theory". Foundations and Trends in Communications and Information Theory, vol. 11, no. 3-4, June 2015, pp. 185-396.
- C. Sun, E. Jorswieck, Y. Yuan, "Sum Rate Maximization for Non-Regenerative MIMO Relay Networks", IEEE Trans. on Signal Processing, vol. 64, no. 24, pp. 6392-6405, Dec. 15. 2016.
- B. Matthiesen and E. Jorswieck, "Efficient Global Optimal Resource Allocation in Non-Orthogonal Interference Networks", IEEE Trans. on Signal Processing, vol. 67, no. 21, pp. 5612-5627, 1 Nov 2019.

Institute of Mathematical Physics

Prof. Dr. Christoph Karrasch

Researcher's Career

- Full Professor, Institute of Mathematical Physics, TU Braunschweig (since 2019)
- Physics Award of the "Göttinger Akademie der Wissenschaften" (2016)
- Emmy Noether Research Group Leader, FU Berlin (2015–2018)
- Postdoc, University of California, Berkeley, United States (2011–2015)
- PhD in physics, RWTH Aachen (2010)
- Diploma in physics, Universität Göttingen, 2006

Funding

DFG, Emmy Noether Program
DFG, RTG 1952 "Nanomet"
QuantumFrontiers Cluster of Excellence
QUANOMET

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Mission Statement

Deepen our understanding of the collective behavior of quantum many-body systems

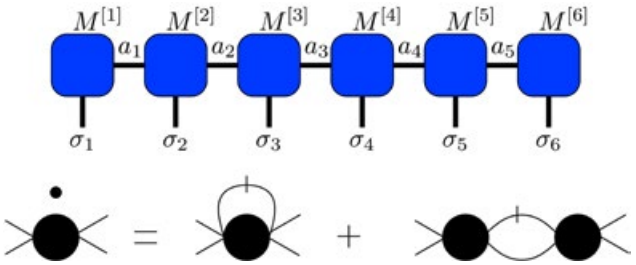
Research

We study strongly-correlated electrons in low-dimensional quantum systems. Our focus is to describe collective phenomena and emergent behavior using both computational and analytical many-body techniques such as

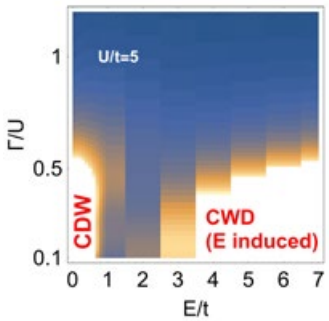
- the functional renormalization group
- tensor networks (DMRG)
- bosonization

Our research areas include

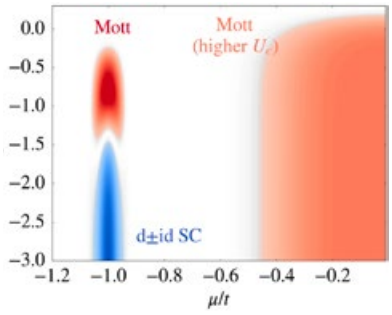
- transport through quantum dots and wires
- non-equilibrium dynamics and phases of matter
- disordered and topological systems
- superconductivity in 2d materials



Fundamental building blocks of tensor networks (matrix product states) as well as of the functional renormalization group (flow equations for vertex functions).



Non-equilibrium phases of matter (blue denotes a metal, white a charge density wave) in an open 1d system with interactions U, reservoirs couplings Γ, and an electrical field E.



Theoretical prediction for the phase diagram of twisted bilayer graphene as a function of the temperature T and the chemical potential μ. The system features unconventional superconductivity (SC).

Publications

- C. Karrasch, T. Hecht, A. Weichselbaum, Y. Oreg, J. von Delft, V. Meden. Mesoscopic to Universal Crossover of the Transmission Phase of Multilevel Quantum Dots, Phys. Rev. Lett. 98, 186802 (2007)
- C. Karrasch, J. H. Bardarson, J. E. Moore. Finite temperature dynamical DMRG and the Drude weight of spin-1/2 chains, Phys. Rev. Lett. 108, 227206 (2012)
- D. M. Kennes, J. Lischner, C. Karrasch. Strong Correlations and d+id Superconductivity in Twisted Bilayer Graphene, Phys. Rev. B 98, 241407(R) (2018)
- K. S. C. Decker, C. Karrasch, J. Eisert, D. M. Kennes. Floquet engineering topological many-body localized systems, Phys. Rev. Lett. 124, 190601 (2020)
- B. Bertini, F. Heidrich-Meisner, C. Karrasch, T. Prosen, R. Steinigeweg, M. Znidaric. Finite-temperature transport in one-dimensional quantum lattice models, Rev. Mod. Phys. 93, 025003 (2021)

LENA Laboratory for Emerging Nanometrology

Prof. Dr. Stefanie Kroker

Researcher's Career

- Science Award Lower Saxony for junior researchers 2020
- Principal investigator in the Cluster of Excellence "QuantumFrontiers"
- Junior professor and junior research group leader at TU Braunschweig and Physikalisch-Technische Bundesanstalt (PTB)
- Postdoc at the Friedrich-Schiller-Universität Jena
- Dr. rer. nat. at the Friedrich-Schiller-Universität Jena, Institute for Applied Physics
- Study of Physics, Jena

Funding

DFG, EU, Industry

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Mission Statement

Research in micro and nano-photonics using a broad spectrum of experimental methods in combination with various modeling techniques is employed to control light fields at the nanoscale for pushing the limits of high-precision experiments in optical and quantum metrology.

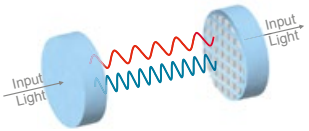
Research

Optical metasurfaces and integrated nanophotonic systems: We investigate optical metasurfaces and photonic waveguides for applications in high-precision optical and quantum metrology (e.g. as ultralow-mirrors in optical resonators and beam steering devices in atomic traps) as well as mechanically susceptible metasurfaces as a tunable platform in cavity optomechanics. The fundamental coupling mechanisms and effects such as cooling and squeezing are analysed in order to access the dynamics and entanglement in optomechanical multi-mode systems. In our experiments, we employ various spectroscopic optical setups at temperatures down to 5K. A major part of these activities are carried within the framework of the Cluster of Excellence QuantumFrontiers.

Fluctuations and non-equilibrium processes: We develop modelling techniques for the description of fluctuation processes in multiscale complex optical systems as employed in laser cavities and gravitational wave detectors. We thereby aim particularly for the development of analytical and semi-analytical approaches for an easy application to other systems.

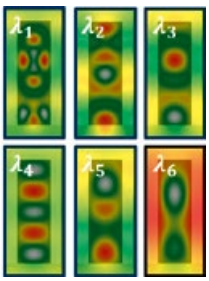
Material research: We perform optical, mechanical and thermal material characterization of bulk and nano-systems at room temperature and cryogenic temperatures. This covers optical spectroscopy such as photothermal common path interferometry and deflection spectroscopy (within the DFG research training group NanoMet), mechanical spectroscopy and polarimetry.

Optical nanometrology: We develop nanometrological tools for the geometric characterization of photonic nanosystems and nanoparticles e.g. (resonance enhanced) scatterometry and imaging ellipsometry. These techniques respectively enable facile possibilities of process control in the fabrication of periodic nanostructures and nanoform analysis.



Schematic of an optical cavity resonant for two different wavelengths. The resonance for both wavelengths is achieved by employing dispersion engineered metasurface mirrors.

Silicon metasurface for application as a highly reflective mirror in the near infrared spectral range.



Magnetic field distribution in a multi-resonant metasurface at different resonance wavelengths. Red and white colors respectively indicate field maxima and minima.

Publications

- Tuniz, O. Bickerton, F. Diaz, T.Käsebier, S. Kroker, E.-B. Kley, S. Palomba, C. M. De Sterke, Modular nonlinear hybrid plasmonic circuit, Nature Communications 11 (2020)
- Z. Samsonova, S. Höfer, V. Kaymak, S. Ališauskas, V. Shumakova, A. Pugžlys, A. Baltuška, T. Siefke, S. Kroker, A. Pukhov, I. Uschmann, C. Spielmann, D. Kartashov, Relativistic interaction of long-wavelength ultrashort laser pulses with nanowires, Physical Review X 9, 021029 (2019).
- J. Dickmann, S. Kroker, Highly reflective low-noise etalon-based meta-mirror, Physical Review D 98, 082003 (2018).
- T. Siefke, S. Kroker, K. Pfeiffer, O. Puffky, K. Dietrich, D. Franta, I. Ohlídal, A. Szeghalmi, E.-B. Kley, A. Tünnermann, Materials Pushing the Application Limits of Wire Grid Polarizers further into the Deep Ultraviolet Spectral Range, Advanced Optical Materials 4, 1780-1786 (2016).
- S. Kroker, J. Dickmann, C. B. Rojas Hurtado, D. Heinert, R. Nawrodt, Y. Levin, S. P. Vyatchanin, Brownian Thermal Noise in Functional Optical Surfaces, Physical Review D 96, 022002 (2017).

Institute of Communications Technology

Prof. Dr.-Ing. Thomas Kürner

Researcher's Career

- 2003-present, Full Professor for "Mobile Radio Systems", Technische Universität Braunschweig, Institut für Nachrichtentechnik
- 1999-2003, Team Manager "Radio Network Planning Support", E-Plus Mobilfunk GmbH & Co KG, Düsseldorf/Germany
- 1994-1999, Project Manager/Specialist "Radio Network Planning Tools", E-Plus Mobilfunk GmbH & Co KG, Düsseldorf/ Germany
- 1993-1994, Freelance Software Developer at L&S Hochfrequenztechnik GmbH, Lichtenau working on spectrum management systems
- 1991-1994, Research Assistant and doctoral candidate (Ph. D. received in 1993) at the Institut für Höchstfrequenztechnik und Elekronik of Universität Karlsruhe
- 1985-1990, Diploma in Electrical Engineering, Universität Karlsruhe

Funding

EU, BMBF, DFG, Industry

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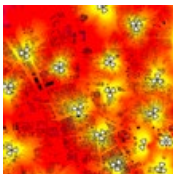
Mission Statement

Deep understanding and knowledge of propagation and channel characteristics are the core of every wireless transmission system. We have key competences in these areas both in modeling and radio measurements, on top of which we build realistic simulators for mobile radio systems.

Research

Research of the Mobile Radio Systems group deals with radio transmission in all its facets. Our fields of research can be classified into a matrix of four fields of competence and application areas each. The fields of competence are **"Wave Propagation and Radio Channel Characterisation"**, **"Link Level Simulation"**, **"System Level Simulation" and "Generation of Realistic Reference Scenarios for the Simulation"**. The application areas are **"Methods and Algorithms for Planning and Optimisation of Infrastructure Networks"**, **"THz Communication"** and **"Vehicle-to-X and IntraVehicle Communication"**. The projects dealt with in our research on cognitive radio network management, future THz communications and wireless connectivity in automotive, for example, can be assigned to one or more of these application areas and in each project research is carried out one or in a number of the stated fields of competence.

The basis for radio network simulations and the propagation modelling is the internally developed **Simulator for Mobile Networks SiMoNe**. Via raytracing and realistic mobility models it enables the modelling and simulation of network topologies and scenarios. Another key part is the as DFG large device sponsored **UWB mm-wave channel sounder** that is deployed in the channel characterisation and modelling of future multi-gigabit indoor communication systems in the THz range.

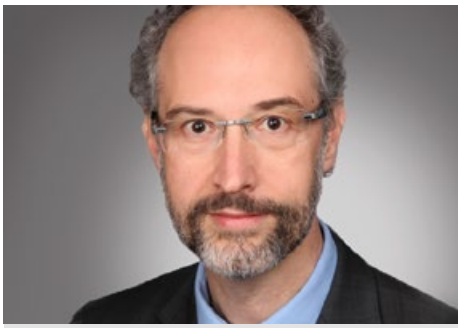


The group is internationally positioned – involved in international projects inside and outside Europe as well. Since 2010, Prof. Thomas Kürner has chaired the IEEE 802.15 Standing Committee THz (formerly THz Interest Group) and from 2014–2017 he chaired the IEEE 802.15 Task Group 3d, which developed the first wireless standard at 300 GHz. He is the project coordinator of the EU-Japan-Horizon 2020 ThoR in the area of THz Backhaul/Fronthaul Links and of the DFG Research Unit FOR 2863 Metrology for THz Communications. He is a Fellow of the IEEE and since 2016 he has been a member of the EurAAP Board of Directors.

Publications

- T. Kürner, Y. Lostanlen: Propagation Models for Wireless Network Planning. in: de la Roche, G., Alayón-Glazunov, A., Allen, B. (Eds.) LTE-Advanced and Next Generation Wireless Networks: Channel Modeling and Propagation, Wiley, pp. 317-347, 2012.
- K.L. Chee, S.A. Torrico, T. Kürner: Radiowave Propagation Prediction in Vegetated Residential Environments. IEEE Transactions on Vehicular Technology, Vol. 62, No. 2, pp. 486-499, 2013.
- S. Priebe, T. Kürner: Stochastic Modeling of THz Indoor Radio Channels. IEEE Transactions on Wireless Communications, Vol. 12, No. 6, pp. 4445-4455, 2013.
- H.-J. Song, S. Priebe, T. Kürner: THz Wireless Communications in Song, H.-J. and Nagatsuma, T. (Eds.), 'Handbook of Terahertz Technologies: Devices and Applications'; pp. 495-526, CRC Press Book 2015
- B. Ai, Guan, M. Rupp, T. Kürner, X. Cheng, X.-F. Yin, Q. Wang, G.-Y. Ma, Y. Li, L. Xiong, J.-W. Ding: Future Railway Services Oriented Mobile Communication Network. Communications Magazine, IEEE, vol.53, no.10, pp. 78-85, October 2015

elenia – Institute for High Voltage Technology and Power Systems



Prof. Dr.-Ing. Michael Kurrat

- ISDEIV (PISC), secretary of Scientific Committee
- FSO Member of Scientific Committee
- CZC Member of Major VCB Research
- VDE Braunschweig, Vice Chair
- BWG, Member

Researcher's Career

- Full-Professor and Director of the Institute for High Voltage Technology and Electrical Power Systems – elenia, TU Braunschweig
- Full Professor at TU Braunschweig, Head of high-voltage department, TU Braunschweig
- Moeller switchgear division, Krefeld, Head of gas-insulated switchgear development
- Dr.-Ing. at Universitaet Dortmund, Lehrstuhl für Hochspannungstechnik und Anlagen
- Study Electrical Engineering at Universitaet Dortmund

Funding
DFG, BMBF, BMWI, BMU, BMVBS, EURAMET

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Mission Statement

Our mission is to face the technological challenges for the power system of the 21st century.

Research

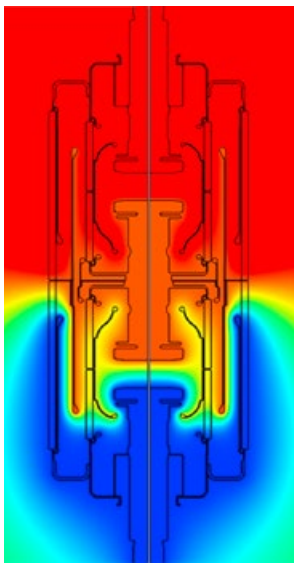
We address three strategic research sectors

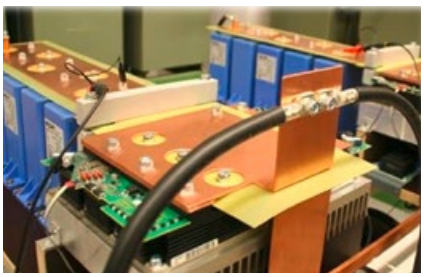
- Advanced Components to enable sustainable power systems
- Systems Engineering to find system solutions for power grids
- Electromobility to reinvent mobility

These focus areas of expertise represent platforms for professional knowledge exchange. Our expert knowledge and research infrastructure is bundled in the research groups.

- High Voltage Technology
- DC Power Systems
- Battery and Hydrogen Technology
- Power Systems Engineering

Disciplinary and cooperative projects as well as industry funded projects constitute the framework of our research activities. elenia is a member of national and international working bodies in IEC, DKE, VDE, FNN, CIGRE, and a member of research centres in Lower Saxony for automotive (NFF), Battery Lab-Factory Braunschweig (BLB) and energy (EFZN). Scientific findings contribute directly to the educational curriculum such as new Master's Degree programs Electromobility or Sustainable Power Systems.





Publications and Patents

- R. Drees, F. Lienesch, M. Kurrat, Fast Charging Lithium-Ion Battery Formation based on Simulations with an Electrode Equivalent Circuit Model, Journal of Energy Storage, PP. 1-10, https://doi.org/10.1016/j.est.2021.102345, 2021
- M. Hoffmann, C. Wei, M. Kurrat, Requirement Analysis with SysML for Concept Design of Offshore Wind Farm Grid Connection, ETG-Kongress 2021 - Von Komponenten bis zum Gesamtsystem für die Energiewende, 2021
- CIGRE Technical Brochure, Electrical Insulation Systems at Cryogenic Temperatures, final report of WG D1.64, 2021
- Schefer H.; Fauth L.; Kopp T. H.; Mallwitz R.; Friebe J.; Kurrat M.: Discussion on Electric Power Supply Systems for All Electric Aircraft, IEEE Open Access Journal, 2020
- T. Runge, T. Kopp, M. Kurrat, A Novel Approach for Maximum Plasma Pressure Estimation at Surge Current Based on Experimental Investigations. IEEE Transactions on Plasma Science Jg.(2018), S. 2935-2941. DOI: 10.1109/TPS.2018.2850364, 2018

Institute of Condensed Matter Physics

Prof. Dr. habil. Peter Lemmens

- Adm. Head of the Institute of Condensed Matter Physics
- Verkin Prize 2020, Nat. Acad. Sciences of Ukraine
- Member of Laboratory for Emergent Nanometrology (LENA)
- Member of DFG-RTG Nanomet, Exzellenzcluster Quantum Frontiers
- Associated Editor of Journal Physical Society of Japan
- Member of B-IGSM, Nanomet, Quanomet, Co-PI of Cluster of Excellence QuantumFrontiers

Researcher's Career

- Professor for Physics at the TU Braunschweig
- Postdoc with Prof. B. Keimer, MPI-Stuttgart
- Deputy Prof. at TU Braunschweig and RWTH Aachen
- Junior Group Leader and Habilitation with Prof. G. Güntherodt, RWTH Aachen
- Postdoc at Hiroshima University with Prof. H. Fujita and Y. Maeno, Japan

Funding

DFG, ESF, EU, State Lower Saxony, IWAS, JSPS

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Mission Statement

Fundamental research in solid-state physics, structure property relationship, and advanced concepts of sensing and metrology. These topics include electronic correlations and topological invariants. Different experimental techniques and analytical tools are developed. We implement and contribute to outreach and mentoring programs in physics.

Research

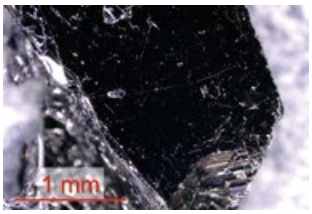
Enhanced spectroscopies, i.e. surface enhanced Raman scattering: For more than 25 years we have used optical spectroscopies to probe electronic, magnetic and topological properties of solids and molecular materials. The sensitivity of Raman scattering is enhanced using resonance effects, quantum fluctuations, plasmons and charge transfer. Light-matter coupling is tuned in tailored nanostructures including molecular components that are energetically tuned to plasmon energies.

Topological materials: Topological invariants in solids have the potential to establish technologies for future devices. In a broad, materials-oriented collaboration with international partners we study excitations, their lifetime and interactions. We investigated transport anomalies that could be used for dissipation-less energy transport.

Quantum spin systems with competing interactions: Competing interactions can be used to tune the material response to external stimuli. Adding quantum fluctuations leads to dynamic states behaving similar to complex biological systems such as nervous systems. Within a project financed by the European Science Foundation (ESF-HFM) we established a joint and open networking activity that led to a mutual European advance in this field. In Braunschweig, Stockholm, and Dresden the materials-oriented activities are coordinated.

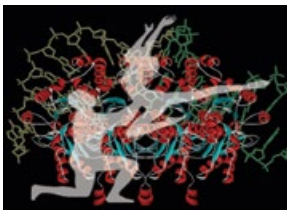
Tailored Nanostructures, dynamics of charge, spin transfer and spin: Nanostructured materials prepared using principles of self-organization can be used as a basis for environmental sensing. We work in the fields of heavy metal detection and medical tracers.

Propagation of Twisted Light through Media – New Possibilities for Information Transfer: Within the Excellence Cluster QuantumFrontiers we study light-matter interaction for light states with orbital angular momentum. Here, several chiral molecular systems and topological solids are investigated with the aim of developing and evaluating schemes of quantum communication.



Majorana fermions found in $RuCl_3$ have implications for topologically stable systems and quantum computing, Wulferding, D., et al., Nature Communication, (2020).

Quantifying enhanced Raman scattering is an important task for life science analysis and metrology. Liu. B., et al., J. Phys. Chem. (2019).



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Publications

https://orcid.org/0000-0002-0894-3412

- Magnon bound states vs. anyonic Majorana excitations in the Kitaev honeycomb magnet α-$RuCl_3$, D. Wulferding, Y.-S. Choi, S.-H. Do, Ch. H. Lee, P. Lemmens, C. Faugeras, Y. Gallais, and K.-Y. Choi, Nature Commun. 11, 1603 (2020).
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- Quantifying the Contribution of Chemical Enhancement to SERS: A Model Based on the Analysis of Light-Induced Degradation Processes, B. Liu, B. Thielert, A. Reutter, R. Stosch, and P. Lemmens, J. Phys. Chem. C 123, 31, 19119 (2019).
- Magnetic structure in $Mn_{1-x}Co_xGe$ compounds, E. Altynbaev, S.-A. Siegfried, P. Strauß, D. Menzel, A. Heinemann, L. Fomicheva, A. Tsvyashchenko, and S. Grigoriev, Phys. Rev. B 97, 144411 (2018).
- Raman spectroscopic signature of fractionalized excitations in the harmonic-honeycomb iridates β- and γ-Li_2IrO_3, A. Glamazda, P. Lemmens, S.-H. Do, K.-Y. Choi, Nature Commun. 7, 12286 (2016).

Institute of Control Engineering – Department Vehicle Electronics

Prof. Dr.-Ing. Markus Maurer

- Chair of Department Automotive Electronics Systems
- Member of the "round table automated driving" of the Federal Ministry of Transport and Digital Infrastructure;
- Member of the founding board of the "Niedersächsisches Forschungszentrum für Fahrzeugtechnik" (2008-2016);
- Founding member of the Uni-DAS e.V.

Researcher's Career
- Full Professor for Automotive Electronics Systems at TU Braunschweig
- Project manager and Head of the development department of "Driver Assistance Systems" at Audi
- Ph.D. at Universität der Bundeswehr München, E.D. Dickmanns.
- Studies in electrical engineering at TU München

Funding
BMBF, BMVI, BMWi, Daimler and Benz foundation, DFG, State Lower Saxony, industry

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Mission Statement

Systems for assisted and autonomous driving change the way we use our cars. In our research we focus on the enabling technology. Our mission is to research and develop concepts, methods, and algorithms for vehicle guidance systems including environment perception, (ethical) decision making, (value-based) behavior, and safety.

Research

Autonomous Driving / Driver Assistance Systems: Based on the DARPA Urban Challenge participation of TU Braunschweig in 2007, we have operated automated vehicles in our lead project Stadtpilot in public urban traffic since 2010, thus combining all our research activities to an overall system. Our research focuses on AI-based and classic algorithms for environment perception, on value-based decision making for driving decisions, and on trajectory generation and vehicle control.

More recently, we started focusing on the risk associated with autonomous vehicles in public streets, on roads and highways: These vehicles will fail even when designed most diligently and in compliance with all standards. There is an inherent risk in autonomous vehicles, which can be minimized but not eliminated. Due to the complexity of the driving task, the complexity of the technical systems and their operating environment, and the expected high number of autonomous vehicles worldwide, messages from accidents and victims will accompany their market introduction.

These risks are caused by functional reasons – its machine perception and its machine behavior and by systemic reasons – the (incomplete) definition of the requirements, the (incomplete) validation and verification of the requirements. Therefore, we study safety-by-design approaches for developing autonomous vehicles including holistic safety concepts as well as a systematic definition of requirements, architectures, and test cases.

Our most advanced test vehicle is called MOBILE, a self-built overactuated full-by-wire electric vehicle. It allows us to research and develop algorithms for failure detection and handling in electric and electronic vehicle systems. Our research combines vehicle dynamics control as well as hardware, software, and functional redundancies to new methods targeting at fail-safe and fault-tolerant operation of vehicles.

MOBILE features a unique actuator setup, which includes wheel individual electric motors, electric steering, and electromechanical brakes. In combination with autonomous vehicle technology, MOBILE allows us to deeply investigate vehicle architectures and vehicle systems.

Publications

- Bagschik, G.; Menzel, T.; Maurer, M.: Ontology based scene creation for the development of automated vehicles. 2018 IEEE Intelligent Vehicles Symposium (IV). S. 1813-1820.
- Maurer, M.; Gerdes, C.; Lenz, B.; Winner, H. (Eds.): Autonomous Driving – Technical, Legal and Social Aspects. Springer, 2016.
- Ulbrich, S.; Menzel, T.; Reschka, A.; Schuldt, F. Maurer, M.: Defining and substantiating the terms scene, situation, and scenario for automated driving. 2015 IEEE 18th International Conference on Intelligent Transportation Systems. S. 982-988.
- Matthaei, R.; Maurer, M.: Autonomous Driving – A Top-Down-Approach. In: at Automatisierungstechnik, vol. 63, no. 3, 2015, pp. 155-167.
- Bengler, K.; Dietmayer, K.; Farber, B.; Maurer, M.; Stiller, C.; Winner, H.:Three Decades of Driver Assistance Systems – Review and Future Perspectives. In: IEEE Intelligent Transportation Systems Magazine, vol. 6, no. 4, 2014, pp. 6-22.

Institute for Electron Devices and Circuits (BST)

Prof. Dr. Bernd Meinerzhagen

- Head of the Institute for Electron Devices and Circuits
- Dean (EE and Physics Dept.) (2011-2013)
- DFG-Fachkollegiat since 2012

Researcher's Career

- Diploma in Electrical Engineering, 1977, RWTH-Aachen
- Diploma in Mathematics, 1981, RWTH-Aachen
- Ph.D. in Electrical Engineering, 1985 RWTH-Aachen
- Member of Technical Staff, AT&T Bell Labs (Pa, USA), 1986-1987
- Oberingenieur, Inst. für Theoretische Elektrotechnik, RWTH-Aachen, 1988-1995
- Consultant for Motorola, Phoenix (Az, USA), 1994-2002
- Habilitation (Theor. Elektrotechnik), 1995, RWTH-Aachen
- Professor for Theory of Electrical Engineering, Univ. Bremen, 1995-2003
- Professor for Circuit Technology, TU Braunschweig, since 2003

Funding

DFG, BMBF, EU, SRC (USA), Industry

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www.nst.ing.tu-bs.de/index.html

Mission Statement

Electron devices and analog circuits are indispensable building blocks (BB) of microelectronic systems. The BST incorporates the relevant knowledge about the modeling, design and characterization of theses BB into its undergraduate and graduate courses. The numerical simulation of advanced devices and the design of millimeter wave transceiver circuits are important research topics.

Research

Numerical Simulation of Semiconductor devices: The focus of this research is to provide numerical models which support the scaling of existing or the development of new semiconductor devices. Moreover, these models serve as a reference for the development of compact models which are the basis of circuit design. Depending on the device dimensions, models with different levels of complexity are needed for predicting the transport properties of a device as a function of its geometrical and material properties.

Semi-Classical and classical numerical device models: If the device band structure can be considered as known, and tunneling is not a dominant transport mechanism, the numerical solution of Poisson and Boltzmann-Transport equation is typically the method of choice, and quantum effects can be considered by well calibrated empirical models. For critical device dimensions larger than about 50 nm, ballistic transport is typically negligible and the mobility concept becomes valid so that simplified classical transport models like the drift diffusion equations can be used. For these two simulation domains Prof. Meinerzhagen and his coworkers have developed the numerical simulators ELWOMIS and GALENE III, respectively. Several semiconductor manufacturers have licensed these simulators for their development work. Today the research in these domains is mostly focused on the intelligent combination of both domains for the predictive simulation of noise or hot carrier effects, for example. A recent example is the predictive simulation of read disturbances in nanoscale flash memories by our group.

Simulation of transport in nanoscale MOS-transistors: For the transport in modern nanoscale field effect transistors (FETs) the bias dependent band structure needs to be considered. Additionally, the Schrödinger equation must be solved. Here our research is currently focused on the development of the first simulator for advanced p-channel FETs solving k•p-Schrödinger equation in confinement direction and Boltzmann-Transport equations within the resulting k•p-subbands in transport direction without applying the Monte-Carlo algorithm.

Design of Millimeter Wave tranceiver circuits: Since 2010 design and characterization of millimeter wave integrated circuits is a new research topic of our institute. The focus is currently on circuits for 24GHz and 77GHz radar sensor applications. First results include different versions of direct conversion receivers at 24 GHz fabricated in 130 nm CMOS.

Publications

- C. Jungemann, B. Neinhüs, C. D. Nguyen, A. J. Scholten, L. F. Tiemeijer, B. Meinerzhagen: "Numerical Modeling of RF Noise in Scaled MOS Devices" Solid-State Electron., Vol. 50, pp. 10-17, 2006.
- A. T. Pham, C. Jungemann, B. Meinerzhagen: "Deterministic multisubband device simulations for strained double gate PMOSFETs including magnetotransport" IEDM Tech. Dig., pp. 895-898, San Francisco, CA (USA), 2008.
- C. Jungemann, A. T. Pham, S. M. Hong, B. Meinerzhagen: "Deterministic solvers for the Boltzmann transport equation of 3D and quasi-2D electron and hole systems in SiGe devices" Solid-State Electronics, Vol. 84, pp. 112-119, 2013.
- A. Kuligk, C. Dong Nguyen, D.A. Löhr, V. Beyer, B. Meinerzhagen: "Accurate and Efficient Physical Simulation of Program Disturb in Scaled NAND Flash Memories" Proceedings of ULIS, pp. 157-160, University of Warwick (England), 2013.
- J. Dang, P. Sakalas, A. Noculak, M. Hinz, B. Meinerzhagen: "A K-band High Gain, Low Noise Figure LNA using 0.13 um Logic CMOS Technology" Proc. of the 10. EUMIC Conf. ,p. 120 , Paris (France), 2015

Institute for Theoretical Physics – Department of Numerical Plasma Simulations

Prof. Dr. Uwe Motschmann

- Chair, Department of Numerical Plasma Simulations

Researcher's Career

- Full Professor for Theoretical Physics, TU Braunschweig
- Guest Professor, German Aerospace Center (DLR), Institute of Planetary Research, Berlin
- Werner-Heisenberg-Stipend of DFG
- Postdoc, Imperial College, London
- Habilitation in Theoretical Physics, University of Potsdam
- PhD (Dr. sc. nat.), Academy of Sciences, Berlin
- Postdoc, Institute for Space Research, Berlin
- PhD (Dr. rer. nat.), University of Jena
- Study of Physics, University of Jena

Funding
DFG, HLRN, JSC

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Mission Statement

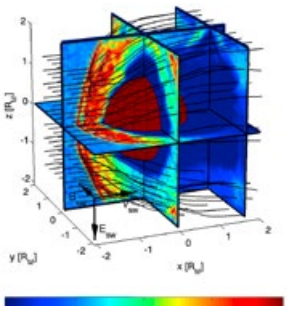
The space between the stars and planets is filled with a faint ionized gas, called space plasma. This material controls the interaction of astrophysical objects to a high degree. We develop and apply numerical models for the action and reaction of the bodies mediated by the space plasma. Our research supports the design of space missions and the interpretation of their results.

Research

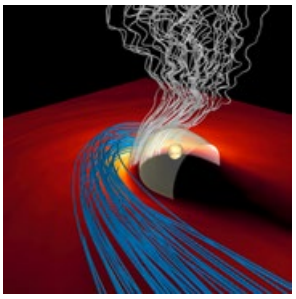
Loss of water on Mars: For the early Martian conditions an enhanced influence of the Sun's radiation flux to the Martian ionosphere is claimed. For a moderate Sun the water loss is equivalent to the depth of a global Martian ocean of about 2.6 m over the last 4.5 billion years. The induced Martian magnetic field strength was increased by up to about 2,000 nT. Our modeling with a very active Sun even results in a water loss of an equivalent global Martian ocean up to 205 m depth during 150 million years after the Sun reached the zero age mean sequence. Thus Mars is very dry today as observed by the Mars-Express mission.

Plasma environment of comet 67P/Churyumov-Gerasimenko: The Rosetta mission with its long term flight in formation and the landing on the surface revolutionized our knowledge of comets. Our simulated plasma environment predicted the Rosetta observations of the magnetic field, particle density and flow structures with high accuracy. A new type of quasi-coherent, large-amplitude magnetic field oscillation which dominates the immediate plasma environment of the nucleus was identified and interpreted.

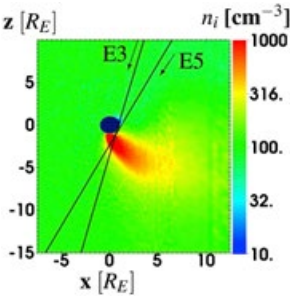
Geysers on Saturn's icy moon Enceladus: An extended plume of water vapor and ice grains at the south pole of Saturn's icy moon Enceladus was the fascinating discovery of the Cassini mission. Our investigation of the mutual feedback between the ice grains and Saturn's plasma environment explains the sophisticated twist of the magnetic field and the filamentary ion density structure observed by the Cassini plasma instruments.



Mars



Comet



Enceladus

Publications

- A. Bößwetter,, H. Lammer, Y. Kulikov, U. Motschmann, S. Simon, Non-thermal water loss of the early Mars: 3D multi-ion hybrid simulations, Planet. Space Sci., 58, 2031–2043, 2010.
- H. Comişel, Y. Narita, U. Motschmann, Alfvén wave evolution into magnetic filaments in 3-D space plasma, Earth, Planets and Space 72:32, https://doi.org/10.1186/s40623-020-01156-8, 2020.
- W. Exner, D. Heyner, U. Motschmann, L. Liuzzo, D. Shiota, K. Kusano, T. Shibayama, Coronal Mass Ejection hits Mercury: A.I.K.E.F. hybrid-code results compared to MESSENGER data,Planetary and Space Science, 153, 89-99, https://doi.org/10.1016/j.pss.2017.12.016, 2018.
- J. Mueller, S. Simon, U. Motschmann, J. Schuele, K.-H. Glassmeier, G. J. Pringle, A.I.K.E.F. Adaptive Hybrid Model for Space Plasma Simulations, Computer Physics Communications, 182, 946-966, doi:10.1016/j.cpc.2010.12.033, 2011.
- H. Kriegel, S. Simon, P. Meier, U. Motschmann, J. Saur, A. Wennmacher, D.F. Strobel, M.K. Dougherty, Ion densities and magnetic signatures of dust pick-up at Enceladus, J Geophys Res, 119, 2740-2774, doi:10.1002/2013JA019440, 2014.

Institute of Mathematical Physics

Prof. Dr. Patrik Recher

Researcher's Career

- Full professor for Theoretical Physics at the TU Braunschweig
- Emmy Noether group leader (DFG) at the Universität Würzburg
- Postdoc at the Universiteit Leiden and TU Delft
- Postdoc at Stanford University and University of Tokyo
- PhD in Theoretical Physics at the Universität Basel
- Diploma in Theoretical Physics at the Universität Basel

Funding

DFG, EU, Lower-Saxony

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Mission Statement

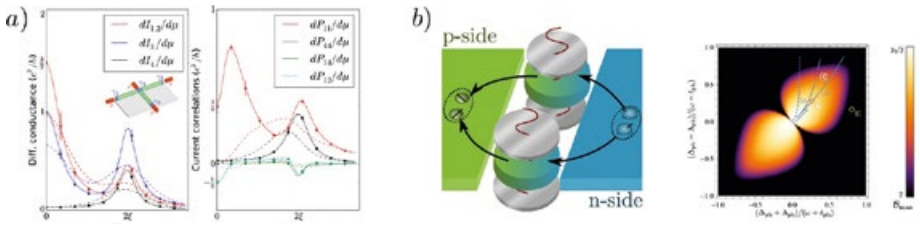
The theory of quantum transport in condensed matter systems is at the heart of a profound understanding of charge, spin and energy transport at the nano- and mesoscale. We work towards predictions of new transport means for information and computing in new materials and devices.

Research

Creation and detection of spin-entangled electrons: The notion of entanglement, non-classical correlations between distant particles, is one of the most elusive but useful predictions of quantum theory. We work theoretically towards the creation and detection of mobile and pairwise spin-entangled electrons at superconductor-normal hybrid structures which combine metals and semiconductors at low temperatures. We use the theory of coherent electron transport in non-equilibrium in combination with effective low-energy quantum models.

Probing new phases of matter by quantum transport: In recent years new materials that mimic the dynamics of massless relativistic particles were brought into focus of modern condensed matter research. The hallmark of these materials are so called topologically protected surface states which host quasiparticle excitations with fascinating properties, e. g. anyons with non-abelian statistics or spin-momentum locked Dirac-states exhibiting Berry phase effects. We investigate how electron transport can probe and manipulate such excitations. In addition we are also interested in designing new material hybrid structures that would host such surface states. This research direction is also part of our cluster of excellence "QuantumFrontiers".

Quantum Metrology: The physics of measurement and a precise definition of standards is a key issue in metrology. We work within the graduate school "NanoMet" on questions of quantized transport phenomena that could be used for metrological applications. Further, we consider the conversion of entangled electronic degrees of freedom to polarization-entangled photons, e. g. in superconducting light-emitting diodes, and investigate the quantification and stability of these entangled electrons- and photon pairs.



a) Transport properties (conductance and noise) of a topological T-junction (inset) as a function of voltage μ (taken from L. Weithofer et al., Phys. Rev. B 90, 205416 (2014))
b) emission of photon pairs in a superconducting p-n junction with two quantum dots embedded in photonic cavities, the Bell parameter B_{max} measures the fidelity of the entanglement of the photon pairs (taken from A. Schroer and P. Recher, Phys. Rev. B 92, 044514 (2015))

Publications

- S. Park, H.-S. Sim, P. Recher, Electron-Tunneling-Assisted Non-Abelian Braiding of Rotating Majorana Bound States, Phys. Rev. Lett. 125, 187702 (2020).
- C. De Beule, F. Dominguez, P. Recher, Aharonov-Bohm Oscillations in Minimally Twisted Bilayer Graphene, Phys. Rev. Lett. 125, 096402 (2020).
- A. Schuray, L. Weithofer, P. Recher, Fano Resonances in Majorana Bound States-Quantum Dot Hybrid Systems, Phys. Rev. B 96, 085417 (2017).
- A. Schroer, P.G. Silvestrov, P. Recher, Valley-Based Cooper Pair Splitting via Topologically Confined Channels in Bilayer Graphene, Phys. Rev. B 92, 241404(R) (2015).
- L. Weithofer, P. Recher, T.L. Schmidt, Electron Transport in Multiterminal Networks of Majorana Bound States, Phys. Rev. B 90, 205416 (2014).

Institute for Electrical Measurements and Foundations of Electrical Engineering

Prof. Dr. Meinhard Schilling

- Head of the Institute for Electrical Measurements and Foundations of Electrical Engineering since 2001
- Speaker of the Braunschweig International Graduate School of Metrology since 2007
- Speaker of the RTG 1952/1 since 2014
- Dean of studies (EE) 2010 – 2012
- Member of Braunschweigische Wissenschaftliche Gesellschaft since 2015
- Founding partner of 3 spin-off companies Magnicon GmbH, Capical GmbH, Fabmaker GmbH

Researcher's Career

- Universität Hamburg, Diploma in Physics, 1989
- Universität Hamburg, Ph.D. (Dr.rer.nat) in Physics, 1992
- Universität Hamburg, Habilitation, (Experimentalphysik), 1998
- Universität Hamburg, Scientific Assistant, 1989-1998
- Universität Hamburg, Privatdozent, 1998-2001
- TU Braunschweig, Full Professor (Electrical Engineering), since 2001

Funding

DFG (SFB508, SFB578, GrK1952/1, SPP1681), BMBF, BMWi, BMZ, Humboldt-Foundation, MWK Niedersachsen, EU Projects

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Mission Statement

The research topics cover the manufacturing of novel sensors from metals and metal oxide ceramic materials and their integration into sensor systems by analog electronics operated by microcontroller systems. Main application areas are electromagnetic sensor systems, biomedical diagnostic instruments and ultrahigh frequency measurements. The institute hosts the Braunschweig International Graduate School of Metrology and the DFG RTG 1952/1 "Metrology of Complex Nanosystems" and is founding member of the Laboratory of Emerging Nanometrology LENA.

Research

In the cleanroom facility of the institute ultrasensitive SQUID-Sensors and Josephson junctions from high-temperature superconductors are manufactured. From magnetic materials AMR, GMI and Fluxgate sensors are built and patterned by UV-lithography and electron beam lithography. The characterization is accomplished by electron microscopy (SEM, TEM, EDX) and by scanning force microscopy, as well as by x-ray diffraction. The sensor characterization is done by electrical transport and noise measurements in a shielded environment, especially in the magnetically shielded room Vakuumschmelze AK3b at the institute.

These preparation methods are complemented by high-resolution additive manufacturing of thermoplastic material, ceramics and metal structures. For commercialization we support our spin-off company Fabmaker GmbH, Braunschweig.

For biomedical diagnosis electrical measurements on the human body surface, we developed with research partners novel instruments for heart diagnosis and for brain-computer-interfaces based on capacitive electrodes. With these electrodes the signal can be measured without direct electrical contact to the skin. The new ECG systems are approved as medical devices and are sold by our spin-off company Capical GmbH, Braunschweig.

The investigation of magnetic nanoparticles as markers in immunoassays is the main topic of many projects. Magnetic iron-oxide nanoparticles are biocompatible and are approved for use in human body as contrast agent. We investigate the preparation of nanoparticles, their stabilization and functionalization and employ them in diagnostic systems such as magnetic particle imaging.

With our terahertz microscope we investigate ultrafast electronic circuits with operating frequencies up to above 1 THz. This instrument can measure and visualize the spatial radiation distribution above a microwave circuit with 100 nm resolution.

Publications

- Heim E, Ludwig F, Schilling M, 2009, Binding assays with streptavidin-functionalized superparamagnetic nanoparticles and biotinylated analytes using fluxgate magnetorelaxometry, J. Magn. Magn. Mater. 321:1628
- Ludwig F, Guillaume A, Schilling M, Frickel N, Schmidt A M. 2010. Determination of core and hydrodynamic size distributions of $CoFe_2O_4$ nanoparticle suspensions using ac susceptibility measurements. J. Appl. Phys. 108:033918
- Dieckhoff J, Schilling M, Ludwig F. 2011. Fluxgate based detection of magnetic nanoparticle dynamics in a rotating magnetic field. Appl. Phys. Lett. 99:112501
- I Yoshida T, Enpuku K, Dieckhoff J, Schilling M, Ludwig F, 2012, Magnetic fluid dynamics in a rotating magnetic field, J. Appl. Phys. 111: 053901
- Ludwig F, Wawrzik T, Yoshida T, Gehrke N, Briel A, Eberbeck D, Schilling M, 2012, Optimization of magnetic nanoparticles for magnetic particle imaging, IEEE Trans. Magn. 48:3780

Institute of High Frequency Technology – THz-Photonics Group

Prof. Dr. Thomas Schneider

Researcher's Career

- Full Professor for Terahertz-Systemtechnik, TU-Braunschweig
- Full Professor for High-Frequency Technology, HfT-Leipzig
- Head of the Institute for High Frequency Technology, Leipzig
- Guest Professor, Ecole Polytechnique Federal de Lausanne (EPFL), Switzerland
- Guest Scientist, Heinrich Hertz Institute, Berlin,
- Guest Scientist Telekom-Laboratories, Berlin
- Ph.D. in Physics TU-Cottbus
- Development engineer AEG-Postautomation, Berlin
- Diploma Degree in Electrical Engineering, Humboldt Universität zu Berlin

Funding

BMBF, DFG, VW-Stiftung

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Mission Statement

The data rates in all communication pipes such as the Internet, data centers, or even between the cores of a super-computer, are increasing drastically. To keep pace with these increasing data rates, new approaches are required. Thus, the aim of our research is to find new methods of data communications and signal processing.

Research

Ultra-high Bitrate Communications: The maximum possible symbol rate can be transmitted in a channel if each sub-channel has a rectangular bandwidth. This requires sinc-shaped symbols in the time domain. However, such a shape is just a theoretical construct. We have found ways to circumvent this physical problem through the generation of periodical symbols. With these symbols we can transmit sub-channels directly adjacent to each other without any guard-band between them. For wireless communications, like WiFi or the cellphone networks, usually carrier frequencies below 10 GHz are used. However, this drastically limits the transmittable data rates. Thus, another very important field of our research is to find methods to transmit ultra-high data rates with carrier frequencies in the mm- and THz-range of the electromagnetic spectrum as well as the generation of these frequencies.

Optical Signal Processing: For ultra-high data rates the electrical signal processing comes to its limits. Thus, we investigate ways to make the complete signal processing all-optically. This includes optical sampling, optical storage and optical spectrum analysis.

Integrated Optics: "... with cutting-edge supercomputers, the trick is to keep them from melting." (Nature 492, 174, 2012). A solution for these rising temperatures and corresponding energy consumption in modern electronics can be to use photons instead of electrons for the signal processing. However, this requires small-footprint, integrated solutions. Thus, we are working on Silicon-on-Insulator based optical chips for all-optical signal processing, optical transmitters and receivers.

Distributed Fiber Sensing: Another important field of our research is distributed Brillouin fiber sensing. These sensors can measure the temperature and strain over distances of 30-50 km with a resolution of 1 m. Thus, they can be seen as thousands of sensors in just one fiber and can be used to monitor pipelines, railway tracks, motorways, buildings etc.. Our aim is to enhance the sensitivity and resolution of these sensors.

back: Karanveer Singh, Stefan Preussler, Cheng Feng, Ranjan Das, Janosch Meier, Thomas Schneider, Lucas Ribeiro (f.l.t.r.)
front: Madhurima, Das, Rajanya Das, Weihong Liang, Sabrina Seidel, Souvaraj De, Nabil Alchami

Publications

- Optical sinc-shaped Nyquist pulses of exceptional quality. M. A. Soto, M. Alem, M. A. Shoaie, A. Vedadi, C. S. Brès, L. Thévenaz, and T. Schneider. Nature Commun. 4:2898 doi: 10.1038/ncomms3898 (2013.
- Frequency-time coherence for all-optical sampling without optical pulse source. S. Preußler, G. Raoof-Mehrpoor and T. Schneider. Sci. Rep. 6, 34500; doi: 10.1038/srep34500 (2016).
- Nonlinear Optics in Telecommunications (Advanced texts in physics, ISSN 1439-2674). T. Schneider, Springer-Verlag, Berlin Heidelberg New York (2004), ISBN 3-540-20195-5, Reprint for the Peoples Republic of China, Science Press Beijing (2007).
- Nonlinearity-and dispersion-less integrated optical time magnifier based on a high-Q SiN microring resonator. A. Misra, S. Preußler, L. Zhou, T. Schneider, Sci. Rep. 9, 14277; doi: 10.1038/s41598-019-50691-2 (2019).
- Link budget analysis for terahertz fixed wireless links. T. Schneider, A. Wiatrek, S. Preussler, M. Grigat, M. P. Braun. IEEE Trans. on THz Science and Technol., 250–256 (2012).

Institute of High Frequency Technology (IHF) – Microwave Engineering Lab

Prof. Dr.-Ing. Jörg Schöbel

Researcher's Career

- TU Braunschweig: University Professor for Microwave Engineering
- Bosch Corporate Research and Advance Engineering: R&D engineer and project leader in automotive radar systems research and RF-MEMS
- Dr.-Ing. at TU Braunschweig
- TU Braunschweig: Research Associate in the field of organic electronics & electronic properties of layer interfaces
- AT&T Bell Laboratories, Holmdel, USA: Visiting Scientist in the field of Silicon oxidation technologies
- Study of Electrical Engineering (microelectronics, microwave technology and optical communications) at TU Braunschweig

Funding

Industry and public funding with a focus on SMEs

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Mission Statement

Our work comprises state of the art research on conception, design, analytical modeling and numerical simulation covering high-frequency components up to entire microwave systems. Applications comprise radar and sensing, communications, and materials characterization and processing. We put a strong focus on the application of scientific results in terms of prototyping and demonstration.

Research

IHF's microwave engineering lab focuses on research and advanced development in the following fields:

Radar and ground penetrating radar, microwave imaging, and signal processing: We investigate microwave radar and imaging systems for a multitude of applications. Industrial applications range from civil engineering to agriculture, aviation (collision warning for ultralight aircraft, passive-radar localization of aircraft), quality control for thin-film processing (synthetic-aperture imaging radar) and automotive radar with very large array antennas. In this context we design and realize radar system prototypes based on different concepts and implement signal processing for functional demonstration.

Microwave circuits and antennas for applications in communications, sensing, and security systems: Our experience in antenna design comprises broadband antennas as well as planar patch arrays and beamforming with Rotman lenses in a range from MHz to millimeter waves. We design and realize microwave circuits for radar, communication, sensing and security applications, such as detection and localization of radio emission and ultrafast tunable and ultrawideband microwave signal generation. We have a full range of equipment for prototyping as well as for microwave and antenna measurements up to 170 GHz. Commercial software is employed for circuit design and for 3D electromagnetic simulation of antennas and passive structures.

Analytical and numerical modeling, development and application of mode-matching algorithms for 3D electromagnetic simulation and filter design: We study analytical and numerical modeling of microwave systems, components and signal processing concepts. The mode-matching framework developed in our group enables extremely fast and accurate simulation and optimization of passive microwave structures.

Microwave material characterization and processing, microwave plasma technology: We investigate energy-efficient microwave heating processes. In this context, we study and implement accurate material characterization techniques to exactly predict material properties also at elevated temperatures.

Millimeter-wave and Terahertz technology for communications and sensing: Much experience has been gained in the design and realization of RF front ends, as well as planar antennas and arrays with beam forming devices, employing low-cost RF technology, micro-technology and commercial MMICs, e.g. for 77 GHz automotive radar.

Publications

- Markus Krueckemeier, Fabian Schwartau, Joerg Schoebel, A modular localization system combining passive RF detection and passive radar, 2019 Kleinheubach Conference, 23-25 Sept. 2019, Miltenberg, Germany, ISBN: 978-3-948571-00-9.
- Fabian Schwartau, Stefan Preussler, Markus Krueckemeier, Florian Pfeiffer, Hannes Stuelzebach, Thomas Schneider, Joerg Schoebel, Modular Wideband High Angular Resolution 79 GHz Radar System, German Microwave Conference GeMiC 2019, , March 25-27, Stuttgart, Germany, DOI: 10.23919/GEMIC.2019.8698121.
- D. Seyfried, J. Schoebel, Ground Penetrating Radar for Asparagus Detection, Journal of Applied Geophysics, Volume 126, March 2016, Pages 191-197.
- S. Brueckner, D. Seyfried, J. Schoebel, Locating utility pipes using m-sequence ground penetrating radar, 2015 German Microwave Conference (GeMiC), Pages: 351-354.
- J. Schoebel, P. Herrero, Planar Antenna Technology for mm-Wave Automotive Radar, Sensing, and Communications; in: Radar Technology, ed. Guy Kouemou, Intech, Croatia, December 2009, pp. 297-318, http://www.intechopen.com/books/radar-technology.

Institute of Control Engineering

Prof. Dr.-Ing. Walter Schumacher

Researcher's Career

- Conference SPS/IPC/Drives, Chair of the Drives Part
- Member of the International Steering Committee of PEMC
- Member of the Executive Committee and International Steering Committee of European Conference on Power Electronics and Applications
- Leader of the Institute of Control Engineering
- University (Full) Professor for Control Engineering at Technische Universität Braunschweig
- Division Manager Systems Engineering at Institut für Angewandte Mikroelektonik GmbH, Braunschweig
- Dr.-Ing. at Technische Universität Braunschweig
- Study of Electrical Engineering at Technische Universität Braunschweig

Funding
DFG, BMBF, BMWi, Lower Saxony, Industry

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Mission Statement

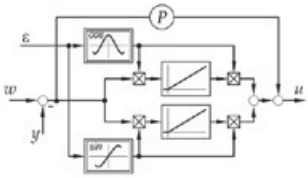
Dynamic and closed-loop systems are present in almost every technical system. Based on fundamental research on control theory methods, our group focuses on improving control of electrical drives and electrical energy distribution in cooperation with partners in industry and research.

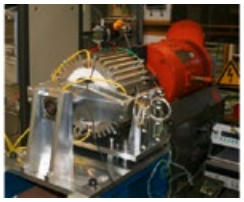
Research

Control methods: Control performance is directly linked to the knowledge of a system's structure and its parameters. Therefore, model-based control methods are one focus of our research. Further fields of research are resonant and multi-resonant control schemes (harmonic control) providing disturbance rejection for a selectable fundamental frequency as well as its harmonics. Third, we are using bit streams of delta sigma converters, long time known in the field of audio applications, without digital low pass filtering as inputs of control algorithms by employing a bit stream algebra. This results in high dynamics comparable to analog designs and the parameter stability of digital approaches while shifting the sampling frequency to formerly unachievable values.

Electrical drives: During the 1970s, field-oriented current control for induction machines was developed at our institute, and our research still continues in this area. More recently, we have developed enhanced models of synchronous machines and special drives like transverse flux machines with regard to magnetic saturation and harmonics in model parameters. Thus, we were able to enhance the quality of encoderless control approaches and the precision of torque control. In other research projects, we have used FPGA technology to enhance position and speed acquisition as well as control performance through reduced sampling times in the current control. The application of delta sigma control using bit stream algebra has led to further improvements in performance.

Power systems: The increasing amount of renewable energy sources present in electrical power grids requires thorough scientific investigation. Our work concentrates on the modeling and stability analysis of current and future power grids consisting of decentralized sources like PV-parks and wind farms as well as classical energy producers. We have been able to enhance control designs by developing models of interconnected power plants with reduced complexity that provide a better insight into grid dynamics.





Publications

- Hans, F.; Schumacher, W.; Chou, S.-F.; Wang, X. (2019): Passivation of Current-Controlled Grid-Connected VSCs Using Passivity Indices. In: IEEE Transactions on Industrial Electronics, vol. 66, no. 11, Nov. 2019, pp. 8971-8980
- Hans, F.; Oeltze, M.; Schumacher, W. (2019): A Modified ZOH Model for Representing the Small-Signal PWM Behavior in Digital DC-AC Converter Systems. In: 45th Annual Conference of the IEEE Industrial Electronics Society, (IECON 2019), 2019
- Hans, F.; Schumacher, W.; Harnefors, L. (2018): Small-Signal Modeling of Three-Phase Synchronous Reference Frame Phase-Locked Loops. In: IEEE Transactions on Power Electronics, vol. 33, no. 7, 2018, pp. 5556-5560
- Klein, A.; Thielmann, M.; Schumacher, W. (2018): Sensorless Current and Speed Control of a PMSM Driven with a ΔΣ-PWM. In: 2018 20th European Conference on Power Electronics and Applications (EPE'18 ECCE Europe), 2018, pp. 1-10
- Hans, F.; Schumacher, W. (2017): Modeling and small-signal stability analysis of decentralized energy sources implementing Q(U) reactive power control. In: 11th IEEE International Conference on Compatibility, Power Electronics and Power Engineering (CPE-POWERENG), Spain, IEEE, 2017

Institute for Condensed Matter Physics

Prof. Dr. Stefan Süllow

Researcher's Career
- Supernumerary professor at TU Braunschweig
- Scientific Assistant and junior professor at TU Braunschweig
- Postdoc at University of Michigan, Ann Arbor, USA, and MPI-CPfS, Dresden
- Ph.D. at Leiden University, Kamerlingh Onnes Laboratory, Netherlands
- Study of Physics at TU Braunschweig

Funding
DFG, DAAD, JSPS, ESF

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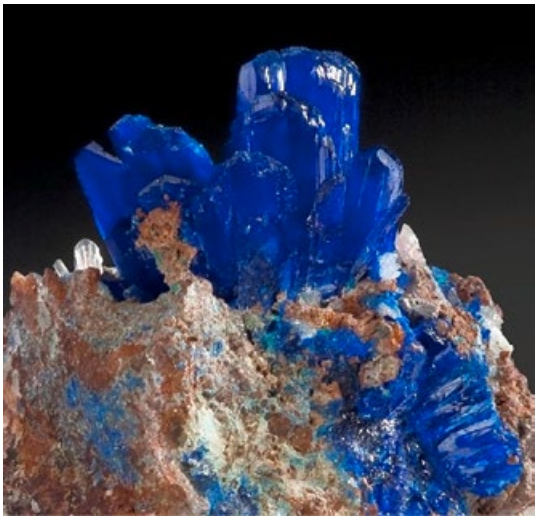
Mission Statement

In solid-state materials, new and exotic phenomena emerge as a result of strong electronic interactions, and which form the basis for future applications of such materials. It is our aim to better understand these phenomena and the underlying quantum mechanical concepts.

Research

Fundamental Condesed Matter Physics: The main research focus lies on studies of the electronic and magnetic properties of new solid state materials. In this field, emergent phenomena – viz., new ground state phases resulting from cross correlation between electronic, structural and spin degrees of freedom – challenge our understanding of the physics of condensed matter. Typical examples for such emergent phenomena are novel superconducting states or exotic field induced phases with a character resembling so-called Bose-Einstein-condensates.

In this context, we study the physical properties of new materials by a multitude of different experimental techniques, ranging from essential laboratory tools like electrical resistivity or magnetization to advanced microscopic probes offered at large scale facilities such as neutron scattering or muon spin relaxation. These experiments are carried out under extreme environments, such as low temperatures down into the milliKelvin range, or high magnetic fields a million times larger than the earth magnetic field. In close collaboration with theory, the results of these studies are used to further develop the modelling of new and modern materials. This way, in particular insight is obtained into the role of quantum mechanical effects controlling material properties.



Publications

- B. Willenberg, M. Schäpers, A.U.B. Wolter, S.-L. Drechsler, M. Reehuis, J.-U. Hoffmann, B. Büchner, A. Studer, K.C. Rule, B. Ouladdiaf, S. Süllow, S. Nishimoto: Complex field induced states in Linarite $PbCuSO_4(OH)_2$ with a variety of high-order exotic SDWp states - Phys. Rev. Lett. 116 (2016) 047202
- D. Rauch, M. Kraken, F.J. Litterst, S. Süllow, H. Luetkens, M. Brando, T. Förster, J. Sichelschmidt, A. Neubauer, C. Pfleiderer, W.J. Duncan, F.M. Grosche: Spectroscopic study of the metallic magnetism in single-crystalline $Nb_{1-x}Fe_{2+y}$ - Phys. Rev. B 91 (2015) 174404
- B. Willenberg, H. Ryll, K. Kiefer, D.A. Tennant, F. Groitl, K. Rolfs, P. Manuel, D. Khalyavin, K.C. Rule, A.U.B. Wolter, S. Süllow: Luttinger-Liquid Behavior in the Alternating Spin-Chain System Copper Nitrate - Phys. Rev. B 91 (2015) 060407(R)
- B. Willenberg, M. Schäpers, K.C. Rule, S. Süllow, M. Reehuis, H. Ryll, B. Klemke, K. Kiefer, W. Schottenhamel, B. Büchner, B. Ouladdiaf, M. Uhlarz, R. Beyer, J. Wosnitza, A.U.B. Wolter: Magnetic Frustration in a Quantum Spin Chain: The Case of Linarite $PbCuSO_4(OH)_2$ - Phys. Rev. Lett. 108 (2012) 117202
- K.C. Rule, A.U.B. Wolter, S. Süllow, D.A. Tennant, A. Brühl, S. Köhler, B. Wolf, M. Lang, J. Schreuer: Nature of the spin dynamics and 1/3 magnetization plateau in azurite - Phys. Rev. Lett. 100 (2008) 117202

Department of Electrical Engineering, Information Technology, Physics

Prof. Dr. Andrey Surzhykov

Researcher's Career

- Full Professor for Theoretical Atomic Physics at Braunschweig University of Technology
- Head of the Institute "Fundamental Physics for Metrology" at National Metrology Institute (PTB)
- Senior Researcher at Helmholtz Institute Jena
- Helmholtz Young Investigators Group Leader at University of Heidelberg
- Guest Researcher at École normale supérieure, Paris
- Postdoc at Max Planck Institute for Nuclear Physics, Heidelberg
- Dr. rer. nat. at the University of Kassel
- Study of Physics, Lomonosov Moscow State University

Funding

BMBF, DFG, HGF

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Mission Statement

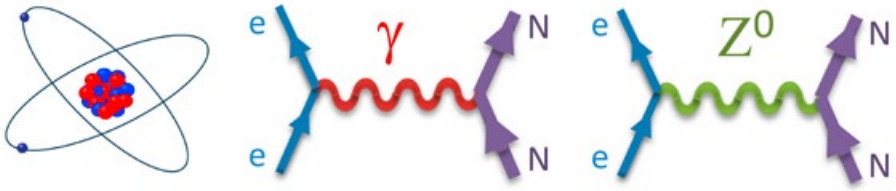
Development of novel theoretical approaches to study electronic structure and interactions of neutral atoms and positively charged ions. Knowledge about the properties of these atomic systems is of high demand for probing fundamental symmetries of nature, realizing high-precision atomic clocks, or even searching for the "New Physics".

Research

High-precision atomic structure calculations: We develop and implement methods aiming at accurate predictions of atomic energy levels, lifetimes and transition probabilities. Based on the multi-configuration Dirac-Fock and configuration-interaction approaches, these methods provide theoretical data for the analysis and guidance of modern experiments with trapped atoms and ions.

Isotope shift studies and search for the New Physics: During the last years we have performed detailed theoretical investigations of the isotope shift in highly-charged ions. Besides the nuclear properties, this shift is believed to be affected by the coupling of an ion with new hypothetical boson particles. Our studies, which were performed in collaboration with research colleagues from the PTB, allowed us to establish new restrictions on the properties of these (New-Physics) particles.

Investigations of atomic parity-violation phenomena: Based on the relativistic many-body calculations we have proposed a number of scenarios to observe the parity mixing of atomic states as caused by the Z^0-boson exchange between nucleus and electrons as well as by the nuclear anapole moment.



Development of non–perturbative approaches for time-dependent Dirac problems: This work promises to have a profound impact not only for the accurate description of fundamental processes, accompanying atomic and ionic collisions, but also for the design of new ab-initio methods in quantum chemistry.

Studies of interactions of vortex light beams: In recent years we have paid special attention to the interaction of vortex photon beams with trapped ions. We have shown that the use of these beams can significantly modify the properties of fundamental photo-induced atomic processes. This opens new opportunities for the high-precision spectroscopy of electric dipole-forbidden atomic clock transitions.

Publications

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- Yerokhin, V. A. & Surzhykov A. (2019) Theoretical Energy Levels of 1sns and 1snp States of Helium-Like Ions. J. Phys. Chem. Ref. Data 48:033104. doi:10.1063/1.5115353
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Institute of Semiconductor Technology – Hybrid Nanostructures and Time-Resolved Nanooptics

Prof. Dr. Tobias Voss

Researcher's Career

- Professor at the Institute of Semiconductor Technology, TU Braunschweig
- Substitute Professorship "Nanotechnology" at the Institute of Microsystems Engineering IMTEK, University of Freiburg
- Business Development Manager at the Fraunhofer Heinrich Hertz Institute, Fiber-optical sensor systems, Goslar
- Senior Research Assistant at the Institute of Solid State Physics, University of Bremen
- Postdoc at the School of Engineering and Applied Science, Harvard University, USA
- Dr. rer. nat. at the Institute of Solid State Physics, University of Bremen
- Diploma degree in physics at Clausthal University of Technology, Clausthal-Zellerfeld
- Visiting researcher at JILA/University of Colorado at Boulder, USA

Funding

DFG, BMWi, BMU

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Mission Statement

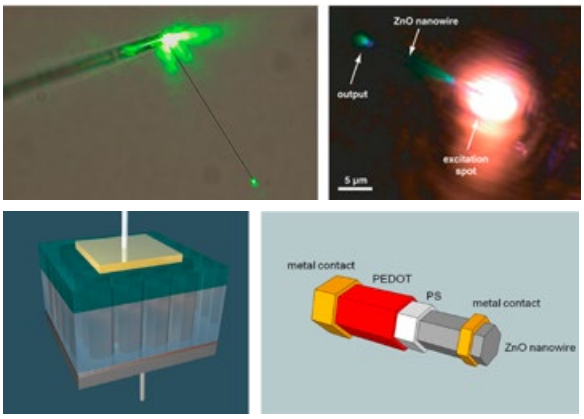
We develop hybrid nanomaterials for optoelectronic and sensing applications and analyze the relevant electron- and energy-transfer processes at the hybrid interfaces with the focus on time-resolved optical spectroscopy methods

Research

Chemical vapor deposition of polymer layers: The design and fabrication of organic-inorganic hybrid devices have attracted considerable attention in basic research and for applications because they offer the possibility to combine the stability and tunable electronic properties of inorganic semiconductors with the large functionality and selectivity of organic chemistry. In semiconductor technology, gas-phase deposition techniques are often favorable for achieving controlled interfaces. We develop and study chemical vapor deposition (CVD) techniques for different kinds of polymers that allow us to achieve a conformal coating of porous or 3D-nanostructured substrates with ultrathin polymer layers.

Fluorescent carbon nanoparticles and colloidal quantum dots: Strongly luminescent and environmentally friendly Carbon nanodots (C-Dots) with diameters below 10 nm offer a great potential for optimized color conversion in LED displays and selective gas detection in sensing devices. Low toxicity, biocompatibility, excellent chemical and photo stability, cheap large-scale fabrication schemes and tunable photoluminescence emission are among their outstanding properties. Our research focuses on functionalization schemes in which C-Dot with optimized photo-stability and tailored absorption and emission spectra are combined with inorganic semiconductor nanostructures in optoelectronic or sensing devices.

Nanooptical investigations of semiconducting and hybrid materials with picosecond time-resolution: We employ various optical spectroscopy techniques (with the focus on picosecond time-resolved laser spectroscopy) to study the dynamics of electronic excitation in optoelectronic devices. The detailed analysis of relaxation, recombination, and trapping processes allows us to develop strategies for improving the device performance, efficiency, and stability.



Publications

- Functional ZnO/polymer core-shell nanowires fabricated by oxidative chemical vapour deposition (oCVD) J.-P. Richters, A. Dev, C. Ronning, J. Gutowski, and T. Voss; Journal of Physics D: Applied Physics 47, 394004 (2014).
- Intense intrashell luminescence of Eu-doped single ZnO nanowires at room temperature by implantation created Eu-Oi complexes; S. Geburt, M. Lorke, A. da Rosa, T. Frauenheim, R. Röder, T. Voss, U. Kaiser, W. Heimbrodt, and C. Ronning; Nano Letters 14, 4523 (2014).
- Oxygen-controlled photoconductivity in ZnO nanowires functionalized with colloidal CdSe quantum dots; D. Hou, A. Dev, K. Frank, A. Rosenauer, and T. Voss; Journal of Physical Chemistry C 116, 19604 (2012).
- Scalable fabrication of nanowire photonic and electronic circuits using spin-on glass; M. A. Zimmler, D. Stichtenoth, C. Ronning, W. Yi, V. Narayanamurti, T. Voss, and F. Capasso; Nano Letters 8, 1695 (2008).
- High-order waveguide modes in ZnO nanowires; T. Voss, G. T. Svacha, S. Müller, C. Ronning, D. Konjhodzic, F. Marlow, and E. Mazur; Nano Letters 7, 3675 (2007).

Institute of Semiconductor Technology – Semiconductor- and Nanotechnology

Prof. Dr. Andreas Waag

Researcher's Career

- Quantum Valley Lower Saxony (TUBS speaker)
- Cluster of Excellence QuantumFrontiers (TUBS Speaker)
- Cluster of Excellence PhoenixD (member)
- Laboratory for Emerging Nanometrology LENA (Speaker of the Execute Board)
- Epitaxy Competence Center ec2 (director)
- Hannover-Braunschweig Research Alliance on Quantum- and Nanometrology QuanoMet (TUBS speaker)
- Member of International Graduate School on Nanometrology IGSM, Braunschweig
- Speaker of the Advisory Board "Advanced UV for Life" (BMBF)
- Full Professor for Semiconductor Technology at Braunschweig University of Technology (2003-present)
- Associate Professor at the department of semiconductor physics, Ulm University (2000–2003)
- Visiting Assistant Professor at Purdue University, West Lafayette, USA (1996–1997)
- Gaede Award of the German Vacuum Society (1996)
- PhD at the University of Würzburg, Germany (1990)
- Study of physics, University of Würzburg, Germany (1980–1985)

Funding

EU, DFG, BMBF, Industry, VW Foundation

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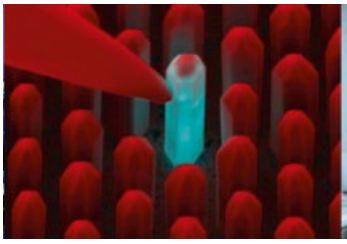
Mission Statement

Enspiring novel applications by developing semiconductor technology from fundamental research to novel device architectures.

Research

The institute is one of the few university places worldwide exploring both epitaxy, chip processing and nanoanalysis in clean room facilities with an infrastructure, which is compatible with industry standards. In the Epitaxy Competence Center ec2, which has been initiated jointly with Osram Opto Semiconductors GmbH, Regensburg, the Waag group is working in the field of GaN technology in close collaboration with our international partners. Due to the opening of our new research center LENA, the Laboratory for Emerging Nanometrology, we have access to top infrastructure for material and device analysis. Many projects are related to GaN microLED technology for structured light illumination with potential applications in life science, augmented reality, optical sensing or neuromorphic computing. Research on the quantum control of light is related to projects in the Excellence Cluster QuantumFrontiers as well as the Quantum Valley Lower Saxony moonshot program Q1.



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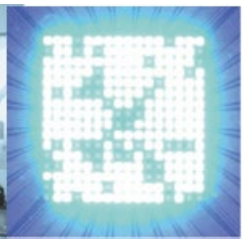

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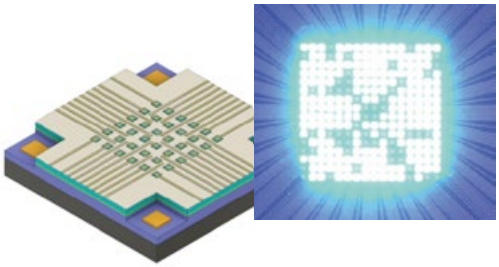
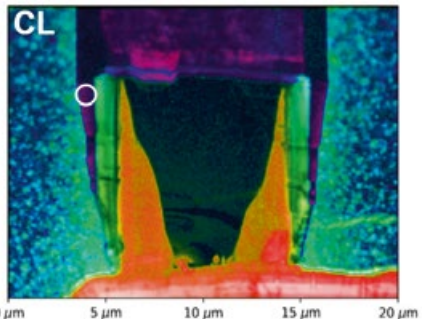


GaN microLED arrays for Structured Micro Illumination Light Engines (SMILE ©) from ec2. Photo: © Jan Gülink, TUBS



Nanoanalytics of a UV emitting LED structure by spatially resolved e-beam luminescence in LENA.
© Christoph Margenfeld, TUBS

Publications

- H.S. Wasisto, J.D.Prades, J.Gülink, A.Waag, Beyond solid-state lighting: Miniaturization, hybrid integration, and applications of GaN nano-and micro-LEDs, Applied Physics Reviews 6(4),Y (2019)
- G. Scholz, (...), A. Waag, Continuous live-cell culture imaging and single-cell tracking by computational lensfree LED microscopy, Sensors 19(5),1234 (2019)
- F. Steib, (...), A.Waag, Defect generation by nitrogen during pulsed sputter deposition of GaN, Journal of Applied Physics 124(17), 175701 (2019)
- Normally off Vertical 3-D GaN Nanowire MOSFETs with Inverted p-GaN Channel, F.Yu (...) A.Waag, IEEE Transactions on Electron Devices, 65(6), pp. 2439-2445 (2018)
- S. Li and A. Waag, "GaN based nanorods for solid state lighting", J. Appl. Phys. 111 (2012) 071101 (rank #2 of most often downloaded papers of JAP in 2012).

6

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English and American Studies

Prof. Dr. Carmen Becker

Researcher's Career

- Full Professor Foreign Language Pedagogy, TU Braunschweig
- Associate Professor Foreign Language Pedagogy, TU Braunschweig
- Associate Professor Foreign Language Pedagogy, Leibniz Universität Hannover
- Dr. Phil., Leibniz Universität Hannover
- Research Assistant, Leibniz Universität Hannover
- Lecturer for Foreign Language Pedagogy and Applied Linguistics, Leuphana Universität Lüneburg
- Member of NiLS, Lower Saxony State Institute for Teacher Education and School Development
- Teacher at primary and secondary schools in Cuxhaven, Sülze and Celle
- Teacher Training, Second State Examination, Oldenburg
- Study of English and General Science Sachunterricht, Kassel/Monmouth (OR), First State Examination

Funding

MWK; BMBF; European Union

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Mission Statement

The aim is to identify factors that facilitate language acquisition/learning in instructional settings and to design evidence-based state-of-the-art methods, approaches and materials for language learning and teaching, for the purpose of impacting the English curriculum and English language teaching practice.

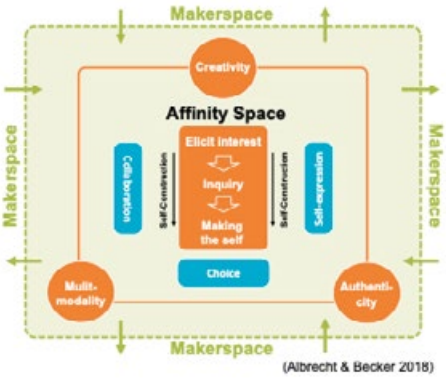
Research

MakerSpace Foreign Language Learning: There has been a major shift in the availability of access to authentic learning spaces for autonomous foreign language learning in the 21st century. As learners increasingly access learning environments online, schools as formal physical learning spaces lose their monopoly over language learning. We explore existing learning spaces for autonomy that offer the opportunity to merge personal and institutional learning environments and which can stimulate constructive learner activities, engagement and competency development through creative self-expression. From our research we derive key competencies to be integrated into teacher education to prepare future teachers to transcend learning landscapes and develop innovative foreign language environments.

Intercultural Citizenship Education through Picturebooks in early English Language Learning (ICEPELL): The main aim of this three-year ERASMUS + project, which focuses on innovation in the Higher Education and School Education Sectors, is to strengthen the profile of the teaching profession through the development of practitioner competencies to confidently integrate intercultural citizenship education (ICE) into early EFL education. The target group is the school community – practitioners (teachers of English, teacher librarians, student teachers), children aged 5 to 12 years, and teacher educators.

Inclusive foreign language pedagogy / Zertifikat Inklusiv Englisch Lehren und Lernen (ZiEL): The Convention of the United Nations for the rights of persons with disabilities grants all individuals access to an inclusive primary and secondary education with others in the communities in which they live. At the same time the European policy Mother Tongue +2 requires all European citizens to learn and speak two additional languages. We examine the implementation of the UN Convention in the foreign language classroom identifying teaching conditions and teacher competences for successful inclusive foreign language learning.

Digital logbook in the reflection space: The main aim of this project within DIBS (Digitale Kompetenzen für die Lehrkräftebildung an der TU Brauschweig) is the development, implementation and evaluation of a digital logbook which serves as structural element for critical reflection. The digital logbook links all labs, serves as a medium for documentation, reflection and evaluation and also addresses the biographical perspective of teacher students.



(Albrecht & Becker 2018)

Publications

- Becker, C.; Blell, G. & Rössler, A. (Eds.) (2016). Web 2.0 und komplexe Kompetenzaufgaben im Fremdsprachenunterricht. Frankfurt: Peter Lang.
- Becker, Carmen & Blell, Gabriele (2018): "Multimedia Narratives – Digital Storytelling and Multimedia Literacies." Anglistik 29.2 (2018) (Focus on Teaching Multimodality and Multiliteracy), S. 129-143.
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Georg Eckert Institute for International Textbook Research – Member of the Leibniz Association (GEI)

Prof. Dr. Eckhardt Fuchs

- Director of the Georg Eckert Institute
- Chair for History of Education/ Comparative Education at the Technical University Braunschweig

Researcher's Career

- Research director and deputy director of the Georg Eckert Institute
- Assistant professor at the University of Mannheim
- Research fellow at the Historical Commission in Berlin, the John F. Kennedy Institute of the Freie Universität of Berlin, the German Historical Institute in Washington and the Max Planck Institute for the History of Science in Berlin
- Studies and PhD at the University of Leipzig

Funding
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Mission Statement

Researchers at the GEI analyze textbooks and other teaching materials from diverse geographical regions and time periods in their respective contexts from the perspective of a range of academic disciplines. They make recommendations to policymakers and educational practitioners on how textbooks might be used to transcend difficulties in communication and understanding within or between societies. The research infrastructure of the GEI enables research into textbooks and allows us to support international partners working towards similar aims.

Research

The GEI conducts applied, multidisciplinary research into textbooks and educational media, informed primarily by history and cultural studies. It also provides advisory services to national and international education policymakers, practitioners and organisations, and acts as a coordinator and mediator in international issues and projects around textbooks. Research, knowledge transfer and research infrastructure services are all closely interconnected at the GEI; as a non-university institution both carrying out and facilitating research into textbooks and educational media, the institute is an internationally recognised centre of excellence in the field.

Prof. Dr. Eckhardt Fuchs combines research on the history of education and comparative education with textbook research. Based on a cooperation agreement he is a full professor at the Technical University and director of the GEI. His research interests include the global history of modern education, international education policies, and curriculum and textbook development. He focuses on the history and politics of transnational organizations involved in the field of education by emphasizing in particular their dependence on national and regional development processes. His approach is theory-based and comparative, transcending the bounds of national history and examining the interaction between international diffusion and interpenetration processes and regional appropriation processes. Furthermore, he has investigated the function of teaching and learning materials for secondary schools by international comparison as well as the impact of curricular reforms resulting from global developments on teaching practices especially in the field of history. He also has been writing extensively on the history and current status of textbook research and is editor of several educational journals.

Prof. Fuchs has been an advisor for international organizations such as UNESCO and OSCE and is involved in projects on textbook revisions in many parts of the world. He has been awarded scholarships by a variety of organizations and foundations and served as a visiting professor in Sydney, Umeå, Tokyo, and Seoul.

Villa Bülow – Georg Eckert Institute

Publications

- France, Corine; Faure, Romain; Fuchs, Eckhardt (Hg.) (2015): Bildung in Deutschland nach 1945. Transnationale Perspektiven. Frankfurt/Main.
- Fuchs, Eckhardt; Carrier, Peter; Messinger, Torben (2015): The International Status of Education about the Holocaust. A Global Mapping of Textbooks and Curricula. Paris: UNESCO.
- Bagchi, Barnita; Fuchs, Eckhardt; Rousmaniere, Kate (Hg.) (2014): Connecting Histories of Education: Transactions, Transculturalism and Transnationalism. New York: Berghahn Books.
- Fuchs, Eckhardt; Niehaus, Inga; Stoletzki, Almut (2014): Das Schulbuch in der Forschung. Analysen und Empfehlungen für die Bildungspraxis. Göttingen: V&R unipress (Eckert. Expertise 4).
- Fuchs, Eckhardt; Otto, Marcus (Hg.) (2013): Postcolonial Memory Politics in Educational Media. In: Journal of Educational Media, Memory and Society (JEMMS) 5 (1). Oxford, New York: Berghahn Books.

Institute for Educational Science

Department of Further Education and Media / Center of Excellence in Lower Saxon Higher Education

Prof. Dr. Stefanie Hartz

- Full Professor for Further Education
- Scientific Head of Center of Excellence in Lower Saxon Higher Education

Researcher's Career

- Full Professor for Further Education, TU Braunschweig, Institute for Educational Science
- Scientific Head of Center of Excellence in Lower Saxon Higher Education, TU Braunschweig
- Postdoctoral Researcher at Eberhard Karls University Tübingen
- Scientific Assistant at the German Institute for Adult Education – Leibniz Center for Lifelong Learning (DIE)
- Dr. phil., Ruhr-University Bochum
- Assistant at Ruhr-University Bochum
- Master's Study Program of Educational Science, Saarland University, Trier University

Funding

Federal Ministry of Education and Research (BMBF), Ministry of Sciences & Culture for Lower Saxony, Private Industry

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Mission Statement

We are dedicated to the assessment and enhancement of lifelong learning processes of individuals and organizations by engaging in applied and basic research using a broad spectrum of quantitative and qualitative research methods.

Research

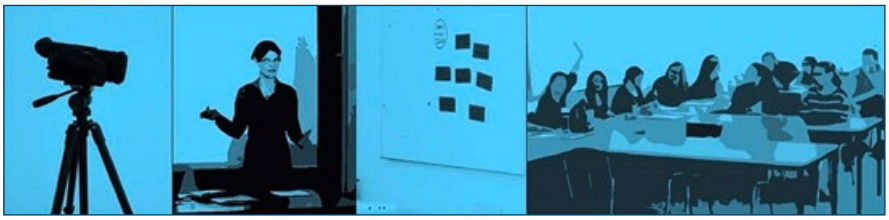
Our research on learning processes of individuals focuses on the following areas:

- analyzing the teaching competencies of academic teachers,
- examining key factors of influence on the learning processes of academic teachers participating in university teachers' training programs,
- analyzing the development of pedagogical/educational knowledge conveyed in academic teachers' training programs,
- evaluating the conditions of theoretical knowledge transfer in teacher-learner interaction.

In the context of organizational education, we explore learning processes in, by and between organizations. In this respect we analyze

- why and how organizations incorporate the principles of (quality) management models into their existing organizational lines of reasoning and action,
- how organizations acquire and assimilate management models,
- how organizations evolve instigated management models to the level of teacher-learner-interaction, and
- how or whether they ensure that management systems have an impact on the learner.

We realize applied and basic research implementing a complex combination of qualitative and quantitative research methods (surveys, case studies, expert interviews, group discussions, analysis of documents, videography etc.) with different measuring times. The data analyses are based on explorative, descriptive and multivariate procedures.



Publications

- Hartz, S., Aust, K., Gottfried, L. M., & Kurtz, C. (in Druck). Kompetenzentwicklung und Lerntransfer in der Hochschullehre. Eine empirische Studie mit Erhebungs- und Auswertungsinstrumenten. Wiesbaden: Springer VS.
- Beuße, M., & Hartz, S. (2021). Ein Instrument zur Messung von Lerntransferbedingungen im Kontext der hochschuldidaktischen Weiterbildung. Zeitschrift für Erziehungswissenschaft. 24(1), 155-184. https://link.springer.com/content/pdf/10.1007/s11618-021-00993-x.pdf.
- Kurtz, C., Hartz, S., Aust, K., & Gottfried, L. M. (2020). Pädagogische, methodisch-didaktische Kompetenz von Hochschullehrenden und deren Erfassung durch Videographie. In M. Merkt, A. Spiekermann, T. Brinker, A. Werner, & B. Stelzer (Hrsg.), Hochschuldidaktik als professionelle Verbindung von Forschung, Politik und Praxis. Tagungsband 2018 der Deutschen Gesellschaft für Hochschuldidaktik in der Reihe Blickpunkt Hochschuldidaktik (Band 137) (S. 67-80). Bielefeld: wbv.
- Hartz, S. (2018). Qualitätsmanagement und -entwicklung als Gegenstand der Organisationspädagogik. In M. Göhlich, A. Schröer, & S. M. Weber (Hrsg.), Handbuch Organisationspädagogik (S. 567-578). Wiesbaden: Springer Fachmedien.
- Hartz, S., Marx, S., Spielmann, J., & Voigt, V. (2018). Kompetenzzentrum Hochschuldidaktik für Niedersachsen: Weiterbildung, Beratung und Forschung. In B. Berendt, A. Fleischmann, N. Schaper, B. Szczyrba, & J. Wildt (Hrsg.), Neues Handbuch Hochschullehre (L 1.36). Berlin: DUZ Verlags- und Medienhaus GmbH.
- Aust, K., & Hartz, S. (2018). Ein Kompetenzmodell für die Hochschullehre. In B. Berendt, A. Fleischmann, N. Schaper, B. Szczyrba, & J. Wildt (Hrsg.), Neues Handbuch Hochschullehre (A 1.15). Berlin: DUZ Verlags- und Medienhaus GmbH.
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Institute of English & American Studies

Prof. Dr. Rüdiger Heinze

Researcher's Career
- Full Professor for American Literary and Cultural Studies, TU Braunschweig
- Associate Professor for American Literary and Cultural Studies, TU Braunschweig
- Assistant Professor for American Literary and Cultural Studies, Freiburg University
- Dr. Phil., TU Braunschweig
- Study of American Literature and Culture, Linguistics, History, and Comparative Literature, Braunschweig/Austin (TX)/ Bloomington (IN)

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BMBF, MWK, Andrea von Braun, DAAD, Fulbright, FRIAS

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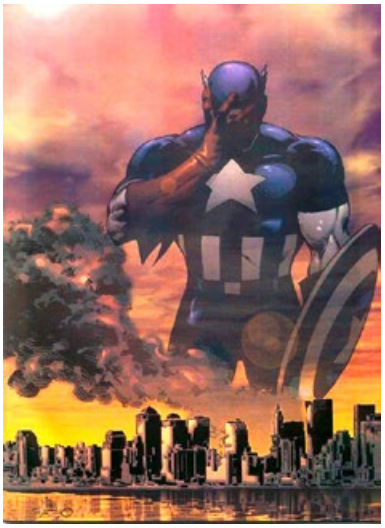
Mission Statement
Conceptualizing and delineating how literary and cultural texts represent and project who and what we (as a person or community) are and who we can or want to be.

Research
- A transdifferent and comparative literary and cultural history of US-American literatures of migration.
- Transmedial storytelling: how do storyworlds and entire fictional universes change when they move across media?
- Serial and transmedial young adult dystopias.



Source:
Mike Deodato Jr., Denis Calero
"Heroes" (New York: Marvel, 2001)

Publications

- Heinze, R. & Kraemer, L. (2015). Remakes & Remaking: Concepts – Media – Practices. Bielefeld: transcript.
- Heinze, R. & Mueller, K. (2010-). Reihe Kultur- und Naturwissenschaften im Dialog. Muenster: LIT.
- Melting Pots & Mosaics: Children of Immigrants in US-American Literature. Bielefeld: transcript, 2018.
- "Fiktionalität und Unnatürliches Erzählen." Grundthemen der Literaturwissenschaft: Fiktionalität. Hrsg. Lut Missine, Ralf Schneider, Beatrix van Dam. Berlin: de Gruyter, 2020. 254-267.
- "Alien Adapted (Again and Again): Fictional Universes between Difference and Repetition." Adaptation in the Age of Media Convergence. Hrsg. Johannes Fehrle und Werner Schäfke-Zell. Amsterdam: Amsterdam UP, 2019. 159-174.
- "Through a Glass, Darkly: Contemporary Young Adult Dystopias." "Tell Freedom I Said Hello". Issues in Contemporary Young Adult Dystopian Fiction. Hrsg. Christian Ludwig & Nicole Maruo-Schröder. Anglistik & Englischunterricht 88. Heidelberg: Universitätsverlag Winter, 2018. 27-46.

Institute of Educational Psychology

Prof. Dr. Elke Heise

Researcher's Career
- Full Professor for Educational Psychology, TU Braunschweig
- Full Professor for Educational Psychology, Dortmund University
- Postdoctoral Lecture Qualification (Habilitation), Göttingen University
- Young Scientist Award of the German Psychological Society (DGPs), 1992
- Dr. rer. nat., Göttingen University
- Study of Psychology (Diploma), Göttingen University

Funding
DFG, BMBF, APS

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Mission Statement

Our empirical research focuses on processes of learning and teaching within the educational system, including the role of diversity and diversity management.

Research

Student satisfaction: Based on the person-environment-fit model, we examine how much of the variance in students' satisfaction and success at the university can be explained by the fit between abilities and demands on the one hand and needs and supplies on the other. Our empirical findings show that different aspects of student satisfaction (contents, conditions, coping with study-related stress) can be predicted by different aspects of person-environment-fit.

Diversity and diversity management: With increasing diversity of university students, diversity management (DiM) is required in the context of university education. We analyze if students' diversity and their perception of DiM can predict student satisfaction and students' organizational commitment to their university. In a study with first-year students we were able to show that DiM-fit regarding students' cognitive and motivational skills is a significant predictor of both satisfaction with the conditions of studying and satisfaction with one's coping with study-related stress. At present we are interested in the potential change of relevant DiM-factors with more advanced students. Our results can be applied to the development of a DiM-system within university education.

Motivation and well-being:
We investigate the determinants of subjective well-being in educational contexts and the role of motivational variables such as the satisfaction and frustration of basic psychological needs. In addition, we focus on the design and evaluation of interventions that increase teachers' subjective well-being and reduce perceived stress and emotional exhaustion.

Publications

- Ebersold, S., Rahm, T. & Heise, E. (2019). Autonomy support and well-being in teachers: Differential mediations through basic psychological need satisfaction and frustration. Social Psychology of Education. DOI 10.1007/s11218-019-09499-1.
- Rahm, T. & Heise, E. (2019). Teaching happiness to teachers - development and evaluation of a training in subjective well-being. Frontiers in Psychology, 10:2703. doi: 10.3389/fpsyg.2019.02703.
- Westermann, R. & Heise, E. (2018). Studienzufriedenheit. In D. H. Rost, J. R. Sparfeldt & S. R. Buch (Hrsg.), Handwörterbuch Pädagogische Psychologie (5. Aufl.) (S. 818-825). Weinheim: Beltz.
- Heise, E. & Thies, B. (2015). Die Bedeutung von Diversität und Diversitätsmanagement für die Studienzufriedenheit. Zeitschrift für Pädagogische Psychologie, 29, 31-39.
- Heise, E. & Zaepernick-Rothe, U. (2012). Zufriedenheit von Lehrenden an deutschen Universitäten mit ihrer Lehrtätigkeit. In F. G. Becker, G. Krücken & E. Wild (Hrsg.), Gute Lehre in der Hochschule – Wirkungen von Anreizen, Kontextbedingungen und Reformen (S. 115-135). Bielefeld: W. Bertelsmann.

English and American Studies

Prof. Dr. Holger Hopp

Researcher's Career

- Full Professor for English Linguistics, TU Braunschweig
- Full Professor for Multilingualism, University of Mannheim
- Visiting Researcher, Pennsylvania State University
- Assistant Professor for English Linguistics, University of Mannheim
- Ph.D in Linguistics, University of Groningen, (NL)
- MA in Linguistics and English Language, University of Durham (UK)
- Studies at the Universities of Gießen, Göttingen, East Anglia, Berlin (FU)

Funding

DFG, BMBF, DAAD

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Mission Statement

Our group investigates how languages interact in the multilingual mind and how speakers navigate different languages and linguistic repertoires. We study how children and adults acquire and learn English as a first, second or third language and how they produce and understand language in real time.

Research

Multilingual Language Processing: Building on formal grammatical theories, we investigate linguistic and cognitive aspects of multilingualism. Our projects focus on second language (L2) and L3 acquisition and processing of English at the interfaces of grammar and cognition. In eye-tracking and reaction-time experiments, we examine how bilingual and L2 learners acquire and process grammatical knowledge in and across different domains of language (e.g. morphology, lexicon, syntax, semantics).

Linguistic and Cognitive Aspects of Multilingualism: In a joint project with the University of Mannheim, we examine whether early multilingualism provides general (cognitive) benefits in English language acquisition in primary school and how multilingualism can be used as a resource in early foreign-language teaching (MEG-SkoRE: BMBF 01JM1702A/B; 11/2017-10/2020; www.megskore.de).

Language Contact and Language Attrition: We study how cross-linguistic influence from a dominant second language can lead to erosion of the native language in different populations and how development in first language attrition compares to second language acquisition.

Language Processing and Language Learning: In a joint project with the TU Dortmund, we explore the role of language processing in grammar learning among adolescent learners of English as a foreign language (Co-LEAP: Cognition, Learning and Processing; DFG HO-5923-3; 9/2020-8/2023; www.coleap.de).

English as a Second Language versus English as a Third Language: In psycholinguistic experiments, we study how the acquisition of English as a second language (L2) compares to the acquisition of English as an L3 in children and adults in order to find out whether the L1 or the L2 affect further languages in differential ways.

Publications

- Hopp, H. & Thoma, D. (2020). Foreign Language Development During Temporary School Closures in the 2020 Covid-19 Pandemic. Frontiers in Education, 5, 601017, 41(3), 627-656.
- Hopp, H. (2020). Morphosyntactic adaptation in adult L2 processing: Exposure and the processing of case and tense violations. Applied Psycholinguistics.
- Hopp, H., Jakisch, J., Sturm, S., Becker, C., & Thoma, D. (2020). Integrating multilingualism into the early foreign language classroom: Empirical and teaching perspectives. International Multilingual Research Journal, 14(2), 146-162.
- Hopp, H., Steinlen, A., Schelletter, C., & Piske, T. (2019). Syntactic development in early foreign language learning: Effects of L1 transfer, input and individual factors. Applied Psycholinguistics, 40(5), 1241-1267.
- Hopp, H., Vogelbacher, M., Kieseier, T., & Thoma, D. (2019). Bilingual advantages in early foreign language learning: Effects of proficiency in the minority and the majority language. Learning and Instruction, 61, 99-110.
- Hopp, H. (2019). Cross-linguistic influence in the child L3 acquisition of grammar: Sentence comprehension and production among Turkish-German and German learners of English. International Journal of Bilingualism 23(2), 567-583.

Institute of Philosophy

Prof. Dr. Nicole C. Karafyllis

Researcher's Career

- Full Professor of Philosophy, TU Braunschweig
- Full Professor of Philosophy, United Arab Emirates University (UAEU), Abu Dhabi (UAE)
- Visiting Professor for Cultural Philosophy of Science, Vienna University (Austria)
- Habilitation in Philosophy at Stuttgart University
- Post-Doc at Goethe University Frankfurt am Main
- Franzke-Award for Technology and Responsibility, TU Berlin
- PhD (doctorate) at the International Centre for Ethics in the Sciences and Humanities, Tübingen University
- Research projects on technology assessment of renewable resources at the Center for Small-scale Technologies and Local Development (Ain-Shams University, Cairo) in Egypt and at the German Wuppertal-Institut für Klima, Umwelt, Energie
- Parallel studies of Biology (Dipl.-Biol.) and Philosophy at the universities in Erlangen-Nuremberg, Stirling (UK) and Tübingen

Funding

BMBF, DAAD, BBAW, VDI, State Lower Saxony

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Mission Statement

Philosophy of Science and Technology, analyzing problems occurring at the interface of Biology, Biotechnology and Engineering. This embraces STS, Anthropology, Phenomenology, Applied Ethics (Environmental, Agricultural and Engineering Ethics, Bioethics), Intercultural Philosophy and the History of Philosophy.

Research

Theory of biofacts: biofacts are intermediary entities between artefacts and natural living beings. They grow, but not by themselves. In the light of biotechnologies and synthetic biology, how can we still differentiate between nature and technology? Is the Aristotelian concept of growth (physis) still a useful candidate to make a difference? This research includes the investigation of modern seed banks, its knowledge orders and theories of living collections, melting into two projects funded by the BMBF and entitled "The language of biofacts: semantics and materiality of high-tech plants" (BIOFAKTE) and MIKROBIB (Contamination and readability of the world: articulating microbes in collections).

Plants and agriculture as utopy: in the modern age, plants emerge as a Academic Exchange Service symbol for both the non-technical and non-animal (anthropology/ontology). On the contrary, the plant is a flexible object for modern laboratory methods in biotech: cloning, vaccination and transplantation derived from agricultural technics. It is analyzed how different concepts of the plant and its cultivation interact with modern and premodern concepts of technology, and how plant-metaphors help articulating modes of mediality and potentiality.

Intercultural concepts of "technics" and "technology": Technology is not universal. Research focus is on how different cultures have conceptualized technics, how they regarded technology as encroaching on nature, how the relation of technology and progress, and of high-tech and low-tech is modeled, and how the present dialogues on global ethics of technology and educational issues in the STEM-field could profit from cultural insights.

The philosopher's (auto)biography: Narrating one's life is a difficult task, particularly if it is one's own life – and the life of a philosopher. This research area unites the idea of "life" in a 1st-person-perspective and philosophy of history, asking the question how philosophers can be material objects of biographical narration and, at the same time, scholars of a discipline that used to strictly separate life from thought.

Publications

- Kirchhoff, T., Karafyllis, N. C. et al. [Ed.]: Naturphilosophie. 2nd ed. Tübingen: UTB 2020. Renn, O., Karafyllis, N. C., Hohlt, A., Taube, D. [Ed.] (2015): International Science and Technology Education: Exploring Culture, Economy and Social Perceptions. London: Routledge.
- Karafyllis, N. C. (2015): Willy Moog (1888-1935): Ein Philosophenleben. Freiburg: Alber
- Karafyllis, N. C. (2013). Putzen als Passion. Ein philosophischer Universalreiniger für klare Verhältnisse. Berlin: Kulturverlag Kadmos (2nd ed. 2015)
- Karafyllis, N.C. and G. Ulshöfer [Ed.] (2008): Sexualized Brains. Scientific Modeling of Emotional Intelligence from a Cultural Perspective. Cambridge, Mass.: MIT Press
- Zittel, C., Nanni, R., Engel, G. and Karafyllis, N.C. [Ed.] (2008): Philosophies of Technology. Francis Bacon and his Contemporaries. 2 Volumes. Leiden/Boston: Brill

Historical Institute

Prof. Dr. Christian Kehrt

Researcher's Career

- Full Professor of History of Science and Technology TU Braunschweig
- Assistant Professor Helmut-Schmidt-University of the Armed Forces Hamburg
- Fellow at the Rachel Carson Center for Environment and Society Munich
- Assistant Professor at the Research Institute for the History of Science and Technology Deutsches Museum Munich.
- PhD at the interdisciplinary post-graduate college "Technology and Society" at the University of Technology Darmstadt
- Study of History and Philosophy University of Tübingen and Stony Brook, NY.

Funding
DFG, VWStiftung

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Mission Statement

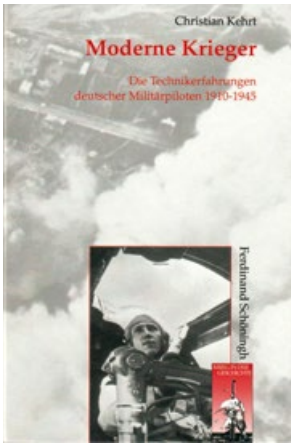
The objective is a broad historical understanding of modern technological cultures, in which science, technology and society are inseparably intertwined. I share the Science and Technology Studies approach of interdisciplinary work as well as a focus on contemporary problems and constellations.

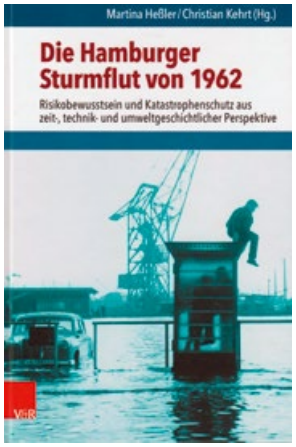
Research

1. Aviation: The technological experiences of military pilots
In order to examine pilots experiences of flight, physiological, psychological and technical aspects were investigated with the help of an integral approach from cultural history. Active control and male commanding of technology as well as calm, athletic prowess and desire for adventure characterized the civilian and military pilots' habitus in the First and Second World War.

2. Nanotechnology: Instruments, Images and Visions in the Practice of Nanotechnology
The nanotechnology protagonists from Munich were located in a differentiated research and innovation landscape. The nanoscience networks CeNS and NIM were founded in order to be able to react more quickly and flexibly to transdisciplinary research trends within the institutional constraints of universities. The example of nanotechnology offers an insight into how research at universities answers to external demands – from the political, public and economic spheres – for more "applicability" and "transparency" in order to continue to experiment freely with molecules and electrons.

3. The Polar Regions in Environmental Perspective
The polar regions were, in addition to outer space and the deep sea, one of the central areas of conflict and laboratories of the Cold War. During this period, knowledge of ice, snow, wind and weather, oceans and higher levels of the atmosphere increased markedly. This knowledge that was constituted during the Cold War was an essential prerequisite to the perception of global climate and environmental problems.





Publications

- Kehrt, C. (2016), Mit Molekülen spielen. Wissenskulturen der Nanotechnologie zwischen Politik und Medien. Bielefeld.
- Kehrt, C.; Heßler, M. (Hg.) (2014), Die Hamburger Sturmflut 1962. Risikobewusstsein und Katastrophenschutz aus umwelt-, technik- und zeithistorischer Perspektive, Göttingen.
- Kehrt, C, Torma, F. (2014), Einführung: Lebensraum Meer. Globales Umweltwissen und Ressourcenfragen in den 1960er und 1970er Jahren. In: Geschichte und Gesellschaft 40, 313-322.
- Christian Kehrt, Peter Schüßler, Marc-Denis Weitze (Hg.) (2011), Neue Technologien in der Gesellschaft. Akteure, Erwartungen, Kontroversen und Konjunkturen, Bielefeld 2011.
- Kehrt, Christian. "The Wegener Diaries: Scientific Expeditions Into the Eternal Ice." Digital exhibition, Environment & Society Portal (Rachel Carson Center for Environment and Society, 2013). http://www.environmentandsociety.org/exhibitions/wegener-diaries

Institute of Educational Science

Prof. Dr. Katja Koch

Researcher's Career
- Full Professor for School Education, TU Braunschweig
- Liaison professor Friedrich-Ebert-Stiftung
- Postdoc, Georg-August-University Göttingen
- Dr. phil. Philipps-University Marburg
- Study of History, German language and literature, Education Philipps-University Marburg

Funding
BMBF, BMFSFJ, Mercator, NLQ

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Mission Statement

Command of the instruction language is the most important predictor for success in school. In the context of my research, my team and I seek to discover how educational institutions are managing to foster, better than heretofore, the language acquisition process of children who have a different original language.

Research

The research activities in my field of work relate to the following other fields:

Basic research in second language acquisition:
I am interested in what educational facilities can do to support children of kindergarten or primary school age who, for example, have a different original language. In the process I am searching for kindergartens and schools that are rather successful at this. One of the most important findings from our programme is the fact that collective meals have proven to be a very good venue for fostering/developing language acquisition in children.

Evaluation of educational-policy measures in the field of German as a Second Language:
What receive the most time and effort in my working field are research activities that evaluate educational-policy measures for language promotion. Thus we were able to show, for example, for the implementation of on-going language training, that the process runs the same in almost all schools, and that well-trained and motivated teaching staff in the schools are able to further the pupils' development.

Development of a training programme regarding language teaching strategies:
In order to do justice to our complex research topic of second language acquisition for children, we work together with colleagues from other research disciplines and universities. For example, we are designing together with colleagues from the Developmental Psychology Department a teachers' training programme that combines language learning with the conveyance of concrete knowledge and emotional knowledge.

Development and implementation of innovative teaching-learning formats:
So that prospective teaching staff learn how they can properly react to the challenges of an increasingly heterogeneous student body, we are developing innovative teaching-learning formats such as an interdisciplinary blended-learning unit regarding migration and language promotion. And together with eight other universities in Lower Saxony, we are designing university-didactic materials regarding language development and language education.

Publications

- Koch, K. (2016): Schulartenspezifische Aspekte der Sprache in der Bildung. In: Kilian J.; Brouër, B.; Lüttenberg, D. (Hrsg.): Handbuch Sprache in der Bildung. De Gruyter Mouton: Berlin. pp. 362-379
- Hormann, O.; Krüger, M.; Hofmann,B.; Jüttner, A-J. & Koch, K: (2015): Von Strukturen und Prozessen zu Strukturen in Prozessen. In: Cloos, P. ; Koch, K. ; Mähler, C. (Hrsg.). Entwicklung und Förderung in der frühen Kindheit. Interdisziplinäre Perspektiven. Weinheim: Beltz Juventa; pp. 160-177
- Schulz, S.; Koch, K. (2014): Projekt "Netzwerk für Deutsch als Zweit- und Bildungssprache, Mehrsprachigkeit und Interkulturelle Kompetenz in Niedersachsen (DaZNet)". Niedersächsisches Landesinstitut für schulische Qualitätsentwicklung (NLQ).
- Koch, K. (2014): Kinder mit einer anderen Herkunftssprache im Übergang in die Grundschule. In: Liegmann, A, Mammes, I. ,Racherbäumer, K. (Hrsg.): Facetten von Übergängen im Bildungssystem. Nationale und internationale Ergebnisse empirischer Forschung. Wiesbaden, pp. 23-34
- Koch, K. (2012): Zweitspracherwerb am Übergang vom Elementar- in den Primarbereich. Herbert Utz Verlag, München

English and American Studies – Didactics of English Language Teaching

Prof. Dr. Angelika Kubanek

Researcher's Career

- First and Second State Exam for Teachers (Bavaria) : English/German for secondary schools,
- school teacher for 5 years
- Diploma (Univ.) in Adult Education
- Ph.D.: The representation of the Third World in English as a Foreign Language Textbooks used in Germany.
- Habilitation (Katholische Universität Eichstätt): Child oriented early foreign language teaching: from history to the present day (1997)
- Visiting professor in Turkey, visiting professor University of Koblenz-Landau,
- full professor in Braunschweig since 2001
- lectures, expert and teacher trainer in German and various international contexts

Funding

EU, ministries of education, other educational institutions, DFJW,

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Mission Statement

I. Foreign language didactics is education for peace, and learners can, via their competences in English and other languages, contribute to conflict solving and the appreciation of the diversity of cultures. II. Foreign language didactics have much to give to, and share with related didactic areas such as museum pedagogy, public understanding of science, the Easy Language movement.

Research

Orpheus Project: Didactic videos in accessible English with sustainability researchers and other experts, for teenagers and laymen

The project is situated within Environmental Humanities and within Foreign Language Didactics. It uses a narrative approach and has the following aims: to support science appreciation, to create teaching material for the English classroom, to investigate comprehension strategies of teenagers, teachers, teacher training students, to investigate the appropriateness of various explanation formats, to support visibility of sustainability research and expertise.

Exploring intercultural processes within a foreign language teaching context

This topic has been investigated in various constellations, most often in a young learner context: e.g. the emergence of European awareness and sense of place of older children learning English, French, Czech or Polish (2002), cultural differences affecting the quality of language programs in kindergarten and primary school in the neighboring Saar territory, (2008), or how pre-service students present their own stays abroad to early learners of English in (primary) school settings. Recently, a bi-national (French-German) qualitative study co-authored by AK with German and French educators and teacher trainers investigated how the different cultural and educational backgrounds affect the reception of new bi-cultural learning material for children, and what needs to be considered as regards child development when planning such material.

Publications

- The main pedagogical principles underlying the teaching of very young learners.Published research, good practice and main principles. Brussels: European Commission 2006. Authors: Peter Edelenbos, Richard Johnstone, Angelika Kubanek (EAC 89/04, Lot 1)
- "Teacher assessment: the concept of 'diagnostic competence'." Language Testing, 21(2004), 3, 259-283. (with Peter Edelenbos)
- Chapter 5: Researching intercultural learning of young foreign language learners - comprehending learning processes in the context of the German-French kidsbox. [Article is in German]. In: Die deutsch-französische Kinderkiste – Sprache und Kultur des Anderen in Kindergarten und école maternelle. G. Brougère, A.Kubanek, D. Macaire, J. Putsche. Berlin/Paris: Deutsch-Französisches Jugendwerk 2015, pp. 201-251.
- Orpheus-Project videos (2014ff): (e.g. Douglas firs, forest care, stress tests with food crops, recycling electronic waste, the meaning of wild & wilderness). They can be accessed via the following link:
- https://opac.lbs-braunschweig.gbv.de/DB=1/CLK?IKT=8063&TRM=Orpheus+Project+-+public+understanding+of+science

Institute of Science Education – Department of Biology and Biology Education

Prof. Dr. Maike Looß

- Head of Department of Biology and Biology Education

Researcher's Career

- Full Professor for Biology and Biology Education, TU Braunschweig
- Scientific assistant for Biology and Biology Education (habil.), University of Flensburg
- Research associate and PhD (Dr. rer. nat.), University of Bremen
- Teacher-trainee for secondary education
- Study of Biology and Art Education, University of Bremen

Funding

BMBF, MWK Lower Saxony

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Mission Statement

Our mission is to enhance professionalization of prospective biology teachers. Our research focuses on several topics of biology education and teacher training. It includes development and evaluation of modern approaches and concepts for learning and teaching biology, diagnostic and experimentation skills.

Research

Diagnostic Competency: Diagnostic competency is a key skill of teacher professionalization. It is an essential condition to give a professional and adequate opinion on the learning behavior of students and requirements of tasks and promotion. The project's aim is to train prospective science teachers' diagnostic competencies relating to domain specific learning processes. By means of video-vignettes the diagnostic skills in identifying students' skills of problem solving were promoted. The progression of prospective science teachers competencies were analyzed regarding subject didactics, teaching methodology, diagnostic skills, research methods and "nature of science".

Competency development in teacher training: This project asks specifically about the matching between acquired teaching skills in the first phase of teacher training at the university and the second phase at teacher training college and school.

Textbook research: Schoolbooks/textbooks can encourage or discourage discussion about social change – by the way they use certain terms, by helping to determine which research findings and content should become part of "common knowledge," and by how they address controversial issues. Textbooks have the potential to initiate and moderate social change processes. In textbook research, current and historical textbooks for biology teaching are analyzed using hermeneutic, ideology-critical, contextualizing and content-analytical approaches. Formal and content-related aspects here are, for example: subject accuracy, task analysis, competence orientation, picture-text interlacing, use of diagrams, moral perspectives, gender aspects.

Benefits of teaching-learning laboratories: In a research supported teaching-project, we analyze the outcomes of an early implemented conjunction of theoretical and practical qualification skills in undergraduate studies using the extension of a learning laboratory to a teaching-learning-laboratory.

Publications

- Looss, M.: Die erstaunliche Haltbarkeit einer unhaltbaren Theorie. In: Education permanente – Zeitschrift für Weiterbildung. 1/2019, 15-18
- Tasci, G./ Looss, M./ Yurdugül, H./ Hilfert-Rüppell, D./ Sülün, A./ Hinrichs, D./ Aydogdu, S./ Klingenberg, K./ Tas, F. S.: Adaption of scale "Working like Scientists" (WLS). A Turkish-language version: validation and reliability. In: Participatory Educational Research (PER), Vol.3 (1), 2016, pp.54-66; http://dx.doi.org/1017275/per.16.03.3.1
- Hilfert-Rüppell, D./Looss, M.: Fach(seminar)leiter im Interview: Welche Basis braucht die zweite Phase? In: Hammann, M./ Mayer, J.(Hrsg.): Lehr- und Lernforschung in der Biologiedidaktik 6. Studienverlag, Innsbruck 2015, S. 155-172
- Looss, M.: Lernstrategien, Lernorientierungen, Lern(er)typen. In: Krüger, D./Vogt, H. (Hrsg.): Theorien in der biologiedidaktischen Forschung. Ein Handbuch für Lehramtsstudenten und Doktoranden. Heidelberg 2007, 141-152
- Editorship: Höner, K./Looss, M./Müller, R. (Hrsg.): Naturwissenschaften vermitteln. Braunschweiger Beiträge zu Lehrerbildung und Fachdidaktik. Münster 2004-2016 (will be continued)

Institute of Didactics of the Natural Sciences

Prof. Dr. Rainer Müller

- Leader of Department of Physics and Physics Education Research

Researcher's Career

- 1990: Universität Konstanz, Diploma in Physics
- 1994: Universität Konstanz, Ph. D. (Dr. rer. nat)
- 1995-1997: Postdoc Ludwig-Maximilians-Universität München (Theoretical Physics)
- 1997-2002: Scientic Assistant, Ludwig-Maximilians-Universität München (Physics Education Research)
- since 2002: Full Professor, Technische Universität Braunschweig (Physics Education Research)

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Mission Statement

My aim is to improve the quality of physics teaching in school and university by developing and testing new and innovative approaches based on empirical research. My research is focused on two fields: (1) Quantum physics, especially the conceptual issues, (2) Physics in daily life and in technical applications.

Research

My research addresses the interplay between physics content, learning theories and results from Physics Education Research. It is founded on empirical research in school and university.

Teaching and Learning of Quantum Physics: My research on the teaching and learning of quantum physics has proceeded since 1995. It is centered around the developed a research-based modern course on quantum mechanics (MILQ) in which the conceptual issues of quantum mechanics are taught at an introductory level. In the MILQ project, virtual laboratories (computer simulations of the double slit experiment and the Mach-Zehnder interferometer) are used to let the students discover from the very beginning how quantum phenomena deviate from our classical everyday experience.

The MILQ project has been empirically tested. The results of the evaluation show that the majority of the students acquired appropriate quantum mechanical conceptions, and that many of the common misconceptions encountered in traditional instruction have been avoided. A comprehensive internet learning platform on the basics of quantum mechanics has been developed (milq.info). It has been continuously developed since 2000. Presently, it consists of a few hundred pages with manuscripts, simulations, and applets. It is visited by several thousand users each month.

In recent years, the field of Quantum Technologies has received considerable attention. Building quantum computers, quantum simulators and quantum sensors is seen as an important future technology. My interest in this field is to contribute to an ecosystem of well-trained workforce in the field of quantum technology. In this sector, I'm active in the coordination of the European Quantum Technology Flagship and the Quantum Valley Lower Saxony (QVLS).

Physics in everyday life and in technical applications: Psychological theories of learning indicate that learning is easier and more interesting if the material is presented in a meaningful context. Thus, a focus of my research is to develop learning materials that present physics topics in everyday contexts or in technical applications that are perceived by students as relevant and interesting. Besides numerous articles in national and international journals, I have authored the physics textbooks "Klassische Mechanik – vom Weitsprung zum Marsflug" (de Gruyter, 2009) and "Thermodynamik – vom Tautropfen zum Solarkraftwerk" (de Gruyter, 2013). In these books, a context-oriented approach is followed for teaching mechanics and thermodynamics.

Publications

- R. Müller (2013): Thermodynamik – vom Weitsprung zum Marsflug. Berlin: de Gruyter (2. Auflage 2016).
- R. Müller (2009): Klassische Mechanik – vom Weitsprung zum Marsflug. Berlin: de Gruyter (4. Auflage 2021).
- R. Müller, O. Mishina (2021): milq -- Quantum Physics in Secondary School, in: Research and Innovation in Physics Education: Two Sides of the Same Coin, Springer Challenges in Physics Education.
- R. Müller (2012): A semiquantitative treatment of surface charges in DC circuits. In: Am. J. Phys. 80, 782.
- R. Müller (2014): The Boltzmann factor: a simplified derivation. In: Eur. J. Phys. 35 055002.

Institute of German Studies

Prof. Dr. Martin Neef

Researcher's Career

- 2015–2017 Dean of the Faculty of Humanities and Educational Sciences
- 2017–2019 Senator of the TU Braunschweig
- Full Professor for German Linguistics, TU Braunschweig
- Assistant Professor for German Linguistics, University of Cologne
- Researcher, SFB 'Theory of the Lexicon', University of Cologne and University of Düsseldorf
- PhD and Habilitation, University of Cologne
- Study of German Studies, General Linguistics, and Pedagogics, University of Cologne

Funding

DFG, BMBF, DAAD, Thyssen-Stiftung

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Mission Statement

Language can be studied from a variety of perspectives. If one considers the language system as an abstract object, which is the defining criterion for the newly developing paradigm of Linguistic Realism,inherent contradictions of the dominant paradigm of Cognitive Linguistics can be resolved which regards language as a mental object.

Research

Grammatical Categories: According to everyday knowledge, grammatical categories originate from semantic categories. In school grammar, for example, the category plural is defined as 'denoting more than one entity'. This is evidently wrong since the plural can also be used to denote exactly one entity (*1,0 Torten*) or nothing (*null Torten*). We reconstruct grammatical categories as formal categories and thus arrive at a clearer understanding of categories that are central for school teaching, like parts of speech, grammatical functions, number, and gender. This is also a basis for an evaluation of practices of so-called 'gender-sensitive language use'.

Grapholinguistics: The usual approach in the analysis of written language is to take phonemes as the starting point and relate them to orthographic forms. The Modular Approach to Grapholinguistics distinguishes between two distinct components: Graphematics reconstructs the way in which sequences of letters relate to phonological representations, while Systematic Orthography asks how words from specific levels of the vocabulary have to be spelled. In this way, it is possible to give an appropriate analysis to the distinct spellings of words with the same phonological representation like *Wal* and *Wahl*.

Autonomous Declarative Phonology: Theories of phonology start out predominantly from the concrete sound signal and arrive at phonological categories through proper abstraction from this basis. This is a questionable approach, as phonological categories should be considered unaffected from such articulatory properties as whispering, singing, or speaking with full mouth. Phonological units can therefore not be considered as rooted in phonetics. In Autonomous Declarative Phonology, phonology as the system of elements of a language system that have the potential to distinguish meaning is conceived as principally autonomous from phonetics.

Word Design: This approach to morphology takes morphological categories as basic instead of morphemes. In a declarative way, diverse categories from inflection and lexeme-formation are modeled, taking grammatical variation into account.

Publications

- Neef, M. (general editor) (2008-2015): Written Language and Literacy, Issues 11.2-18.1. Amsterdam: Benjamins.
- Appelt, A., Balestra, M. & Neef, M. (2015): Orthographic constraints on the spelling of German a-sounds. In: Written Language and Literacy 18.1: 153-174.
- Behme, C. & Neef, M. (eds.) (2018): Essays on Linguistic Realism. Amsterdam: Benjamins (= Studies in Language Companion Series 196).
- Neef, M. (2018): Das Konzept des sogenannten ‚Geschlechtergerechten Sprachgebrauchs' aus sprachwissenschaftlicher Sicht. In: I. Lang-Groth & M. Neef (eds.): Facetten der deutschen Sprache. Berlin: Peter Lang, 44-66.
- Neef, M. (2015): Writing systems as modular objects: proposals for theory design in grapholinguistics. Open Linguistics 2015; 1: 708-721.
- Neef, M. (2014a): Das nächste Paradigma: Realistische Linguistik. In: Muttersprache 124: 105-120.
- Neef, M. (2014b): Satzgliedfunktionen im Deutschen: eine realistische Weiterentwicklung. In: Zeitschrift für germanistische Linguistik 42.3: 420-455.

Evangelical Theology and Pedagogy of Religion

Prof. Dr. Gottfried Orth

Researcher's Career

- Professor for Evangelical Theology and Pedagogy of Religion - TU Braunschweig
- Member of Team ORCA-Institute for Conflict Management and Training
- University docent for Pedagogy of Religion - RWTH Aachen
- Apl. Professor - Evangelical Theology Johann Wolfgang Goethe University Frankfurt
- Habilitation in Practical Theology - Institute fur Theology Johann Wolfgang Goethe University Frankfurt
- Doctorate in Dr. phil. Institute for Theology Johann Wolfgang Goethe University Frankfurt
- Theological Speaker (EKD and DEAE)
- Community and school Pastor

Funding

BMUB, EKHN, Evang.-Luth. Landeskirche in Braunschweig

Contact

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Mission Statement

Evangelical Theology conducts research and teaches confessional theology within the History of Christianity on the horizon of contemporary culture(s) in a globalised world. It reveals itself here to be obligated, in particular, to a non-violent and liberation-seeking practice of Christians, churches and congregations in an ecumenical perspective.

Research

Systematic Theology considers itself to be language teachings of faith (dogmatics) and behavioural teachings of Christians, churches and Christian groups on the ecumenical horizon (ethics). Dogmatics reflects the theological traditions in the face of present-day perceptions of the truth. Ethics reflects historical and present-day courses of action particularly involving issues of justice, peace and the Integrity of Creation.

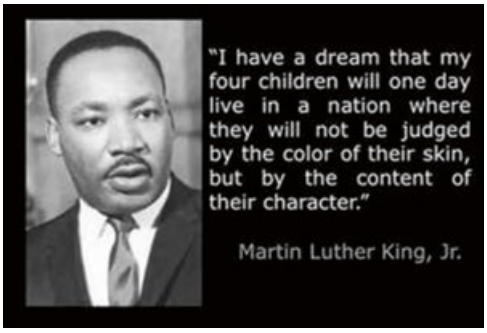
Emphasis for research and teachings in Braunschweig are topics involving Peace Ethics and Peace Theology, and here in particular Christian and non-Christian traditions of non-violence.

This begs the question, on the one hand, of how non-violence can become a central criterion of dogmatic contemplation and discourse – in light of a history of Christianity rich in experience with violence and prospects for peace.

On the other hand, there is a plethora of both ethical questions in the context of increasing non-violent conflict possibilities and movements as well as economic, state-sponsored and terroristic violence.

Particular emphasis is placed on non-violent communication (GFK). Thou shalt love thy neighbour as thyself – how am I supposed to do that? Judge not, that ye be not judged – how can I do that?

These were two key questions posed by Marshall Rosenberg (1934-2015), as he was developing non-violent communication in the context of the North American civil rights movement of the 1960s. One of his main communicative, political and spiritual issues was respectful dealings with oneself and other human beings. For this purpose, Rosenberg developed a communication model that enjoyed increasing significance in, not least, in the context of institutions such as schools, churches and hospitals. This communication model can also be applied hermeneutically, so that a new appreciation of biblical texts and the history of Christianity becomes possible.



Publications

- Dem bewohnten Erdkreis Schalom. In: H. Rupp, S. Schwarz (Hrsg.), Lebensweg, religiöse Erziehung und Bildung. Religionspädagogik als Autobiographie. Band 6. Würzburg 2015. S. 277–295.
- Gewaltfreie Kommunikation in Kirchen und Gemeinden. Die Nächsten lieben wie sich selbst. Paderborn 2016.
- Mitten im Krieg vom Frieden singen. Traditionen der Gewaltfreiheit. Berlin 2017.
- Eva, Kain & Co. Was es heißt, ein Mensch zu sein und wie dabei von Gott erzählt wird. Eine theologische Auslegung der Urgeschichten. Berlin 2019.
- Gottes und der Menschen Genossin. Band 1. Marie Veit: Bibelwissenschaftlerin, Religionspädagogin, Sozialistin. Eine Werkbiographie. Band 2: Marie Veit: Texte 1972–2000. Münster 2021.

Institute of German Studies

Prof. Dr. Jan Röhnert

Researcher's Career

- Junior / Associate Professor TU Braunschweig since 2011
- Habilitation TU Braunschweig 2014
- Lecturer German Academic Exchange Office (DAAD) at Sofia University / Bulgaria 2008–2010
- Assistant Professor at Friedrich Schiller University Jena 2002–2008
- Ph.D. Friedrich Schiller University Jena 2007
- M.A. Friedrich Schiller University Jena 2002
- Lecturer Pedagogic Exchange Office (PAD) at Toulon /France 1999/2000
- Study of German and Comparative Literature, French and Romance Studies, Pedagogics and Intercultural Studies (DaF) at Friedrich Schiller University Jena and Genoa University/Italy

Funding
DAAD, S. Fischer Stiftung, BMW, Volkswagenstiftung

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Mission Statement

Understanding recent German literary history and how it deals with scientific, technical, cultural and political change from early Romanticism (Goethe) via Modernism (e.g. Gottfried Benn) und Post-Modernism (e.g. Elfriede Jelinek) up to the global context of the present day (e.g. Peter Handke).

Research

- German and Comparative Poetry, Poetics, Theory of Poetry 1800–2000
- Contemporary and Intercultural Poetics and Literature – considering the many languages contributing to German letters from Goethe's "Weltliteratur" up to the globalized world
- Interrelations between Science, Technology and Literature – examining a 'scientific turn' in German in recent letters (e.g. Hans Magnus Enzensberger's vast interest in science and technology)
- Landscape and Literature: The transformation of a landscape (or a cityscape) into writing; e.g. how to 'write' the countryside or the autobahn
- Mobility and Literature: how writing perceives and transforms mobility, acceleration and speed
- Media, especially Film and Cinema, and their interaction with Literature, especially Poetry: How did/do poets conceive the cinema
- Non-fictional writing, cross-boundaries between fictional and factual writing, especially in autobiographical narratives; war and autobiographical writing
- Creative Writing, Criticism

Publications

- Di Rosa, V. / Röhnert, J. (2016; eds.): "Im Hier und Jetzt". Konstellationen der Gegenwart in der deutschsprachigen Literatur seit 2000. Köln/Weimar/Wien: Böhlau.
- Röhnert, J. (2016; ed.): Wulf Kirsten – Poesie der Landschaft. Munich: Lyrik Kabinett.
- Röhnert, J. (2015; ed.): Technische Beschleunigung – ästhetische Verlangsamung? Inszenierung von Mobilität in Literatur, Film, Kunst und Musik. Köln/Weimar/Wien: Böhlau.
- Röhnert, J. (2015; ed.): Die Metaphorik der Autobahn. Literatur, Film, Kunst, Architektur. Köln/Weimar/Wien: Böhlau.
- Röhnert, J. (2014): Selbstbehauptung. Autobiographisches Schreiben vom Krieg bei Goethe, Heine, Fontane, Benn, Jünger, Handke. Frankfurt/M.: Klostermann.
- Röhnert, J. (2007): Springende Gedanken und flackernde Bilder. Lyrik im Zeitalter der Kinematographie. Göttingen: Wallstein.

Institute of Philosophy

Prof. Dr. Hans-Christoph Schmidt am Busch

Researcher's Career

- Research Fellow, Exzellenzcluster "Religion und Politik", University of Münster (4/2020-3/2021)
- Professor of Philosophy, TU Braunschweig
- Fellow of the Alexander von Humboldt Foundation, Northwestern University, Georgetown University and Columbia University
- Habilitation, Philosophy, Goethe University Frankfurt
- Ph.D., University of Münster
- Studied Philosophy, Sociology, Political Science and Economics in Frankfurt, Montpellier, Münster and Hagen

Funding

DFG, Humboldt Foundation, Thyssen Foundation, Böckler Foundation

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Mission Statement

Braunschweig's Institute of Philosophy focuses on high-quality discussion and research into both classical philosophical problems and contemporary issues within our complex modern world. We believe that the systematic explorations of philosophical research should be informed by historical knowledge.

Research

Hans-Christoph Schmidt am Busch specializes in social and political philosophy, the history of modern philosophy, and the history of economic thought. Current research topics and questions include:

Recognition: What is recognition? Are there different types of recognition? Do relations of recognition have a specific ethical quality to them? How might these relations be institutionally secured?

Work: In what ways does work contribute to a good life? How should we understand 'work' within the context of this question? Does the contemporary working world offer work that is appropriate? What would justice in the working world amount to?

Rights: What are private property rights? To which objects can such rights apply? How might they be justified? How should Frankfurt School social philosophers deal with private property rights?

Critical Theory: What are the philosophical origins of contemporary critical theory? What perspective does this tradition of thought bring to bear on issues? How can we adequately ground a critical social theory in the contemporary world? Which phenomena would such a theory be used to explain?

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Publications

- La "reconnaissance" comme principe de la Théorie critique, Lyon: ENS Éditions, 2015. (A German version has appeared from de Gruyter.)
- "Why Ethical Life is Fragile: Rights, Markets and States in Hegel's Philosophy of Right", in: D. James (ed.), Hegel's Elements of the Philosophy of Right: A Critical Guide, Cambridge: Cambridge University Press, 2017, pp. 137-159.
- "'The Egg of Columbus'? How Fourier's Social Theory Exerted a Significant (and Problematic) Influence on the Formation of Marx's Anthropology and Social Critique," in: British Journal for the History of Philosophy, 21, 6, 2013, 1154-1174.
- "Cameralism as 'Political Metaphysics': Human Nature, the State, and Natural Law in the Thought of Johann Heinrich Gottlob von Justi," in: The European Journal of the History of Economic Thought, 16, 3, 2009, 409-430.
- "Personal Respect, Private Property, and Market Economy," in: Ethical Theory and Moral Practice, 11, 5, 2008, 573-586.

Institute of German Studies

Prof. Dr. Matthias Steinbach

Researcher's Career

- Study of History, Physical Education, Pedagogy, Philosophy and Art history – Universities of Jena, study visits in Paris, Rome, Sevilla and Metz
- PhD at the Historical Institute of the University of Jena
- Assistant Professor at the University of Jena
- Assistant Professor at the University of Frankfurt/Main
- Full Professor History and History Didactics, TU Braunschweig

Funding

DFG; Stifung Braunschweigischer Kulturbesitz; Fritz-Thyssen-Stiftung

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Historisches Seminar, Geschichte und Geschichtsdidaktik
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Mission Statement

The objectives are a broad understanding and documentation of ego-documents, the representation and examination of border regions and the study of History Didactics as well as the history of historiography. Hereby, I share the approach of interdisciplinary work.

Research

Geteilte Erinnerungen – Divided memories: The project aims at catching and collecting sources and reports about living beyond and next to the inner German border. Special focus is placed on the border area between Lower Saxony and Saxony-Anhalt, especially the so called Braunschweiger Land between Wolfsburg and Bad Harzburg. Despite the fact that the German Reunion has already taken place this area is still of much importance since borders are simply facts. Hence, relevance to the aftermath of the German Division is still given.

Alexander Carteliieri's diaries: This critically commented edition of Alexander Cartellieri's diaries provides input into the history of Historiography from the period of the German Empire until the time of the German Division. Cartellieri's diaries provide a direct insight into the methods of a historian with strong national roots and enlighten the areas of conflict between autonomy and the determination of scientific and political action throughout different political carinations.

Relief of Clemens von Delbrück: The relief of Clemens von Delbrück, which is stored at the library of the University of Jena, is an essential portfolio for investigating the history of the German Empire as well as the early years of the Weimar Republic. This project aims at the recording, sorting and digitalization of Delbrück's relief.

Nietzsche in the GDR – sites and discourses: Friedrich Nietzsche afterlife in Germany, i.e. the GDR, was always political. Almost all German Nietzsche places: Röcken, Naumburg, Schulpforte, Leipzig, Tautenburg, Jena and Weimar, lay in their territory. In the official versions less so than Nietzsche's texts, its mere name and some tags were preferably used against the ideological opponent. At the same time this difficult thinker was seen as anachronistic, maladjusted, lonely and remained as such a possible metaphor for political confusion and subversion. Nietzsche existed in very different political and cultural contexts, and his legacy reveals itself not only in files and books.

Till Eulenspiegel between Elm and Asse: The project is dedicated to the semi-historical Figure Till Eulenspiegel, which is represented in many contemporary scientific and art related works as a trickster who plays pranks on his fellows for his amusement by exposing their vices like folly, greed and hypocrisy.

Born in Kneitlingen near Brunswick, the mostly amoral but also instructive character has left many marks in the area and is still a current and relevant identification figure of the region Brunswick and Wolfenbüttel. Therefore the project aims to collect and analyze Till's traces in the region and create a digital platform combined with analog experience offers for different audiences to discover Eulenspiegel.

Publications

- Wie der gordische Knoten gelöst wurde. Anekdoten der Weltgeschichte historisch erklärt (Hrsg.), Stuttgart 2011.
- Alexander Cartellieri. Tagebücher eines deutschen Historikers. Vom Kaiserreich bis in die Zweistaatlichkeit (1899-1953) (=Deutsche Geschichtsquellen des 19. und 20. Jahrhunderts. Band 69) (als Herausgeber gemeinsam mit U. Dathe), München 2014.
- Der Fall Hodler. Krieg um ein Gemälde 1914-1919 (=Reihe ZeitgeschichteN. Band 13), Berlin 2014
- Mobilmachung 1914. Ein literarisches Echolot, Stuttgart 2014.
- Erinnerung sichtbar machen Braunschweiger Vorträge zur Teilung und Wiedervereinigung Deutschland 2009/2010 (=Braunschweiger Beiträge zur Kulturgeschichte. Band 5) (als Herausgeber gemeinsam mit M. Ploenus), Frankfurt a.M. 2016.
- Das Opernglas der Herzogin. Biografien in Objekten und Selbstzeugnissen (als Herausgeber gemeinsam mit S. Donner), Schellerten 2019.
- "Also sprach Sarah Tustra" Nietzsches sozialistische Irrfahrten. Matthias Steinbach. Halle 2020.

Institute of Educational Psychology

Prof. Dr. Barbara Thies

- Head of Braunschweig Training and Counselling Programme (TrauBe, Braunschweiger Trainings- und Beratungsmodell)

Researcher's Career

- Full Professor of Educational Psychology, TU Braunschweig
- Full Professor of Social Work (main emphasis: psychology), Hochschule (University of Applied Sciences) Emden-Leer
- Postdoctoral lecture qualification (habilitation), University Vechta (Venia Legendi: psychology / educational psychology)
- Dr. phil., University Vechta
- Studies of Psychology, Ruhr-University Bochum, (main emphasis: educational psychology, clinical psychology and developmental psychology, final degree: diploma)

Funding
BMBF, VolkswagenStiftung (Niedersächsisches Vorab)

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Mission Statement

Obtaining a deeper understanding of intra- und interpersonal processes to develop procedures for establishing high-quality-relationships and optimal conditions for learning, education, and society.

Research

Social Perception and Interaction (especially teacher-student-relationships): The quality of the relationships between students and their teachers is the basis for achievement and satisfaction. Therefore, our research focuses on factors endangering this relationship (e.g. missing competences and knowledge on diverse classrooms, stereotypes and prejudices). We develop and evaluate trainings to support (future) teachers to provide classroom settings which serve learning and education. Current projects are investigating digital competences of (ongoing) teachers as well as the quality of internships.

Diversity and Diversity Management in Education: Diversity research in Germany mainly focuses on "objective" socio-demographic features such as gender and ethnicity. We adopt a more subjective perspective and question the relevance of diversity features in different educational settings on students' satisfaction and well-being. Moreover, we critically look at the perceived diversity management of (university) teachers and its effects on diverse students.

Trust (interpersonal, organizational and systemic) Research:
Trust is a highly relevant resource in all spheres of life. Our research interest focuses on the effect of trust and trust breaching in science communication, citizens' protest behaviour and education. Current projects focus on relationships in the educational field. Recently, we integrate different concepts of trust to establish habitual trust as a stressor as well as a resource in educational settings.

Publications

- Bormann, I. & Thies, B. (2019). Trust and trusting practices during transition to higher education: introducing a framework of habitual trust. Educational Research, 61(2), 161-180. doi:10.1080/00131881.2019.1596036
- Hackbart, M. & Thies, B. (2020). Die Bedeutung von Ausbildung, Erfahrung und Wissen in der Sexualerziehung für Lehrkräfte – eine Bestandsaufnahme. HLZ, 3(1), 225–235. doi:10.4119/hlz-2523
- Hannemann, L., Uhde, G. & Thies, B. (2019). Evaluation eines Classroom-Management-Trainings für Lehramtsstudierende. Zeitschrift für Bildungsforschung, 9(3), 309–327. "https://doi.org/10.1007/s35834-019-00255-1" doi:10.1007/s35834-019-00255-1
- Heise, E. & Thies, B. (2015). Die Bedeutung von Diversität und Diversitätsmanagement für die Studienzufriedenheit. Zeitschrift für Pädagogische Psychologie, 29, 31-39. "https://doi.org/10.1024/1010-0652/a000143" doi:10.1024/1010-0652
- Thies, B. (2019). Akzeptanz, Vertrauen und Protest: Eine psychologische Analyse. In B.H. Oppermann & J. Stender-Vorwachs (Hrsg.), Autonomes Fahren (S. 75-89). München: C.H. Beck.

English and American Studies

Prof. Dr. Eckart Voigts

- 2013- Full Professor of English Literature and Head of Literary and Cultural Studies
- 2014-2016, Head of the Institute of English and American Studies

Researcher's Career

- 2013-, Professor of English Literature, TU Braunschweig.
- 2010, Leverhulme Visiting Professor, University of Leeds
- 2006-2013, Professor, University of Siegen
- 1991-2005, Assistant and Associate Professor, University of Giessen
- 2003, 1994, Post-doctoral dissertation, Dissertation, Giessen University
- PL (with D. Elflein, J. Röhnert) "From Avant-garde to Algorithm: Automated Creativity in Music and Literature" (2019-21, NMWK)
- PL (with J. Malkin), "Hyphenated Cultures: Contemporary British-Jewish Theatre" (NMWK/VolkswagenStiftung 2016-19), Association of Adaptation Studies (Trustee), Centre for Adaptations (Honorary Fellow)
- Editorial boards: Adaptation, OUP; Adaptation in Performance and Film, Intellect; Transmedia, Amsterdam UP, et al.
- 2010-16, President of CDE (German Society for Theatre and Drama in English)

Funding

VolkswagenStiftung/NMWK, DFG, DAAD-AH-RC PPP, Leverhulme Trust, Thyssen-Stiftung

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Mission Statement

We provide orientation in an ever more complex world of media and signs. One of the branches within the "Institut für Anglistik und Amerikanistik", the Literary and Cultural Studies unit specializes in transdisciplinary research on the "Anglosphere" that merges literary and cultural studies with media studies.

Research

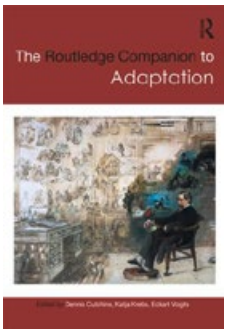
Adaptation and intermediality: Texts have never been stable, but the digital world has intensified this liquid textuality and provided sites of endless textual variation. We consider the ways in which new intertextual forms engendered by emerging technologies, mashups, remixes, reboots, samplings, remodelings and transformations operate under changing media protocols.

The interdisciplinary research project "From Avant-Garde to Algorithm: **Automated Creativity in Literature and Music"** deals with forms and effects of automated creativity that complement, superimpose and transform established practices, ethics and concepts. We ask what social, cultural and aesthetic changes the use of digital technology, algorithms and deep learning applications in music and literature bring about.

Current **dystopian and utopian narratives** have replaced the classic dystopian and apocalyptic imagination in the 20th century (Orwell, Huxley) with narratives of a future societal crisis, responding to the urgent global challenges at the beginning of the 21st century. The project takes a transmedial and comparative look not only at remarkably popular dystopian, post-apocalyptic but also utopian narratives that are engaging globalization, terrorism, climate change, new technologies, etc. in almost all genres and media: literature, film, television, graphic narratives, visual arts, computer games et al.

Contemporary theatre and drama: We live in a performative culture both inside and outside of the confines of the theatre. As a consequence, this research focus specializes in contemporary British theatre and drama. The new *Companion to British-Jewish Theatre since the 1950s* (Bloomsbury 2021) analyses how significant, but hitherto neglected British-Jewish theatre artists have influenced and co-created British theatre. It focuses on the ways in which Jewish religious, ethnic, and cultural inscriptions have found their way into mainstream British theatre.

As a spokesperson of the TU's strategic research focus "Future City", Eckart Voigts also investigates resilience and sustainabilty of both past and future cities.



Publications

- Voigts, Eckart, Jeanette R. Malkin, Sarah J. Ablett, Eds. A Companion to British-Jewish Theatre Since the 1950s. London: Bloomsbury, 2021.
- Voigts, Eckart. "Algorithms, Artificial Intelligence, and Posthuman Adaptation: Adapting as Cultural Technique", Adaptation (6 May 2020).
- Voigts, Eckart, Dennis Cutchins, Katja Krebs. Eds. The Routledge Companion to Adaptation. London: Routledge, 2018.
- Voigts, Eckart, Monika Pietrzak-Franger, Nora A Plesske, Eds. Transforming Cities. Discourses of Urban Change. Heidelberg: Universitätsverlag Winter, 2018.
- Voigts, Eckart, Alessandra Boller, Eds. Dystopia, Science Fiction, Post-Apocalypse. Classics – New Tendencies – Model Interpretations. Trier: WVT, 2015.

Institute of Music and Music Education

Prof. Dr. Bernhard Weber

Researcher's Career

- Director of the institute of music and music education
- Professor for philosophy for music education and didactics
- Director of the institute of music education at the university of music of Lübeck
- Professor for music education at the university of music of Lübeck
- Lecturer for music education and popular music at the university Paderborn
- Guest lecturership for music education and popular music at the HKB Bern (Switzerland)
- Dr. Paed. at University of Education, Freiburg
- Dipl. Paed. at University of Education, Freiburg
- Music teacher
- Member of several associations: DFG, GfPM, IASPM-DACH, BMU

Funding

BMBF, DFG, Bertelsmann-Stiftung, PRO*Niedersachsen, Hochschulbund, Industry

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Mission Statement

My research interests are the philosophy and didactics of music education. In this field I develop postmodern education contexts, with the aim of taking heterogeneous musical cultures into account and based on poststructuralism, constructivism and psychological models.

Research

Digital Cuts in Music Production

With the entry of digital technologies into studios producing popular music, many possibilities arise to manipulate recordings in audio-postproduction. One of the widespread applications are digitals cuts in different modes. In our studies "Inside the Cut" (2010) with novices and experts, we analyze the reception and the evaluation of digital cuts and also the influence of formal instruction.

Poststructuralism aspects in Music Education

In Germany poststructuralism theories, especially by Foucault, Derrida and Lyotard, were mainly received in cultural studies but less so in music education. We transfer different aspects of these theories in didactic contexts and develop prototypes for classroom-teaching. Important subjects are deconstruction (Derrida), postmodern conditions (Lyotard) and analysis of discourses (Foucault).

Blended learning arrangements in Music education

Digital media actually influences our daily lives and will perhaps be granted an important role in music didactics. Against this background we develop blended learning arrangements and flipped classroom concepts, which combine the benefits of face-to-face learning with digital instructional technologies based on various psychological aspects.

Self-regulated learning in informal contexts

Pupils and students, but also professional musicians, use online platforms like YouTube to further their musical competences. We explore these processes with a focus on self-regulated learning. The didactically relevant results should then be transferred to the practice of music lessons.

Music Composition with Apps in Primary Schools

With the increasing importance of digital media in music lessons, we are researching the didactic possibilities of selected digital composition apps for primary schools. The research project, funded by the BMBF, is carried out in cooperation with Prof. Dr. J. Grow from the HMTH Hannover.

Publications

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- Reflexion im Fokus – Videovignetten als Tool in der Lehrendenbildung. In: Simone Kauffeld, Julius Othmer (Hg.): Handbuch gute Lehre. Berlin: Springer 2019), zusammen mit Franziska Günther; Joana Grow, S. 427-439.
- Digitale Medien im Musikunterricht. Bestandsaufnahme, Reflexion, Perspektiven. Handorf 2017, zusammen mit Matthias Rheinländer.
- Prozessualität und Präsenz. Streifzüge durch die Posthermeneutik. In: Bernhard Gritsch, Victoria Gölles (Hg.): Interdisziplinarität in der musikpädagogischen Ausbildung. Innsbruck (2017), S. 51-74.
- Aneignungsformen populärer Musik. Klänge, Netzwerke, Geschichten(n) und wildes Lernen (Studien zur Popularmusik). Bielefeld: transcript 2017, als Hg., zusammen mit Dietmar Elflein.
- Inside The Cut, digitale Schnittmuster in der populären Musik – Entwicklung, Wahrnehmung, Ästhetik, Bielefeld 2010 (als Hg., zusammen mit Immanuel Brockhaus).

Institute of History

Prof. Dr. Johannes Wienand

- 2020 Department Chair of the Department of History
- 2018 Executive Board member, Mommsen Gesellschaft e.V.
- 2019 Full Member of the German Archaeological Institute
- 2018 Founder and speaker of the international network Internal War [DFG]
- 2017 Founder and speaker of the Network of German University Coin Collections (NUMiD) [BMBF]

Researcher's Career

- Full University Professor for Greek and Roman History at the TU Braunschweig
- Junior Fellow at the Historisches Kolleg, Munich
- Assistant Professor of Greek and Roman History, University of Düsseldorf
- Research Assistant, Department of Ancient History, Universität Heidelberg
- Research Assistant, Department of History, Universität Konstanz
- Residences in Pittsburgh, Cambridge (UK), Berlin, Frankfurt/M, Munich
- Dissertation (PhD) in Greek and Roman History, Universität Konstanz
- Study of History and Philosophy in Tübingen, Vienna, and Konstanz

Funding

BMBF, DAAD, DFG, Gerda Henkel Foundation, Fritz Thyssen Foundation, Historisches Kolleg, state funds

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Mission Statement

We investigate the Mediterranean societies from c. 1000 BC to 700 AD. The period is a crucial phase in the development of European cultures: Complex literate societies evolved and gave birth to sophisticated political, economic, legal, religious, and philosophical communication systems. We aim at understanding how this was possible, what it meant for the ancient societies, and what it means for us today.

Research

Civil War in Ancient Greece and Rome

Civil war is a crucial factor of sociocultural development. In a DFG-funded international academic network we investigate the impact of internal conflicts on ancient societies. We develop new approaches to the phenomenon and advance a methodologically sound and comprehensive re-examination of the historic source material.

Death on the Battlefield: War, Democracy, and Philosophy in Ancient Athens

Ancient Athens developed the first full-fledged democracy in world history. The political system was closely bound to a highly belligerent imperialism. Death on the battlefield is a historical lense for studying this unique amalgam. The project investigates the critical intellectual discourses that evolved around the burial of the war dead in classical Athens.

The Precarious Rule of Roman Emperors

The Roman Emperor was a precarious institution: His ability to rule was highly dependent on fragile legitimacy. Triumphal performances were meant to underscore the claim to power. The project investigates the subtle communication strategies around Roman imperial rule.

The Eastern Roman Monarchy in the Seventh Century

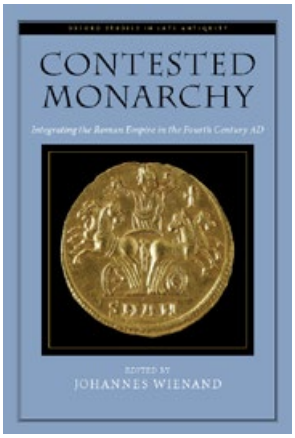
The Seventh Century is a period of transition from Antiquity to the Medieval Era in the West and to the Byzantine Period and to Early Islam in the East. The project investigates how ancient concepts of power and religion were transformed within the changing cultural frameworks of this period.

Digitizing Ancient Coinage

Digitizing ancient coins is a highly promising endeavour: No other source from Greco-Roman times survives in such massive numbers. A smart digitization strategy recovers this precious data treasure. Across Germany, we have brought together more than 40 university coin collections under the common roof of the BMBF-funded digitization network NUMiD (https://numid.online).

Studying ancient inscriptions in Athens

Mapping ancient Coinage



Wienand: Contested Monarchy (OUP)

Publications

- Wienand, Johannes, F. Goldbeck (ed.): Der römische Triumph in Prinzipat und Spätantike, Berlin: De Gruyter 2017
- Wienand, Johannes, M. Squire (ed.): Morphogrammata / The Lettered Art of Optatian: Figuring Cultural Transformation in the Age of Constantine, Paderborn: Wilhelm Fink 2017 [Morphomata series]
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Research Centres

Research Centres

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Battery LabFactory Braunschweig

Battery test system © Marisol Glasserman/TU Braunschweig

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Funding
BMBF, BMWi, BMU, EU, AiF, DFG, State of Lower Saxony, industry

Mission Statement

The Battery LabFactory Braunschweig (BLB) represents an open research center and infrastructure for the development, production and investigation of batteries from laboratory to pilot-plant scale, in particular lithium-ion but also lithium-sulfur and solid-state batteries. The research sprectrum covers the entire circular production and material cycle, from material synthesis through electrode and cell production and up to recycling.

Research

The Battery LabFactory builds on the fruitful and transdisciplinary cooperation of its members from different research institutions. Currently, 19 members from the Technische Universität Braunschweig, the Technische Universität Clausthal, the Leibniz Universität Hannover, the Fraunhofer Institute for Surface Engineering and Thin Films IST and the Physikalisch-Technische Bundesanstalt conduct joint research within the BLB.

The topics covered in the context of battery research generally comprise five areas:

1. Production research for electrodes and cells of current and future battery generations
2. Digitalization of the process and manufacturing chain
3. Diagnosis at material, process, product and system level, especially also during use phase
4. Simulation of battery components and cells, production processes and entire factories
5. Closed material cycles and recycling

Battery cell test © Marisol Glasserman/ TU Braunschweig

BATTERY LABFACTORY BRAUNSCHWEIG

1) The research at the BLB covers both design and new production technologies for electrodes and cells. Current lithium-ion batteries and future battery technologies such as solid-state and lithium-sulphur batteries are produced on laboratory and, in the case of lithium-ion batteries, pilot scale. The focus is on production, tailoring and characterizing active and inactive materials, intermediates as electrodes and assembled cells to provide a comprehensive understanding of the relationship between process, structure and cell performance. Regarding electrode and cell production, research is being conducted primarily into future-oriented processes and plant technologies. This includes the complete continuous production of electrodes by means of the interconnection of continuous slurry production via extrusion and coating systems.

Lamination line © Marisol Glasserman/TU Braunschweig

2) The BLB develops methods and tools to assess and to improve the sustainability of current and future battery technologies and to design flexible, transparent, and efficient factory systems. Based on digitalized battery production chain data-mining techniques, cyber-physical production systems, and tracking and tracing approaches are implemented for systematic improvement of production and recycling processes. The results are further used for political decision support towards sustainable battery supply chains.

3) The Diagnostics aims to gain fundamental knowledge regarding process-structure-property relationships with regard to the production and usage of lithium batteries. Analysis methods are developed and applied to the initial materials throughout the whole production process up to the final cells. By collecting, interpreting and connecting data along the process chain, a broad and fundamental understanding of the circular production and its influ-ence on the respective battery cells is aimed to be achieved. At the same time, specifically designed cells are physically, chemically and electrochemically analysed regarding their operation and aging, among others by means of in operando measurements.

4) Detailed simulation of production processes such as dispersion (using CFD) and calendering (using DEM) can be used to develop in-depth process understanding as well as a predictive modelling. Moreover, simplified models are connected to simulate the entire process chain to produce battery electrodes and cells. At the product level, electrochemical simulations are able to predict the influence of, for example, the electrode structure on the resulting cell properties such as performance. The findings from the individual simulations are used to represent a digital twin of the process chain including the product of the battery cell.

5) Current research at the BLB focuses on the development of innovative recycling processes to increase the yield and material purity and to reduce the energy demand. By closing material cycles and thus reducing the use of new raw material, the environmental impact of battery cells can be further reduced while its economic potential is fully exploited. The vision is the establishment of a circular battery economy according to the cradle-to-cradle principle.

Coating line © Marisol Glasserman/TU Braunschweig

The combination of these topics and the union of the institutes of the BLB allow a holistic view and target- and future-oriented research into the design and production of energy storage technologies.

Publications

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BRICS – Braunschweig Integrated Centre of Systems Biology

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Management Board
- Prof. Dr. Dieter Jahn (Speaker)
- Prof. Dr. Karsten Hiller
- Prof. Dr. Michael Meyer-Hermann (HZI)

Mission Statement

BRICS is a joint interdisciplinary bioinformatics and systems biology research centre of the Technische Universität Braunschweig (TU Braunschweig), the Helmholtz Centre for Infection Research (HZI), the Leibniz Institute German Collection of Microorganisms and Cell Cultures (DSMZ) and the Physikalisch-Technische Bundesanstalt (PTB). Systems biology integrates the knowledge derived from high-throughput omics techniques, biochemistry, genetics and cell biology using bioinformatics into mathematical models. These models in turn allow predictions about biological processes.

Research

Data Science and Metabolomic Network

One major scientific focus is on the metabolism of selected organisms as one of the major readouts of cellular adaption processes. We use a combination of state-of-the-art technical infrastructure analyzing genome, transcriptome, proteome and the metabolome with strong bioinformatic-based modelling. Our data science establishes mathematical models that help to faster and better understand diseases. Moreover, high-end and self-developed spectroscopic and microscopic methods are employed for vizualisation of modelled processes.

Key Project: Metabolic Host/Pathogen Interaction

An infection induces a metabolic cross-talk between host cells and the pathogen. How metabolism is involved in disease progression and how metabolic intervention can be of advantage for disease outcome are of major interest. In this research area we investigate the gram-positive bacterium *Clostridioides difficile*, which causes a high number of gut infections with thousands of deaths per year in Germany. The highly interdisciplinary research consortium examines the role of bacterial adaptation mechanisms, the effect of toxins and of the microbiome on *C. difficile* infections. The aim is a basic molecular understanding of adaptation strategies of the organism in its environment, including the communication of its metabolism with the metabolism of other microbiome bacteria and of the host cells, in order to develop better therapies and diagnostics of *C. difficile* infections.

Key project: Protein complexes of *Pseudomonas aeruginosa*

The gram-negative bacterium *Pseudomonas aeruginosa* is the major cause of death for patients suffering from cystic fibrosis. Essential for the colonization of the lungs is the formation of biofilms in an anaerobic environment, as within the highly viscous mucus, a microaerobic/anaerobic milieu prevails. A team of scientists from TU-BS and HZI focusses on the dynamics and function of large protein complexes of anaerobic respiration (denitrification) involved in energy generation during infection. Besides protein-protein interaction dynamics, the resulting metabolic adaptation processes are of central interest.

BRICS
Braunschweig Integrated Centre of Systems Biology

Systems Biology for Health Research and Biotechnology

BRICS aims at the collaboration of biologists, chemists, physicists, mathematicians, engineers and computer scientists for interdisciplinary research in the field of systems biology. For this reason, BRICS is comprised of 33 principle investigators from the TU Braunschweig, HZI, DSMZ, Twincore and PTB.

The BRICS Building

The BRICS building on the central campus of the TU Braunschweig houses both biological laboratories and theoretical working research groups. The building is designed for interdisciplinary research and teaching: on four floors, BRICS hosts 3 faculties of the TU Braunschweig, 2 research groups of the HZI, one research group of the DSMZ and one research group of the PTB. In addition, internship rooms, e.g. training laboratory and computer pool, for student-training in the fields of biology, biotechnology, bioinformatic and systems biology are provided.

Funding

DFG, BMBF, EU, State of Lower Saxony, VolkswagenStiftung, CF Trust of UK, industry

BRENDA Database

The BRENDA enzyme database (https://www.brenda-enzymes.org) has evolved into the main collection of functional enzyme and metabolism data. BRENDA provides reliable data, continuous curation and updates of classified enzymes, and the integration of newly discovered enzymes. The main part contains >5 million data for ~90 000 enzymes from ~13 000 organisms, manually extracted from ~157 000 primary literature references, combined with information of text and data mining, data integration, and prediction algorithms. Supplements comprise disease-related data, protein sequences, 3D structures, genome annotations, ligand information, taxonomic, bibliographic, and kinetic data. The BRENDA Pathway Maps are completely revised and updated for an enhanced interactive and intuitive usability.

Technologies and Resources at BRICS

- OMICs Technology: Genome, Proteom and Metabolom Analysis
- Databases: BRENDA, BacDive, PRODORIC2
- Biotechnology: Human Antibody Engineering and Phage Display
- Bioengineering: Systems Biotechnology and Fermentation
- Nanomicroscopy: Physical and Theoretical Chemistry Methods.

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Publications and Patents

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Coastal Research Center (Forschungszentrum Küste, FZK)

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Funding
EU, BMBF, BMWi, DFG, State Lower Saxony, Industry

Mission Statement

FZK is a joint institution of Leibniz Universität Hannover and Technische Universität Braunschweig. As a research institution, FZK is working in the fields of coastal and offshore engineering with a focus on laboratory experiments in the Large Wave Flume (GWK), a unique facility for large-scale model tests with water waves, oceanic currents and sediments.

Research

Research at FZK addresses four major topics: Coastal Structures, Sediment transport, Eco-hydraulics and Marine Energy. The backbone of scientific investigations is the Large Wave Flume (Großer Wellenkanal, GWK), allowing for dedicated model tests under controlled laboratory conditions and on a large scale, which is of crucial importance for many phenomena including breaking waves, sediment transport, plants or general turbulence – governed problems.

Research activities range from fundamental and applied research, supported by public funding agencies, to investigations carried out on behalf of industry clients. Most of the projects are carried out in national and international collaboration with other scientific and research institutions. In this context, EU-supported networks, such as Hydralab and MaRINET remain of importance as they join the leading European infrastructures in coastal and marine energy related research, improving their services and allowing external European research groups to carry out their own experiments in GWK, to which they would otherwise have no access.

Further recent national projects at FZK, in which experiments in GWK play a crucial role, cover the whole range of the four major research topics and beyond: from the hydraulic performance of stepped revetments, the recolonization of sea grass meadows and the optimization of sand nourishments as “soft” coastal protection measures to tsunami impact studies and marine aquaculture related research. Marine Energy gained particular significance in this context when the Federal Ministry of Economic Affairs and Energy (BMWi) provided 35 million € for the research project “marTech”, allowing further testing possibilities in GWK to significantly improve and extend unprecedented investigations. It will strongly support the German industry and technology development in this scientific realm.

FZK
FORSCHUNGSZENTRUM KÜSTE

Forschungszentrum Küste (FZK)

FZK combines the expertise of four institutes from Leibniz Universität Hannover (LUH) and Technische Universität Braunschweig (TU BS): Leichtweiß-Institute for Hydraulic Engineering and Water Resources (LWI) and the Institute for Geomechanics and Geotechnics (IGB) at the TU Braunschweig, Ludwig-Franzius-Institute for Hydraulic, Estuarine and Coastal Engineering (LuFI) and the Institute for Geotechnical Engineering (IGtH) (the latter both LUH). The four professors of these institutes represent the Board of Directors of FZK with Univ.-Prof. Dr.-Ing. habil. N. Goseberg (LWI) being the current Managing Director supported by the Operations Manager at GWK, Dr.-Ing. S. Schimmels. As recent member of the German Marine Research Consortium (KDM) and the German Marine Research Alliance (DAM), FZK is the only representative of the coastal engineering research community in these associations, actively contributing to the identification of new research fields and the development of international research strategies**.**

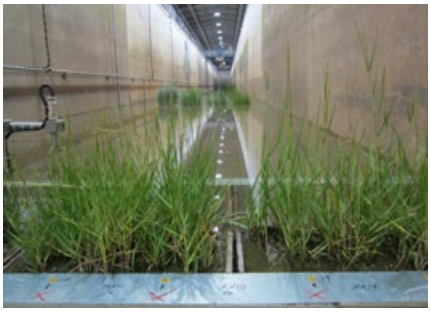
The Large Wave Flume (Großer Wellenkanal, GWK)

GWK is the core facility of FZK and has been in service since 1983. With dimensions of 307 m length, 5 m width and 7 m depth, it is still one of the largest wave flumes worldwide. Due to extensive construction works to improve the testing conditions in GWK within the project "marTech", the flume will likely be out of operation until autumn 2022. Once back in operation, GWK will still have the same dimensions, but will additionally provide a new staggered deep section up to 6 m deep and about 30 m long in total, a new current generation system with a total discharge of about 20,000 l/s and a new wave maker allowing for larger waves with wave heights up to about 3 m. These new features together with high-end measurement techniques and experienced staff at GWK will guarantee top-level research in the fields of coastal and offshore engineering.

The Large Wave Flume (GWK)

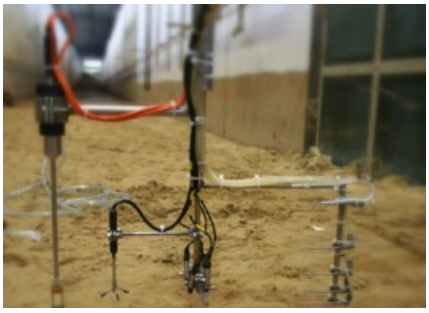
Breaking wave impacting a vertical seawall

Test of an OWC wave energy converter



Testing of real salt marsh plants

Breaking wave on a monopile



Instrument frame for measurements of sediment transport

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Laboratory for Emerging Nanometrology (LENA)

The new LENA building. © christo.cc/TU Braunschweig

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Links:
LENA:
www.tu-braunschweig.de/mib/lena

QuantumFrontiers:
www.quantumfrontiers.de

QVLS:
www.qvls.de

Mission Statement

LENA is a research center focusing on nanometrology – the science of precise measurements at the nanometer scale. Nanometrology is a core technology for the rapidly developing field of quantum and nanotechnology.

Research

Understanding and controlling the smallest structures with dimensions of only a few atoms plays an increasingly important role for our civilisation. LENA performs interdisciplinary fundamental research from synthesis, analysis and theory of nanomaterials to nanotechnological applications. Its scientific activities can be grouped into three core research areas:

1) Research in quantum technologies for the establishment of nanometrological standards that can serve as points of reference for calibrations everywhere
2) Establishment of improved and novel analytical methods to continuously enhance sensitivity and precision
3) Development of highly available integrated sensor modules for various applications like biomedical diagnostics or environmental online monitoring

LENA is equipped with a unique combination of high-end instrumentation for nanoanalytics, including – but not limited to – high-resolution imaging methods, spatially and temporally resolved spectroscopy, surface manipulation and analytics as well as particle property measurement instrumentation. All instruments are operated by the expert member groups of LENA.

LENA High-End analytical Infrastructure – High resolution optical polarimeter for semiconductor material characterization. AG Kroker/IHT, © J.Hosan/TU Braunschweig

LENA Laboratory for Emerging Nanometrology

The LENA Builing:
The LENA research center hosts more than 100 scientist, technicians and students in a new building, which has been launched in 2019, providing laboratory space and high-end analytical instrumentations on ~1,400 sqm and new offices and seminar rooms on ~1,200 sqm. The total investment of more than 33 million € was provided by the Federal State of Lower Saxony and the German Federal Government.

Funding
State of Lower Saxony, German Federal Government, DFG, EU, BMBF, BMWi, Industry

The Research Centre LENA

LENA combines research activities of 12 groups from Technische Universität Braunschweig (TUBS) and 8 groups of the Physikalisch-Technische Bundesanstalt (PTB) Braunschweig from the fields of electrical-engineering, semiconductor-, microsystems-, and particle-technology, physics, chemistry, optics, production measurement technology and more, to enable inter-disciplinary research in the field of nanometrology. LENA is the central infrastructure of the Core Research Area (CRA) Metrology of Technische Universität Braunschweig (TUBS) and one of the central facilities of the Cluster of Excellence "QuantumFrontiers". LENA hosts several junior research groups. The CRA Metrology comprises also joint TUBS/PTB appointments and graduate education programs of the "Metrology Initiative Braunschweig" (MIB).

The LENA Management Board: Prof. Dr. Andreas Waag (TUBS, speaker), Prof. Dr. Meinhard Schilling (TUBS, vice speaker), Prof. Dr. Georg Garnweitner (TUBS), Prof. Dr. Harald Bosse (PTB) and Prof. Dr. Stefan Kück (PTB).

LENA High-End analytical Infrastructure – Time-resolved photoluminescence measurements. AG Hangleiter LENA/IAP, © J.Hosan/TU Braunschweig

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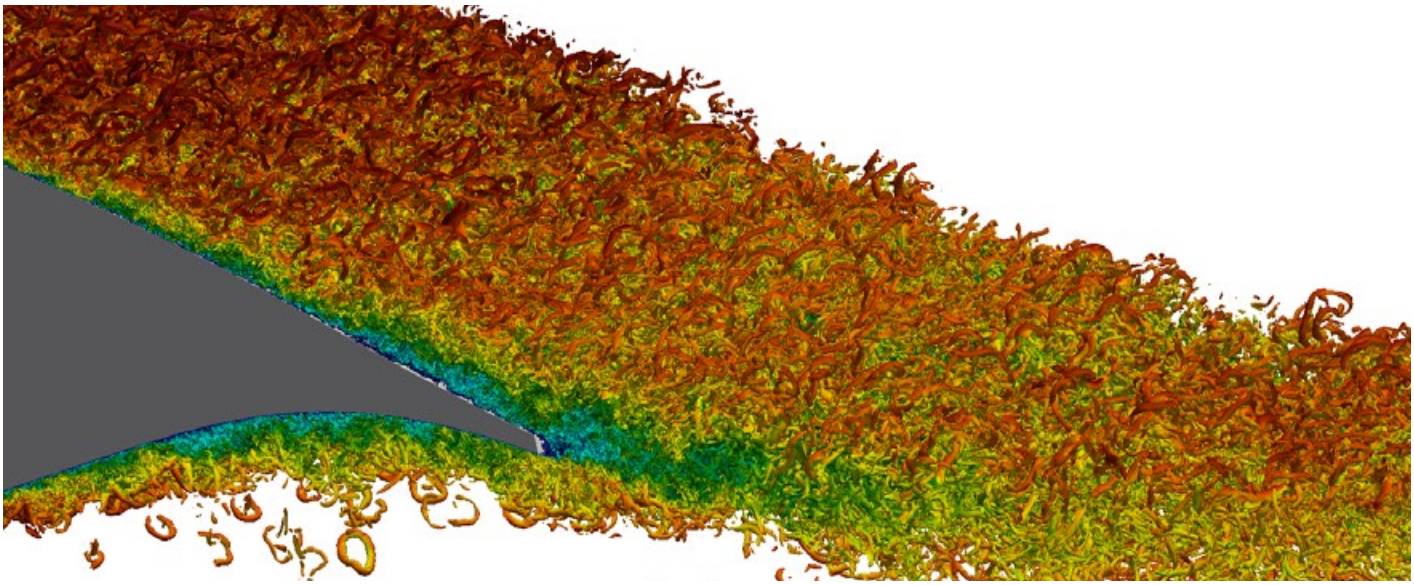
MUSEN Center



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EU, BMBF, DFG, Industry

Management board
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Jun.-Prof. Dr.-Ing. Ulrich Römer (Vice Speaker)
Prof. Dr.-Ing. Markus Böl
Prof. Dr. Dirk Langemann

Mission Statement

The MUSEN research center at TU Braunschweig is bringing together scientists from various disciplines to support research and education and align research and development strategies in the field of Computational Sciences in Engineering through internal and external cooperation in interdisciplinary research and industry projects.

Research

The MUSEN center combines the expertise of scientists from 20 research groups at the TU Braunschweig, TU Clausthal and Universität Lübeck in the fields of mechanical, civil and environmental engineering as well as mathematics and computer science. The activities of the center include in particular the initiation and coordination of joint interdisciplinary research projects in the fields of structural, solid and fluid mechanics as well as thermodynamics and acoustics in combination with highly specialized and innovative numerical methods.

1. Acoustics, Vibration & Tribology
We are dedicated to the identification, modelling, simulation, measurement and active/passive control of dynamical systems. In doing so, we develop future-oriented research approaches in the fields of acoustics, vibrations, tribology and friction.

2. Computer science, mathematics & uncertainties
We make use of methods from mathematics and software engineering to address advanced modelling and simulation tasks. We are constantly further refining these methods in order to provide solutions for new challenges.

3. Engineering Systems & Optimization
The demands on engineering designs are constantly growing, in particular concerning weight reduction and enhanced structural behavior. Lightweight construction and composite materials are, therefore, of great importance for our research work.

4. Particle systems & flows
Flow phenomena continue to be a major challenge for industry and research. We are looking for answers both by experiment and by modelling and simulation, and we are striving to analyse increasingly complex systems with increasing accuracy.

5. Materials & Thermodynamics
Materials are playing an important role in many areas of industry and science. We deal with numerous facets from mechanical material behaviour, heat and mass transfer to current problems of 3D/4D printing.

MUSEN

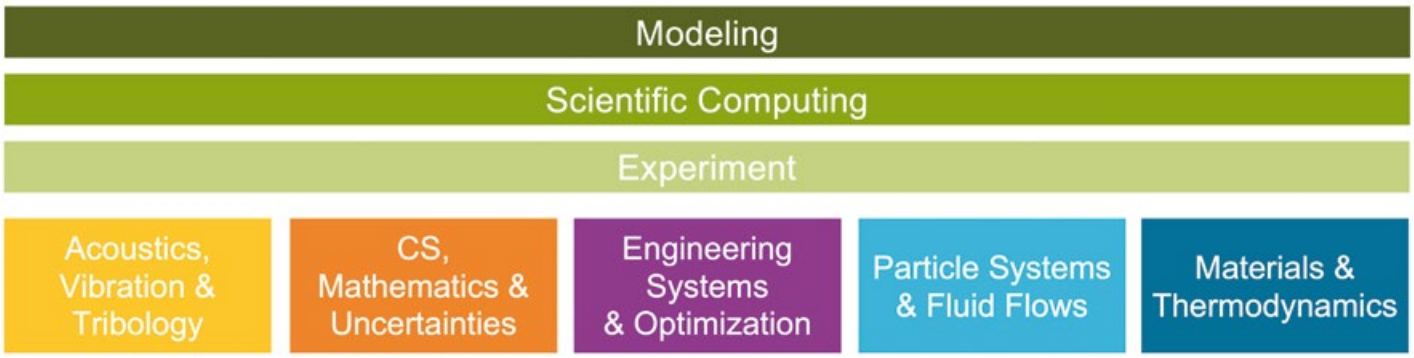
Research Part 2

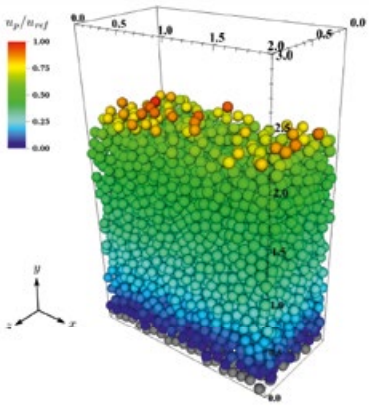
Graduiertenkolleg 2075

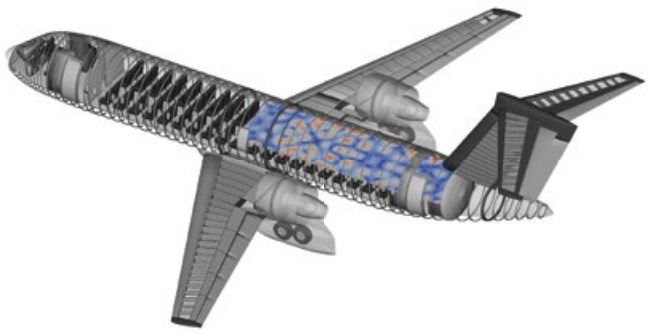
The goal of the research program is the development of scientific approaches to describe and evaluate the changing of properties and quality of buildings and infra structures with respect to physical and chemical effects. The multi-coupled processes, which are responsible for the evolution of building materials, will be described by model equations on different spatial and temporal scales within the theory of continuum mechanics and the theory of porous media. The models will be the basis for prognoses of the development of building materials and structures.

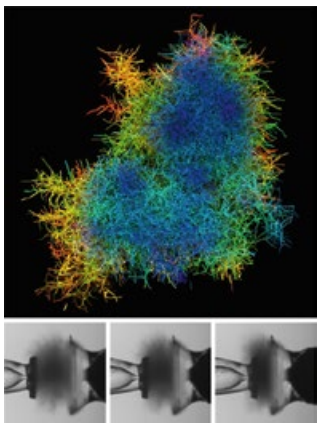
SURESOFT project

Digitization does not stop at science either. Whether it is simulations for mobile phone networks, acoustic problems, pollutant propagation or extensive calculations in chemistry: Scientists increasingly need specific research software for their work. The interdisciplinary project SURESOFT at the Technical University of Braunschweig has recently been granted by the DFG and is now investigating how research software can be developed and documented more sustainably.









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NFF – The Automotive Research Centre Niedersachsen

The NFF building © NFF/Christian Bierwagen

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BMBF, BMWi, BMUB, BMVI, DFG, EU, AiF, MWK(Nds.), MW(Nds.), MU(Nds.)

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- Prof. Dr.-Ing. Markus Henke, Institute for Electrical Machines, Traction and Drives
- Prof. Dr.-Ing. Ferit Küçükay, Institute of Automotive Engineering
- Prof. Dr. Ina Schaefer, Institute of Software Engineering and Automotive Informatics
- Prof. Dr. Thomas Spengler, Institute of Automotive Management and Industrial Production
- Prof. Dr.-Ing. Bernd Ponick, Institute for Drive Systems and Power Electronics (LU Hannover)
- Prof. Dr. Andreas Rausch, Institute for Software Systems Engineering (TU Clausthal)
- Dr.-Ing. Tobias Lösche-ter Horst (Industry)

Mission Statement

The research of the NFF as part of the TU Braunschweig focuses on ground-based sustainable mobility in 5 interdisciplinary research fields. The researchers and members of the NFF are professors of the TU Braunschweig, the LU Hannover and the TU Clausthal as well as institutes of the FhG, the DLR, the Ostfalia and institutional members of the WOB AG and other supporting organisations.

Research

The research field **"Intelligent Vehicles and Connected Driving"** includes the development of methods and technologies for autonomous vehicles, automated driving functions and driving assistance systems.
The aim is to derive user-specific driving strategies to improve road safety, driving safety and efficiency, driver acceptance, fulfilment of mobility requirements and improvement of the "urban compatibility" of future vehicles through cooperative 21st-century approaches. In addition to simulations in the "Virtual Mobility Lab" and the Dynamic Vehicle Road Simulator (DVRS) in the NFF technical centre, the city of Braunschweig serves as an excellent real lab with motorway test sites, a research car park and the city centre.
Driver, vehicle and infrastructure as well as human-machine interaction are studied with regard to the systems themselves, increasing automation and cooperative networking.
Head: apl.-Prof. Dr.-Ing. Roman Henze.

The research field **"Low-emission vehicle and drive systems and charging infrastructure"** looks at the overall efficiency of the vehicle life cycle ("cradle to grave"), which includes the efficiency of vehicle production, drive-energy generation and provision ("well to tank"), the efficiency of the vehicles in operation ("tank to wheel") and the final recycling of the vehicle. This enables the evaluation of the potential of different optimisation approaches in terms of CO_2 emissions, energy efficiency and resource use. In addition to electromobility, the research priorities in the vehicle utilisation phase include the continuous improvement of both conventional biofuels and conventional drives. Other topics are new drive concepts from hybrids to all-electric drives as well as energy management and emission optimisation. The research and evaluation of new drive concepts from hybrids to all-electric drive topologies as well as energy management and emission optimisation are a focal point.
Head: Prof. Dr.-Ing. Markus Henke and Prof. Dr.-Ing. Ferit Küçükay.

"Flexible vehicle concepts and vehicle production" is the area in which new vehicle concepts and production systems are researched for modular, adaptable, lightweight and resource-efficient vehicle concepts that can be flexibly adapted to market requirements. The research

Organisation
Implementing this research vision requires broad, structurally anchored, interdisciplinary collaboration between natural and engineering sciences plus economic and social sciences as is now happening among the 19 permanent members (TU Braunschweig, LU Hanover, TU Clausthal, DLR) and 23 associate members (TU Braunschweig, HBK Braunschweig, LU Hanover, Ostfalia) with more than 700 scientific staff and 70 chief engineers and post-doctorates.

Research Infrastructure
Since August 2014, the required scientific expertise from the institutes and working groups involved has been moving into the new NFF building. This 7500 m² location is the result of a € 60 million investment. It consists of offices and laboratories and is conceptualised as a project building for all the institutes and universities to allow them to take their scientific project cooperation to a new level.

The offices provide 150 workspaces for scientific staff from the member institutes. The Technical Centre and the large-scale test-bench area offer a range of testing equipment which all the institutes can use for their research programs. This includes a modular drive train test bench which allows, as an example, full drive train systems to be built up in prototype form and allow the interaction between the components (electric motor, performance electronics, battery and combustion engine) to be analysed with regard to their functionality and their dynamics. Electric engine test benches and a research laboratory for performance technologies are being installed to allow research into these technologies.

For research on Intelligent Vehicle Systems, an innovative research laboratory has been set up. A total vehicle simulator offers unique characteristics for researching active chassis and drive train regulation systems. The testing facilities are supplemented by an all-wheel-drive rolling test bench with climate control to realistically assess drive systems. The development of operating strategies and the analysis of relevant fuel-influence parameters on the behaviour of the combustion engine are facilitated by engine test benches and fuel-analysis laboratories.

focus is on linking mobile applications with virtual reality technologies, such as testing prototypes in the VR lab created in June 2019. Methodological foundations for flexible and resource-efficient vehicle concepts are being developed and new production concepts and process chains for flexible and economical vehicle production are being researched. A key aspect is the development of integrated large-scale technologies at the overall vehicle and component level. Important infrastructures in this area are the Open Hybrid LabFactory (OHLF) for sustainable manufacturing and production technologies for hybrid lightweight components, and the Battery LabFactory Braunschweig (BLB) as an interdisciplinary research factory for lithium-ion battery cells.
Head: Prof. Dr.-Ing. Klaus Dröder and Prof. Dr.-Ing. Thomas Vietor.

The interdisciplinary research field **"Mobility Management and Logistics"** addresses established and innovative mobility concepts that take up traditional mobility and logistics needs and combine them with new mobility-related services. Innovative concepts for individualised and safe passenger and freight transport are developed in the form of services and business models that meet the technical, ecological and economic requirements for fulfilling society's changing mobility and logistics needs. On this basis, framework conditions for sustainable mobility are created. With the concepts and methods developed at the NFF, service processes are uncovered with regard to the customer's error viewpoint and optimisation measures are derived from this.
Head: Prof. Dr. Thomas Spengler and Prof. Dr. David Woisetschläger.

Digitalisation rounds off the interdisciplinary spectrum of mobility research at the NFF as another major field of research.
Head: Prof. Dr.-Ing. Ina Schaefer and Prof. Dr. Andreas Rausch (TU Clausthal)


Mobility platform PLUTO © NFF/Hanno Keppel


Simulation in the Virtual Reality Lab © Marco Breig (KIT/CroM) for BMBF

Publications and Patents

- Albrecht, M.; Deeg, H.-P.; Schwarzenthal, D.; and Eilts, P. (2020): "Investigations of the Emissions of Fuels with different Compositions and Renewable Fuel Components in a GDI Engine," SAE Technical Paper 2020-01-0285, 2020, doi:10.4271/2020-01-0285
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NFL – Aeronautics Research Centre Niedersachsen

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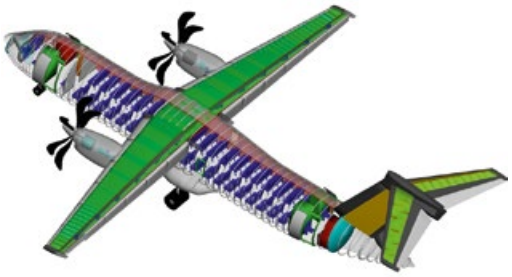
Mission Statement

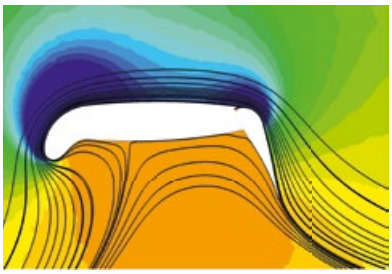
NFL is a research centre of the Technische Universität Braunschweig in cooperation with the German Aerospace Centre DLR, Leibniz University Hanover, PTB, and Fraunhofer-Gesellschaft. The NFL focuses on coordinated fundamental research in the key areas of aeronautics guided by the needs of flight safety, environmental sustainability, and efficiency.

Research

New possibilities through highly efficient solutions

The Collaborative Research Centre SFB 880 developed fundamentals of active high-lift for environmentally friendly future transport aircraft, following the vision of future commercial aircraft that will enable inter-European air transportation from small airports close to cities, enabling efficient point-to-point connections, short runways for take-off and landing, and drastic reductions of aircraft noise. This required fundamental research in aeroacoustics, efficient active high-lift, and flight dynamics resulting in new active wing technologies. SFB 880 was funded by the German Research Foundation, DFG, from 2011 until 2019.





Improving the sustainability of future aircraft

Regarding the current global challenge of climate change, civil aviation needs to perform a rapid transformation to more eco-friendly and sustainable solutions concerning aircraft design, propulsion systems, energy supply and recycling capabilities in the upcoming years. Therefore, NFL initiated the research program “Energy Transition in Aviation” in 2017, investigating the potential of new power trains such as battery-electric aviation, hybrid aircrafts and synthetic fuels, resulting in the TU Braunschweig’s unique Cluster of Excellence “Sustainable and Energy-Efficient Aviation – SE²A” in 2019. This cluster is an interdisciplinary research network that develops technologies for the sustainable and environmentally compatible development of air traffic in over 50 projects and is being funded by the German Research Foundation, DFG, from 2019 until 2025.

NFL
am Campus Forschungsflughafen

The Research Centre NFL
NFL aims at interdisciplinary cooperation across institutions. For this reason, NFL hosts more than 30 members from 24 institutes representing their research disciplines at the five contributing institutions. Members of Technische Universität Braunschweig and
DLR are equally represented in the executive board that is headed by the NFL speaker Prof. Dr.-Ing. Rolf Radespiel.

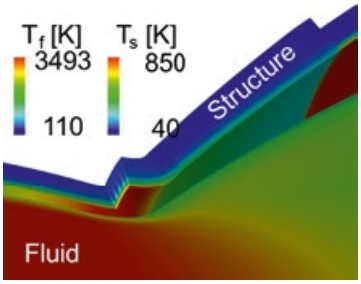
Research Infrastructure
Since all aerospace institutes of the Technische Universität Braunschweig are located in close vicinity to the large aeronautical institutes of DLR at Braunschweig Research Airport, this campus possesses over a large bandwidth of research infrastructure, including research aircraft, wind tunnels, simulators and test stands. Due to this unique environment, NFL is able to perform universal aerospace research of the highest quality.

The NFL infrastructure at TU Braunschweig contains:
- Propulsor Test Facility
- V2500 Research Engine
- Ice Wind Tunnel
- Large Water Tunnel
- Hypersonic Ludwieg Tube
- Space Proximity Laboratory

Operations Laboratory
- Research Aircrafts: DO 128, Cessna F406 and Cessna C172N
- Flight Simulators: A320 and DA42
- Cabin Simulator
- Lightweight Structure Test Stands

Funding
DFG, BMBF, BMWi, HGF, EU, State of Lower Saxony, industry

Higher cost-efficiency and reusability of future space transportation systems
Next-generation space transportation systems will be based on rocket propulsion systems which deliver the best compromise between development and production cost and performance. The SFB-TR 40 focuses on liquid rocket propulsion and its integration into civil space launchers. Reusability of thermally loaded structures and reducing design margins via new simulation capabilities are in the main focus of the project. TR 40 is a cooperation with partners from industry and academia in Aachen, Munich, Stuttgart and Braunschweig, funded by the German Research Foundation, DFG, from 2008 until 2020.



Investigating and solving fundamental problems for a better flight safety
Aircraft icing can pose problems to flight safety and is of particular importance since some accidents happen due to icing caused by so-called Supercooled Large Droplets, SLDs, occurring in the atmosphere under certain weather conditions. Due to new certification regulations for flights under SLD icing conditions published at the beginning of 2015, certain research areas are of high interest. The SuLaDI project by NFL focused on basic SLD research within the scope of the DLR@Uni initiative funded by the Helmholtz Association Fonds, HGF.

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OHLF – Open Hybrid LabFactory

Overview of the OHLF technical center. © OHLF/Massel

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- Dr.-Ing. Marko Gernuks (2nd Chairman), Volkswagen AG
- Prof. Dr.-Ing. Christoph Herrmann, Institute of Machine Tools and Production Technology
- Prof. Dr.-Ing. Thomas Vietor, Institute for Engineering Design

Funding
BMBF, State of Lower Saxony, BMWi, DFG, Industrial Research, AiF, and others

Mission Statement

The Open Hybrid LabFactory (OHLF) researches hybrid lightweight construction and large-scale production of multi-material systems in order to be able to economically realize future mobility applications. The research campus in Wolfsburg was initiated by the TU Braunschweig together with other partners from science and industry and is considered one of the leading addresses in Germany for the research and development of hybrid materials and multifunctional components of the future.

Research

The OHLF enables the research and development of new lightweight construction concepts and processes for the coming generations of vehicles and other mobility modes. The aim is to lay the foundations for the production of particularly lightweight and thus energy- and resource-efficient vehicle bodies and drive systems.

The OHLF as Lightweight Construction Campus offers the ideal basis for efficiently networking science and industry under one roof and as equals, and for accelerating research processes. The campus contains two essential elements for this. Firstly, the LabFactory, a state-of-the-art research factory with a technical centre, laboratories, integrated project buildings and office space. Secondly, with the help of this infrastructure, numerous projects are being carried out to research the use of composite materials as well as new integrated production processes and their implementation in hybrid components. Through the association-based open cooperation structures of science and industry, the OHLF also implements the concept of "open innovation" locally. With this orientation, it provides a forum for pre-competitive innovations that the participating companies can bring to market maturity in their respective fields of expertise.

The focus of research is on technologies for manufacturing and joining processes, production development and automation as well as digitalisation, which can be used in large-scale production of multi-material systems in the future. To this end, the OHLF is building expertise in materials and manufacturing technology for functional hybrid lightweight construction. This is understood to mean the economically and ecologically sustainable production of lightweight components made of metals, plastics and textile structures. These components and subsystem offer the same high safety and performance as conventional vehicles, for example. The implementation also requires the development of flexible manufacturing and production technologies that are capable of producing large numbers of units.

Simultaneous material and production technology development in multi-material systems for function-integrated, hybrid lightweight construction is the focus of activities. The special feature

OPEN HYBRID LABFACTORY
Der LeichtbauCampus.

Organisation

In the Open Hybrid LabFactory (OHLF), which is organised by an association as a public-private partnership, around 250 experts from universities, research institutions and industry are researching and developing innovative manufacturing and materials technology together as equals.
In addition to the institutes of the Technische Universität Braunschweig, the Leibniz University of Hannover and other universities, this facility is complemented by the Fraunhofer Project Centre. With the Open Hybrid LabFactory e.V. it has become a joint platform for industrial partners under one roof.
The Open Hybrid LabFactory is funded by the Federal Ministry of Education and Research (BMBF) as part of the funding initiative "Research Campus – Public-Private Partnership for Innovation". Other industrial partners, the State of Lower Saxony and the City of Wolfsburg are all promoting and supporting the Lightweight Construction Campus, which is located in Wolfsburg, not far from the Volkswagen AG main plant, in the direct vicinity of the MobileLifeCampus and the AutoUni.

Research Infrastructure

At the interface between science and industry, a platform was created with the OHLF in September 2016 that offers unique infrastructure and plant technology: a research factory with a pilot plant, laboratories, integrated project house and office space where partners from different organisations come together in close cooperation.
For the near-series production of hybrid components, the OHLF has manufacturing facilities such as forming presses and injection moulding machines with more than 2,500 clamping force on an area of more than 2,500 m². The plant technology enables the validation and testing of new developments as well as the adaptation of components to new requirements under real conditions.
In the laboratories, analyses of materials, process and quality controls, tests and measurements are carried out or process parameters are determined using smaller laboratory systems in order to later optimise production processes on the large-scale systems in the pilot plant. Life cycle analysis and life cycle design take place in the specially equipped laboratory.

of OHLF, the almost complete consideration of components throughout the entire product lifecycle; from conceptual design, semi-finished fabric and organic sheet production and the production processes of hybrid components, to lifecycle design and engineering.
Comprehensive analysis and testing technology is available for characterising the production steps and multi-material systems.
In addition to technological development and economic considerations, questions of sustainability and CO_2 emissions are becoming increasingly important throughout the value chain. The research focus on mechanical functionality is supplemented by electrical, thermal, acoustic and sensory functional integration. One of the main goals is to support the digitalisation of products and production processes through the corresponding functionalisation of semi-finished products and components.
Another focus of future research work is also on the scalability and flexibility of series production. For this, conventional manufacturing processes suitable for large-scale production are used together with newly developed additive processes and AI-supported development methods.

In the large-volume injection molding process, molten plastic is injected at high pressure into a mold in which the component forms its shape. In such a mold, metal inserts, local fiber reinforcements or organic sheets can also be overmolded to hybridize and functionalize the component in the process. © OHLF/Wecke

For the purpose of studying the interactions in the manufacturing processes and the analysis of hybrid composite components, the surface structure of materials can be imaged and analyzed down to the nanometer and subnanometer range in the imaging laboratory, equipped with versatile and high-resolution microscopes. © OHLF/Christo

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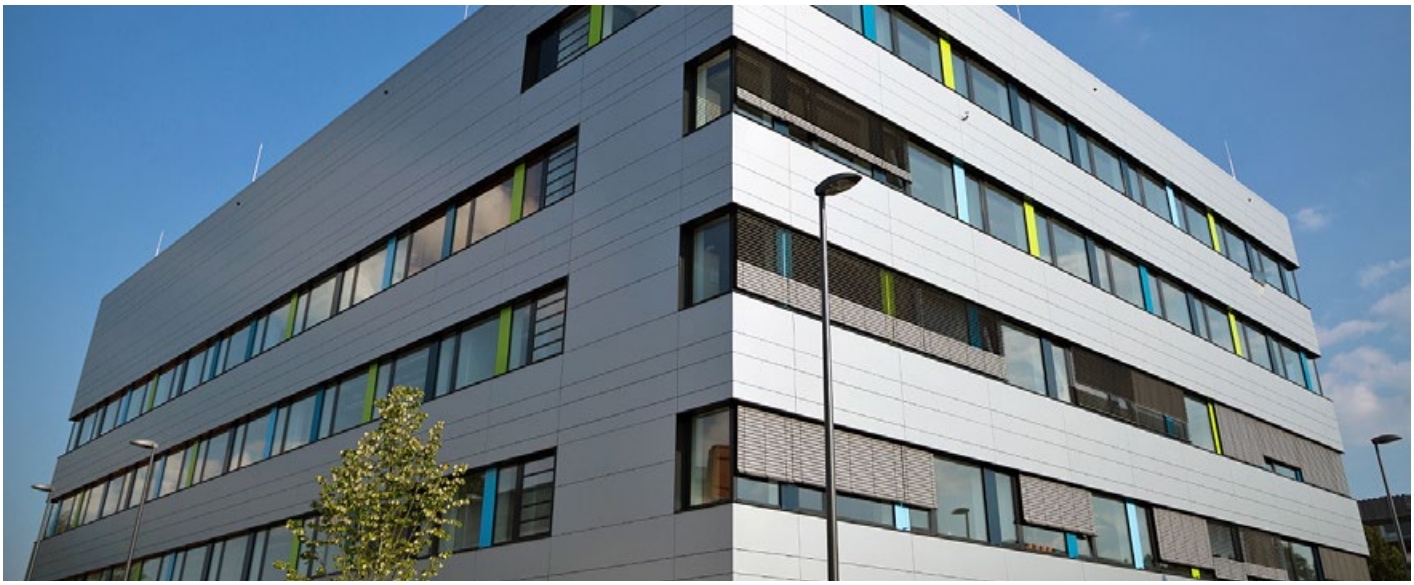
PVZ – Center of Pharmaceutical Engineering



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- Prof. Dr. Heike Bunjes (Vice Speaker)
- Prof. Dr. Ludger Beerhues
- Prof. Dr. Andreas Dietzel
- Prof. Dr.-Ing. Stephan Scholl

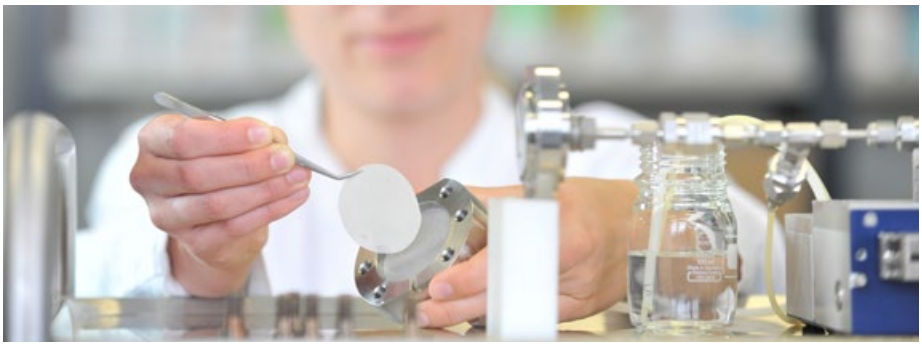
Mission Statement

As Carolo Wilhelmina research center of the TU Braunschweig, the PVZ aims at the production of tailor-made pharmaceuticals at low cost. Three main topics are explicitly addressed: (i) making production processes more efficient by in-depth understanding, advanced design methods and continuous processes, (ii) making drug formulations more effective by processing and formulating poorly soluble or stress-sensitive drugs adequately, and (iii) individualizing medicines to fulfill the needs of special patient groups.

Research

Research competencies

The PVZ efficiently combines expertise from different fields of research at the TU Braunschweig: pharmaceutical scientists closely cooperate with bioprocess and chemical engineers, strengthened by microsystem and production technology engineers. This enables the processing of very small product amounts, concepts and methods for early screening in pharmaceutical development, personalized medicine and inline process analytics. The PVZ covers the complete value chain from chemical and biotechnological API synthesis over purification, formulation and preclinical testing to packaging. Its research efforts are organized between individual projects up to large joint projects.



Manufacturing of colloidal drug carrier systems by premix membrane emulsification. © Frank Bierstedt; TU Braunschweig

Biotechnological and biological methods are applied to produce and characterize antibody fragments and low molecular weight biological APIs. Additionally, micro-analytical strategies for API quantification are developed. Continuous processes for chemical synthesis of APIs are designed, and scale-up strategies for production scale are developed. The special formulation

Zentrum für Pharmaverfahrenstechnik

The PVZ Core Research Topics

- Biomolecule Engineering
- Digital Twins
- Organ-(Human)-on-a-chip
- Individualised Production & Therapy
- Miniaturisation & Parallelisation
- Optimisation of Processes

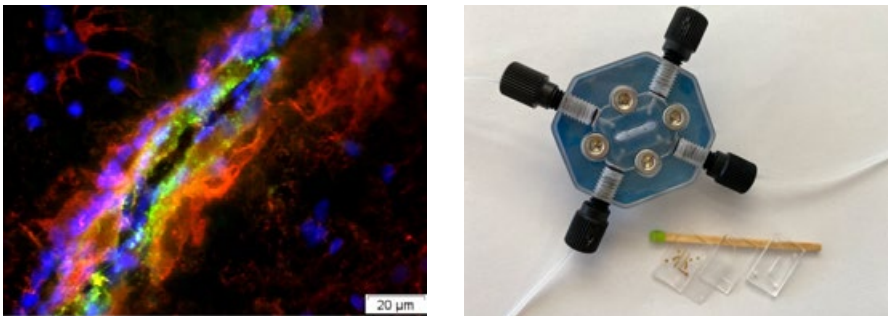
Research Infrastructure

The PVZ is located in a new building at the eastern campus of the TU Braunschweig. It has been developed to jointly accommodate four key departments and two cross-sectional working groups on 3,300 sqm. Specialized laboratories facilitate the clean and safe production of pharmaceuticals as well as microsystems and the chemical and biotechnological synthesis from micro to pilot scale. The building also provides modern offices and meeting rooms as well as a computer pool and seminar rooms for scientific exchange. Tandem teams consisting of pharmacists and engineers are working closely together in six research areas to speed up Pharmaceutical Engineering research. Altogether, approx. 100 scientists from around 20 institutes bundle their research capacities to meet the PVZ overall goal of customized innovative drugs & processes and intelligent production systems.

Funding

DFG, BMBF, BMWi, EU, State of Lower Saxony, industry

needs of poorly water-soluble molecules are systematically addressed. To reduce animal testing and to allow for quick in vitro assays for API and formulation testing, microscale devices are developed and evaluated for cell cultures.



Cross section of brain capillary, immunostaining of microvascular endothelial cells, pericytes and astrocytes (left); Blood-brain barrier-on-chip for drug testing under dynamic conditions (right). © Verena Ledwig, Eugen Koch; TU Braunschweig

iCA – Drug Discovery and Cheminformatics for New Anti-Infectives (iCA).

Based on joint projects SynFoBiA (VW Vorab) and micro-PROPS (Niedersächsisches Promotionsprogramm), PVZ prinicipal investigators have started the doctoral programme iCA. This programme focuses on the development of new effective drugs against bacterial and parasitic infectious diseases (anti-infectives). This requires the development of innovative active compounds that differ chemically from the previously used drugs as well as the identification of new biological targets that are not yet addressed by established drugs. Based on innovative digitalization techniques, the iCA PhD programme is working on new anti-infectives that are introduced through cooperation between the Technische Universität Braunschweig, the Helmholtz Centre for Infection Research and Ostfalia University of Applied Sciences..

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Cluster of Excellence

Research Centres

SE²A 212

EXC2123 QuantumFrontiers 214

Sustainable and Energy-Efficient Aviation – SE²A

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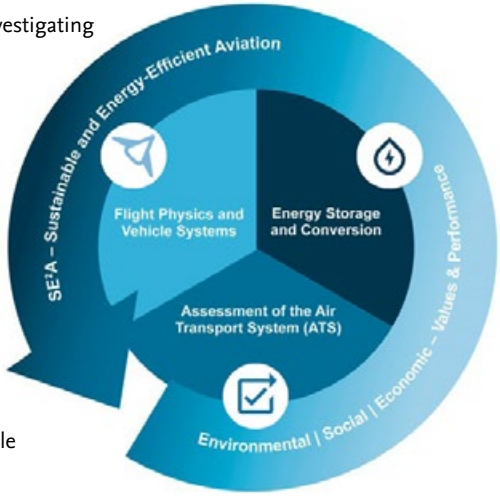
Funding
The cluster is funded by the German Research Foundation, DFG, for 7 years, starting January 2019. A second 7-year funding period is possible, depending on a positive review by the DFG.

Mission Statement

SE²A is an interdisciplinary research cluster investigating technologies for a sustainable and eco-friendly air transport system. Scientists from the TU Braunschweig, DLR, LU Hannover and PTB are working on the reduction of emissions and noise, as well as life-cycle concepts for airframes and improvements in air traffic management.



Overall concept of the SE²A Cluster

Research

The SE²A cluster is working as inter-disciplinary research network to drastically reduce the energy requirements for future commercial aircraft, to develop new, sustainable approaches for energy storage and energy conversion in aircraft, and to holistically evaluate and optimize the ecological efficiency and economic viability of the air transport system.

In SE²A critical research demands are coordinated in three focus areas: **"Assessment of the Air Transport System"** focuses on system analysis and evaluation of the air transportation system in different future scenarios. These scenarios consider environmental, economic and social criteria simultaneously. Technology assessment includes noise exposure and life-cycle analysis.

"Flight Physics and Vehicle Systems" conducts fundamental research on enabling technologies for sustainable transport aircraft with zero-fossile energy supply. These enablers are expected to be active means of load control, drastic reductions of aircraft drag, and knowledge on integrating new functions into load-bearing structures, on new materials, and on design rules for composite structures.

SE²A Sustainable and Energy-Efficient Aviation

Sustainable and Energy-Efficient Aviation – SE²A

Spokesperson
Prof. Dr.-Ing. Jens Friedrichs
Prof. Dr.-Ing. Rolf Radespiel

Structure and principal investigators:
58 professors, 70 doctoral researchers,
4 Independent Junior Research Groups,
5 Independent Junior research projects

Partner Institutions:
German Aerospace Center (DLR)
Leibniz University Hannover (LUH)
Braunschweig University of Art (HBK)
National Metrology Institute of Germany (PTB)
Hannover Airport
Research Airport Braunschweig

International Cooperations
Delft University of Technology – Faculty of Aerospace Engineering, Delft, The Netherlands

Research Infrastructure
Laboratories e.g. at BLB
Test rigs e.g. at IFAS, NFL, DLR
Wind tunnels
Electric aircraft ground lab environment – E²AGLE
Research Airport Braunschweig

Pictures: ©TU Braunschweig / SE²A

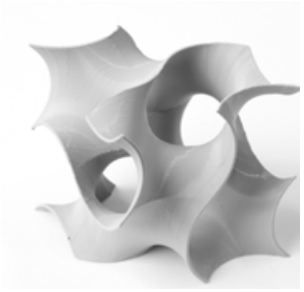
"Energy Storage and Conversion" deals with the fundamentals of providing the amount of energy and energy density required for flight. There are long-term technological prospects for full electrification of regional and short-range aircraft, while long-range aircraft will continue to rely on liquid fuels characterised by high energy density. Between these distinct energy storage alternatives, there are hybrid concepts that open a new design space for adapting the aircraft to specific requirements of its mission profile and for improving overall efficiency.

Novel Active Load Reduction systems for aircraft wings

Research infrastructure: The Cluster of Excellence SE²A is one of the research centers of TU Braunschweig and represents a major research capacity in the key research area "mobility".

Not only the intense exchange and integration of approaches within the three cluster areas but also the flexibility in governance allows to define and integrate new critical research demands "along the road" in the cluster scientific program. Therefore, scientists from the five partner institutions combine their expertise and work in an outstanding research environment: Leading laboratory equipment, modern test rigs including wind tunnels, up to tests in research aircrafts at the Research Airport Braunschweig.

With its own graduate education programme, extensive measures for equal opportunity, and an international collaboration network, the Cluster of Excellence SE²A sets his own marks of excellence not only at the TU Braunschweig but also in the aviation research landscape. The long-term goal is to further strengthen the research alliance in the region together with external partners to establish the world-class scientific structure in aeronautics which is necessary to perform the great challenge of energy transition in aviation.



Gyroid cell in laminar flow control

Midrange aircraft concept, SE²A

Publications and Patents

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EXC2123 QuantumFrontiers

Speakers:
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Prof. Andreas Waag
Prof. Michèle Heurs
Prof. Piet Schmidt

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Funding:
The cluster is funded by the German Research Foundation, DFG, for 7 years, starting January 2019.

Structure:
51 Professors
> 390 members

Mission Statement

The mission of QuantumFrontiers is to merge quantum metrology and nanometrology, in order to advance to the next level of unprecedented sensitivity and precision, and to push the bounds of knowledge at the largest and smallest dimensions: from gravitational wave astronomy to the manipulation of light and matter on the quantum level.

Vision

QuantumFrontiers' research profits from an internationally unique infrastructure across six regional institutions and contributes to the technological advancements of large international research collaborations in a range of fields: geodesy, quantum optics, laser science, solid-state physics, electrical engineering, gravitational physics, nanotechnology and quantum metrology.

Research goals

Within the QuantumFrontiers research program we explore light and matter at the quantum frontier. This means that we exploit quantum metrology and nanometrology to improve sensitivity and precision of measurements, i.e. the foundations of metrology. These advancements in the foundations of metrology enable new precision measurements and measurement technologies that allow us to understand nature better at the smallest and largest scales: from gravitational wave astronomy to light and matter on the quantum level.

Here are some of the topics which QuantumFrontiers' research is advancing:

- optical atomic clocks for the world's most accurate time measurement and future reference systems,
- several orders of magnitude more precise atomic interferometry,
- new electrical quantum standards, sub-wavelength nanophotonics with full state control of the light,
- hybrid CMOS integration for nano-LED platforms in the sub-100 nm range,
- lase interferometric distance measurement in the picometer range for satellites,
- chip-based compact atomic optics and nanophotonics,
- relativistic geodesy with sub-centimeter height resolution.

QuantumFrontiers transfers knowledge to society via specific programs:

- Education and Outreach: e.g. MasterClasses and Coordinating with BMBF and QT Flagship programs
- Tech Transfer: QuantumFrontiers Entrepreneur Excellence Programme (QuEEP), Industry Collaboration Physikalisch-Technische Bundesanstalt (PTB)
- QuantumFrontiers International Research School (QFIRS): Linking physics and engineering, scientific and alumni network

Partner Institutions:

- Leibniz Universität Hannover (LUH)
- Technische Universität Braunschweig (TUBS)
- Physikalisch-Technische Bundesanstalt (PTB)
- Albert-Einstein-Institut (AEI)
- Laser-Zentrum Hannover e.V. (LZH)
- Zentrum für angewandte Raumfahrt-technologie und Mikrogravitation (ZARM)

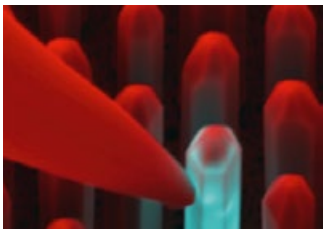
Research Infrastructure

6 Institutions, over 20 institutes,
9 research buildings with large-scale experimental setups
e.g. LENA – Laboratory for Emerging Nanometrology,
HITec Einstein Elevator

Research

Gravitational Wave Detection

- Non-classical light and quantum optomechanics
- Nano-structured mirrors

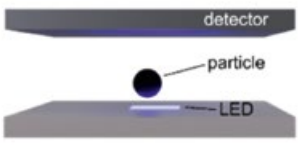


Nano and Quantum Engineering

- Electrical quantum effects
- NanoLight
- TrabFab for quantum chips

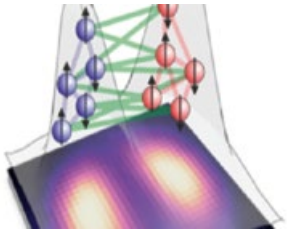
People

- > 300 members
- > 200 Early Career Researchers (incl.PhDs)



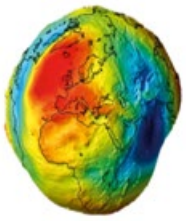
Tech Transfer

- QuantumFrontiers Entrepreneur Excellence Programme



Fundamental Physics

- Variation of fundamental constants
- Quantum objects in gravity
- Entangled many-body quantum systems



Geodesy and Gravimetry

- Gravimetry with light and matter waves
- Reativistic geodesy with clocks
- NanoLight

Education and Outreach

- QuantumFrontiers International Research School
- Masterclasses
- Quantum Engineering Focus

Available Infrastructure

- 6 Institutions
- Over 20 Institutes
- 9 research buildings with large-scale experimental set-ups

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