Technische Universität Braunschweig

Institut für Strömungsmechanik

Bachelor/Master/Course projects in the field of **Fluid Dynamics** and **Machine Learning**

Why combine fluid mechanics and machine learning?

Experimental and computational **fluid dynamics** create vast amounts of data of fluid flows. Unfortunately, these data are not used to their full potential most of the time because they are massive, complex, and hard to analyze. **Machine learning** is the art of creating insight and value from data, and therefore, it is an ideal candidate to automate the analysis and processing fluid flow data. In a nutshell, combining machine learning and fluid dynamics is really all about **making better use of data.**

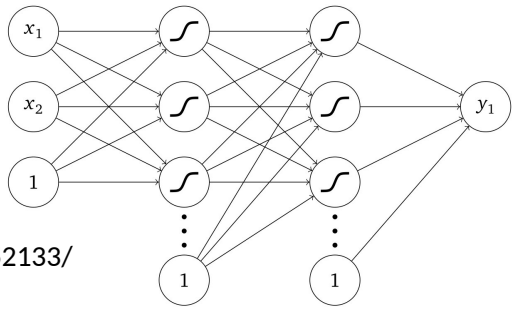
What is in for you?

Here are some arguments why you should consider working on a project under my supervision:

- **portfolio-ready project:** at the end of your project, you will have a public, well-documented, exclusive *Github* repository displaying our work. Such a public demonstration of your skill and experience will make a difference when applying for jobs or internships in industry and academia.
- **close supervision:** I meet with students once a week to discuss the project's current state. Additionally, technical challenges and results are discussed frequently using *Github issues*.
- **research:** you will be actively involved in ongoing research projects. Particularity ambitious students also have the chance to participate in authoring scientific articles. Such articles are an ideal starting point for a career in academia or research.
- **state-of-the-art tools:** during the project, you have the chance to learn and use state-of-the-art tools for data analysis, machine learning, visualization, and computational fluid dynamics.

Get in touch!

Dr.-Ing. Andre Weiner
a.weiner@tu-braunschweig.de
Office 129, Hermann-Blenk-Str. 37, 38108 Braunschweig
Github: https://github.com/AndreWeiner
LinkedIn: https://www.linkedin.com/in/andre-weiner-a79752133/



List of open projects

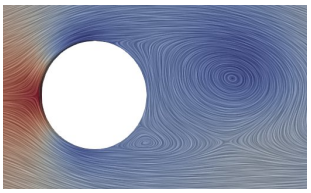
The project descriptions are kept purposefully to a minimum and are adjusted individually to the student's interests and skills and the type of project. Regardless of the specific topic, all projects are conducted using version control (Git/Github) and a Linux-based operating system. Prerequisite knowledge in version control and Linux is wishful but not essential.

Accelerating numerical simulations by smart solver settings
reinforcement learning and *computational fluid dynamics*
Tools: OpenFOAM, PyTorch, C++, Python

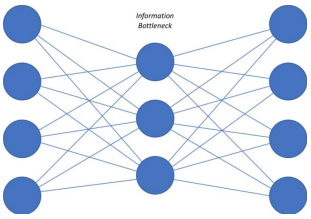
```
"pcorr.*"
{
    solver          GAMG;
    smoother        GaussSeidel;
    cacheAgglomeration no;

    tolerance       0.02;
    relTol          0;
}
```

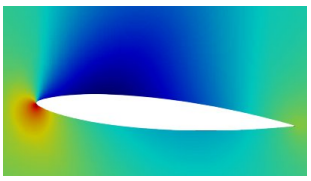
Closed-loop flow control of the flow past a rotating cylinder for drag-reduction
reinforcement learning and *experimental fluid mechanics*
Tools: LabView, PyTorch, C/C++, Python



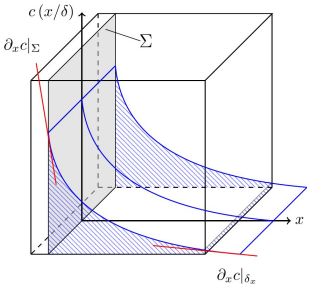
Cluster-based network modeling using auto-encoders
unsupervised learning and *computational fluid dynamics*
Tools: OpenFOAM, PyTorch, flowTorch, Python



Multi-resolution dynamic mode decomposition applied to flows with transonic buffets
unsupervised learning and *computational fluid dynamics*
Tools: OpenFOAM, PyTorch, flowTorch, Python



Data-driven wall function modeling for the simulation of turbulent flows
supervised learning and *computational fluid dynamics*
Tools: OpenFOAM, PyTorch, C++, Python



High-fidelity mass transfer computations at rising bubbles using a hybrid simulation approach
supervised learning and *computational fluid dynamics*
Tools: OpenFOAM, PyTorch, C++, Python