B04

Process Control and Adaptive Path Planning for Additive Manufacturing Processes Based on Industrial Robots with an Extended Degree of Freedom

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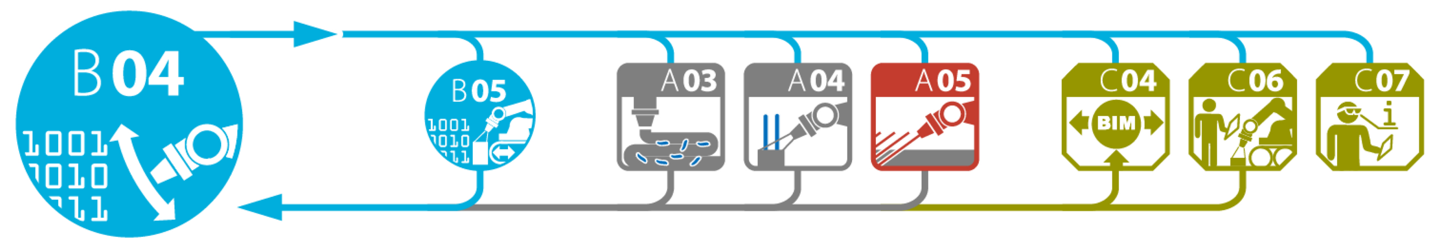
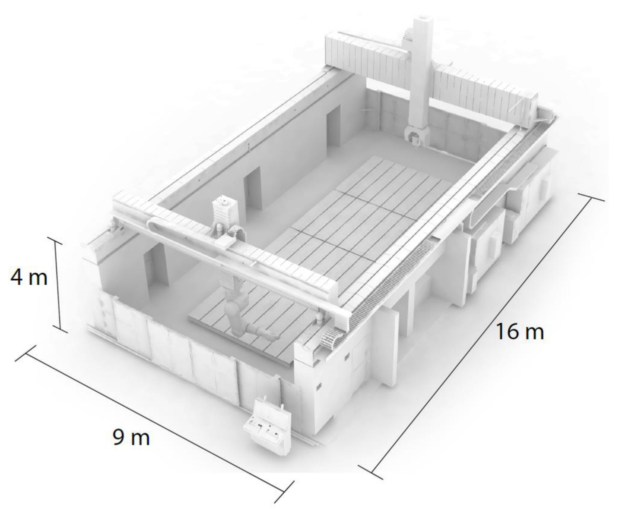
Summary



The integration of robot-guided additive manufacturing in construction increases the degree of automation and can thus lead to increased productivity and improved component quality. In this project, a multi model based path planning is developed. It is based on an application process model that includes geometrical data and a physical material model. Together with multi modal sensors a sensor-guided control for an adaptive online path planning will be developed. Further, multi modal sensors and new control strategies are investigated to control cognitive and cooperative autonomous robot units with an extended degree of freedom.

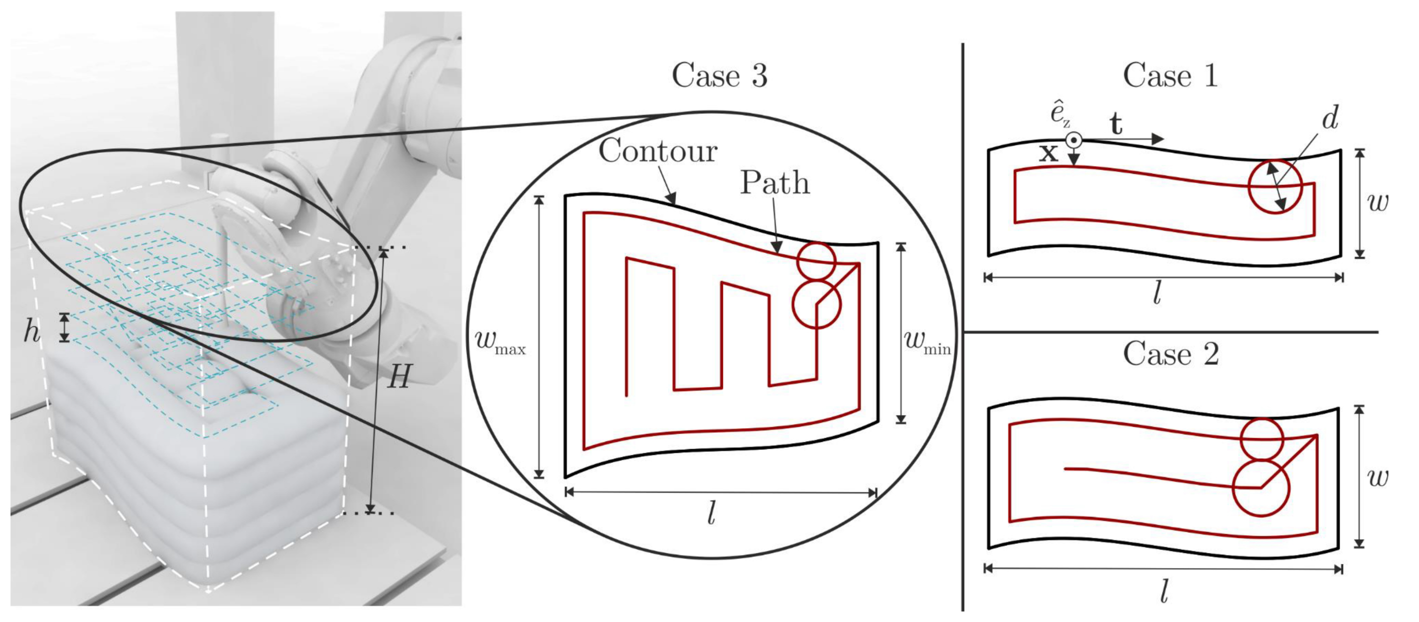
Motivation and Objectives

- Increased productivity and improved component quality of concrete structures
- Robot-guided additive manufacturing raises level of automation
- Manufacturing of large and complex components with SC3DP
- Development of a multi model based adaptive online path planning algorithm
- Enabling robots with > 6 DoF for AM in construction

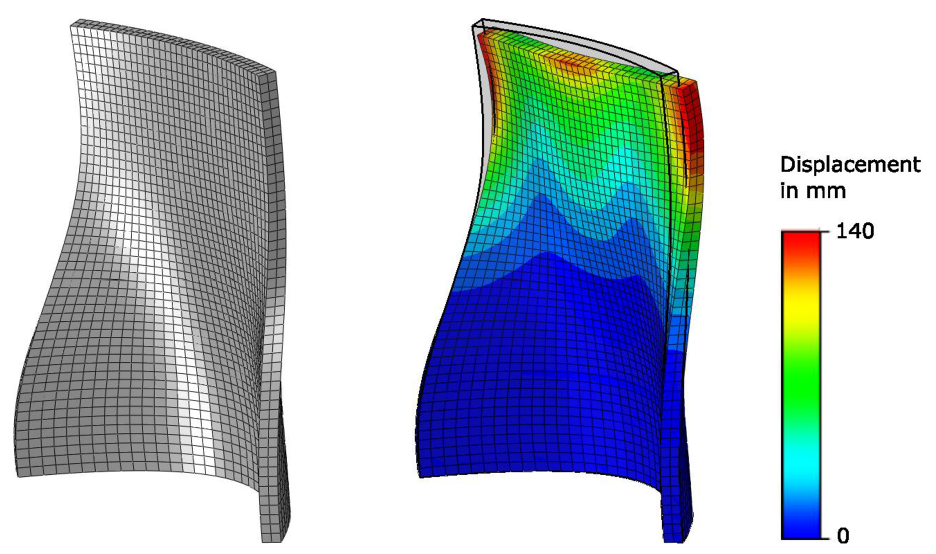


Preliminary Work

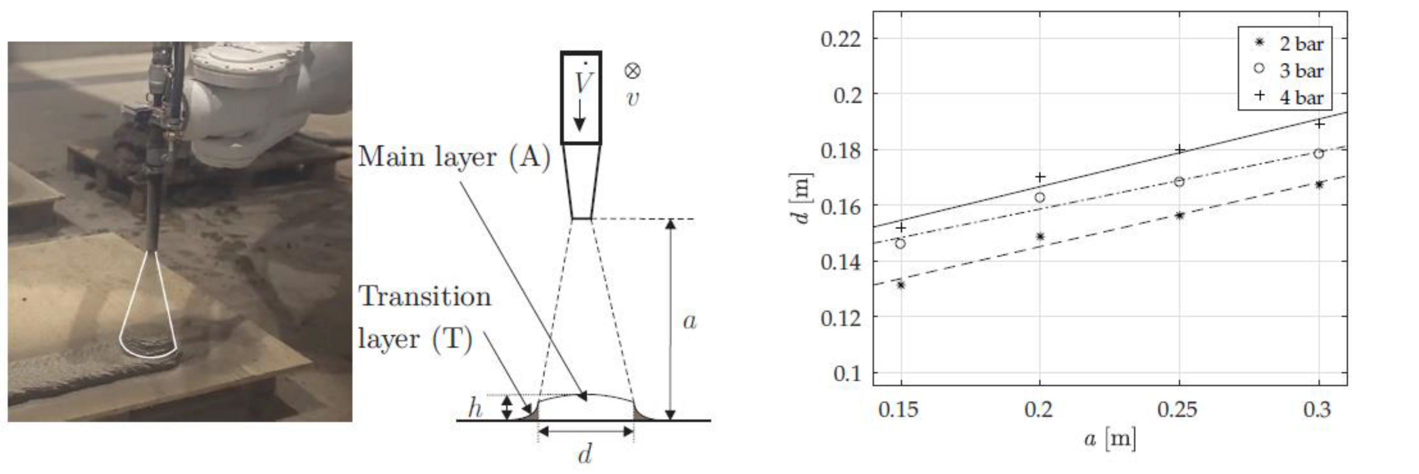
- Development of path planning algorithms based on geometrical data
- Approach for online path planning algorithms using laser scanner
- Material modelling of concrete structures and model reduction
- Control of mobile robot units for production processes



Path planning: Exemplary cases for shotcrete application.



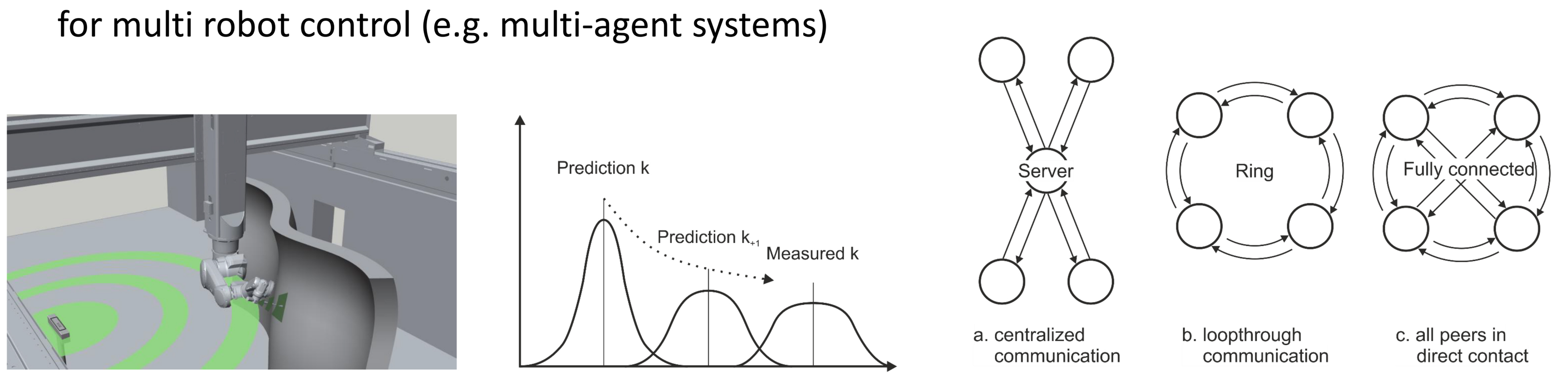
Digital representation of DBFL demonstrator (left) and computed distortion (right).



Application model: Cross sectional area and parameters of the application layer (left) and layer width [d] dependent on the nozzle distance [a] (right).

Approaches and Methods

- Design of experiments for physical data of concrete
- Offline path planning algorithm based on physical and geometrical data
- Sensor data fusion with model data (e.g. Kalman filter) for multi model online path planning
- Investigation of suitable cost functions for solving the ambiguity problem of redundant robots (optimization)
- Investigation of control and communication strategies for multi robot control (e.g. multi-agent systems)



Concept for data fusion (left), adaptive application model (mid), communication strategies (right)