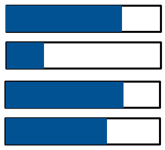
Chair of Computational Modeling and Simulation
TUM School of Engineering and Design
Technical University of Munich

Modeling:
Mathematics:
Programming:
Science:

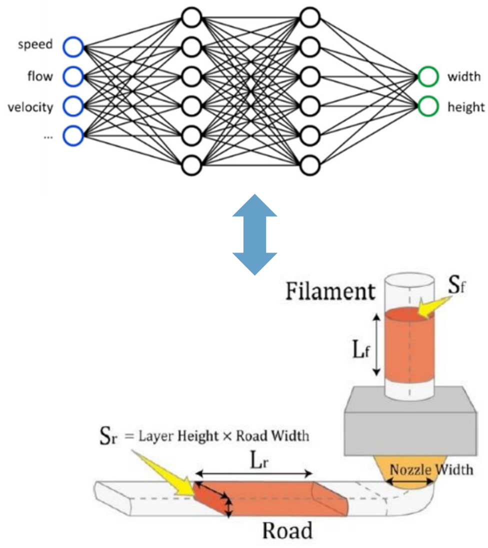


# Software Lab:

# Learning by printing: Prediction of AM-process outcomes

## Description

Extrusion-based concrete 3D printing is becoming increasingly important in the AEC industry. As an AM method, this technology plays a key role in the ongoing digitalization of the construction industry. In this method, components are manufactured by robots controlled on the basis of digital models. But still, full automatization of this construction method may often lead to failures. For a successful print a lot of parameters, such as concrete mixture, geometrical shape and print time, need to be aligned with each other. For complex shapes and dynamic environments an optimized and fixed set of these parameters is difficult to set up [1]. In small-scale 3D printing the required fabrication information for the printing process is usually generated empirically and verified via test prints. However, this approach is not very resource-efficient, especially if it is to be applied to large-scale printing projects. Another approach is to use neural networks to make predictions for a printing process based on data from previous printing processes. Within the framework of this project, suitable experiments with a small-scale setup are to be carried out in order to create a corresponding database for training a neural network.




Prediction of extruded filament geometry using the Learning-by-printing approach. Image (bottom) by [2]

## Task

Predict the outcome of an extrusion-based AM process using a Neuronal Network (NN) trained on as-designed process parameters. To this end, a suitable data set is to be generated using a small-scale clay extrusion printing setup.

GENERAL INSTRUCTIONS:

- Design suitable Experiments for the small-scale printing setup
- Generation of a large data set by systematic parameter variation
- Capturing of “as-printed” geometry
- Comparison of captured and “as-designed” geometry
- Development and training of Neuronal Network (NN) architecture

## Supervisor

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## References

[1] A. A. Rashid, S. A. Khan, S. G. Al-Ghamdi and M. Koç, "Additive manufacturing: Technology, applications, markets, and opportunities for the built environment," *Automation in Construction,* vol. 118, p. 103268, 2020.

[2] H. Takahashi and H. Miyashita, “Takahashi, H., & Miyashita, H. (2017, May). Expressive fused deposition modeling by controlling extruder height and extrusion amount,” *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems,* pp. 5065-5074, May 2017.