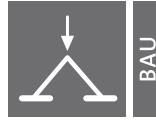**Betreuer und Kontakt:**
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Professur für Baustatik,
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Universität der Bundeswehr München
Institut für
Mechanik und Statik

Bachelorarbeit

Application of artificial neural network to enhance finite element contact simulations of fused filament fabrication

Contact problems can be abundantly found during the polymer extrusion process in fused filament fabrication (FFF). For example, when a polymer filament is fed into the nozzle inlet, the boundaries of the multi-phase polymer body, which has been changing from a solid to a liquid phase under the action of heat, contacts with the nozzle wall before it is extruded out of the nozzle outlet. The extruded polymer strand then contacts with the printing bed, or contacts with other strands in previously deposited strand layers. In order to gain an insight into the complex physical process in FFF, contact computations with the finite element method are thus usually required. In such simulation, a significant amount of computational time is spent on the contact computation, especial in a three dimensional setting.
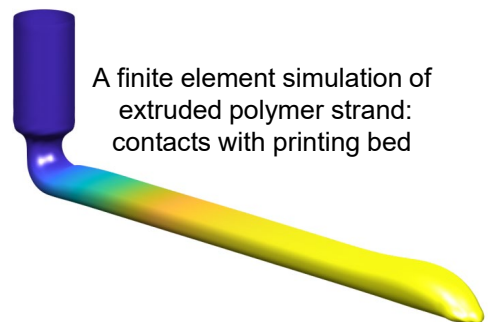
In this bachelor thesis, we propose to apply an artificial neural network (ANN) in order to enhance the efficiency of contact simulations in FFF. In particular, we employ an ANN to improve the performance of the contact search algorithm – which is often the most time consuming task in contact algorithms – within our in-house finite element code for simulations of the polymer extrusion process. The main task of the bachelor thesis will be focusing on training the network with Tensorflow and verifying it with reference solutions.

Tasks:

- Get an overview on FFF and get used to using our simulation tool (provided and assisted by supervisor)

- Generating solution data for training artificial neural network (ANN)

- Training ANN in Tensorflow

- Assessing its performance

- Documentation

A finite element simulation of extruded polymer strand: contacts with printing bed

Requirements :

- Good knowledge of FEM simulations

- Basic knowledge of MATLAB, Python, and Fortran

- Good communication skills and high motivation

Universität *der Bundeswehr* **München**

* Starttermin: flexible * Stand: 5.06.2023