

# Prozessbedingte Effekte bei der Materialextrusion: Vom G-Code zum gedruckten Polymerbauteil

Felix Frölich, M.Sc.

Gutachter/-innen: Prof. Luise Kärger (KIT), Prof. Thomas Hanemann (Albert-Ludwigs-Universität Freiburg / KIT)

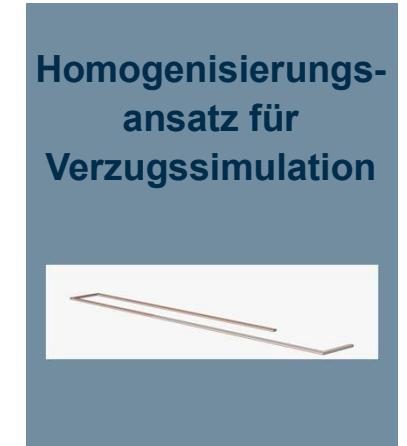
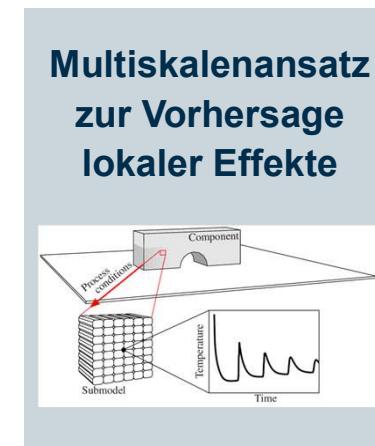
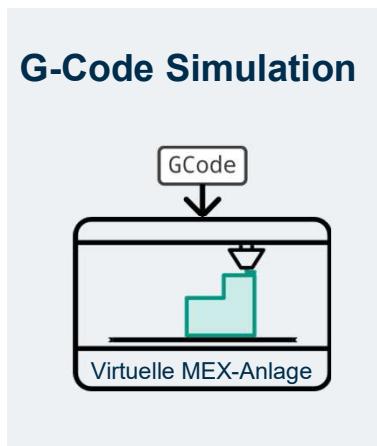
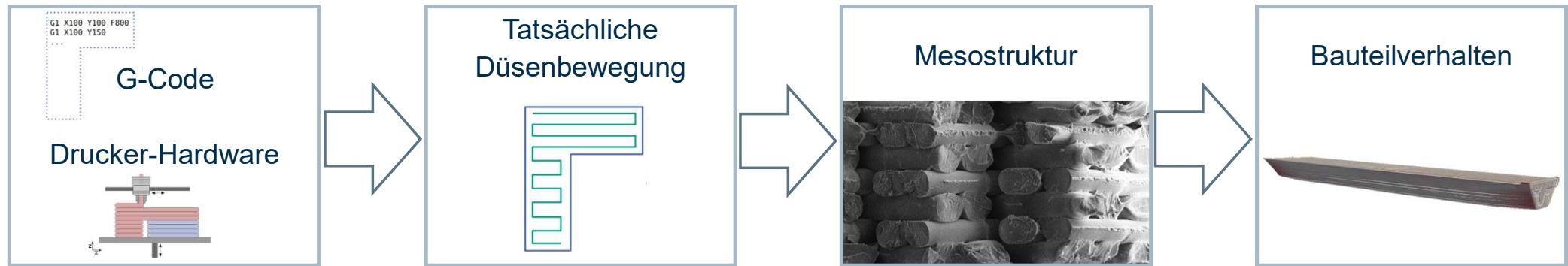
Technologietag Leichtbau 2025

05. November 2025

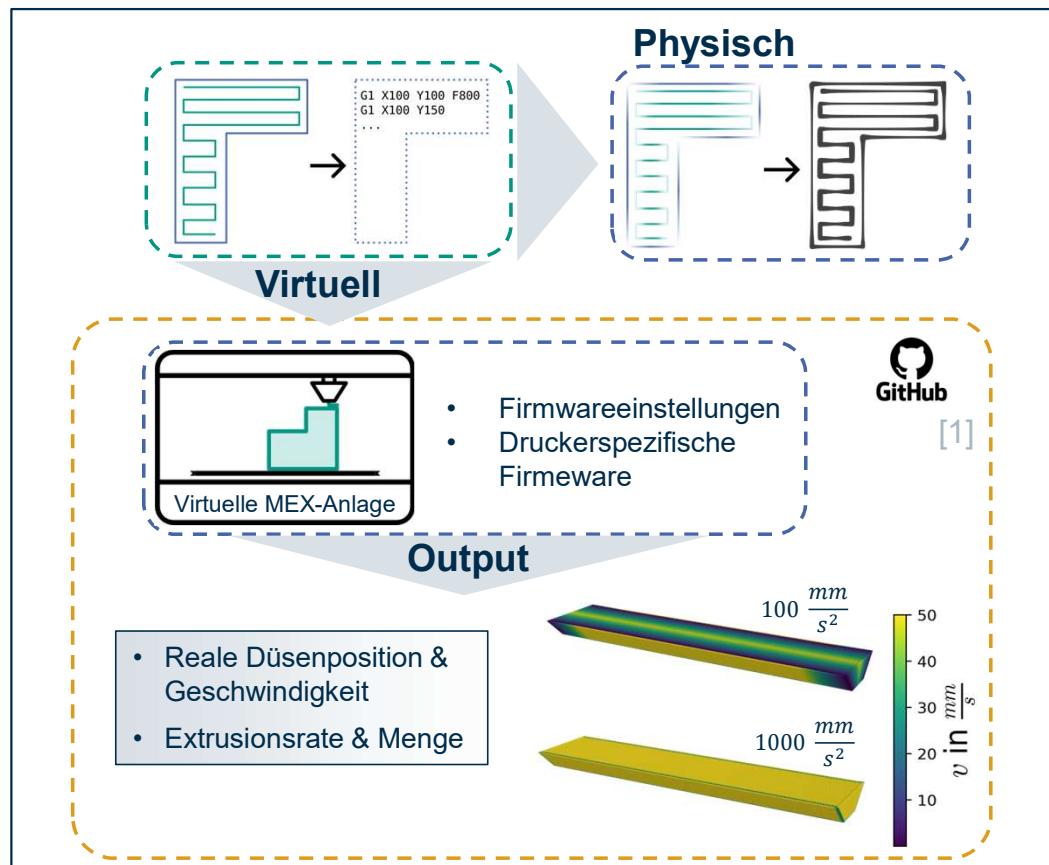
Pfinztal, Deutschland

# Vom komplexen MEX-Prozess zum Digitalen Zwilling

## Motivation

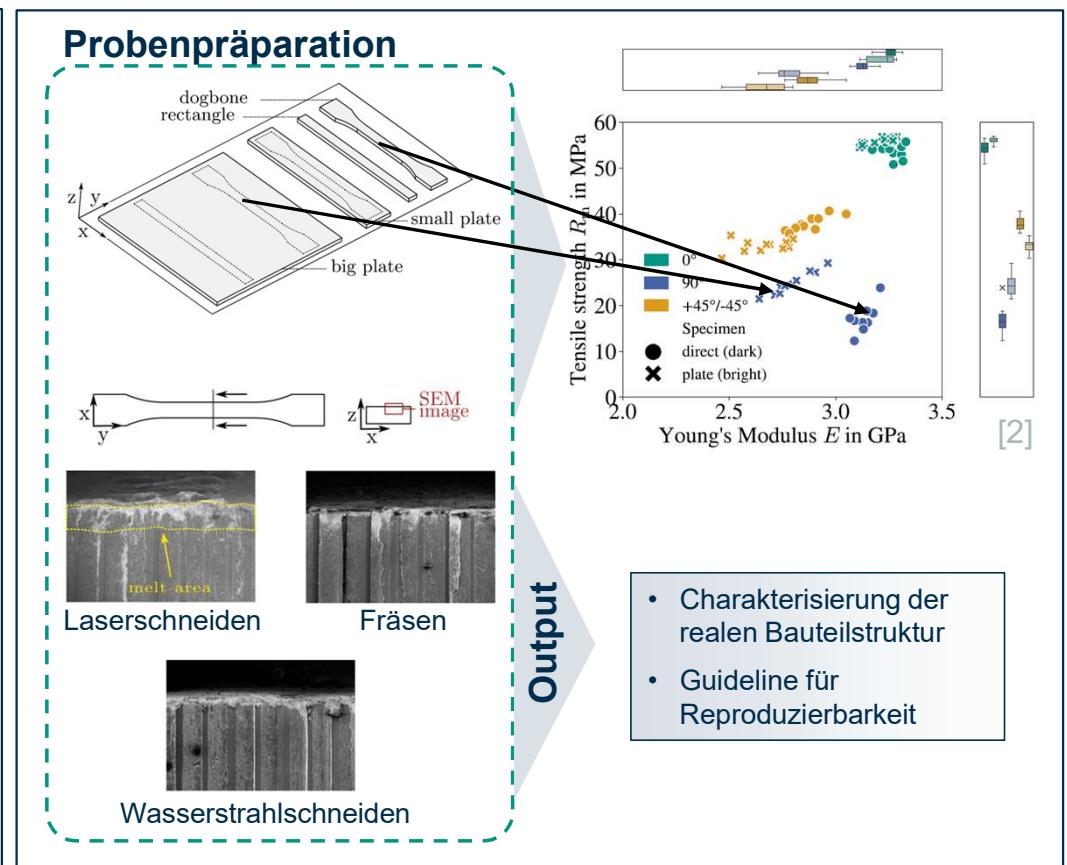


# G-Code Simulation

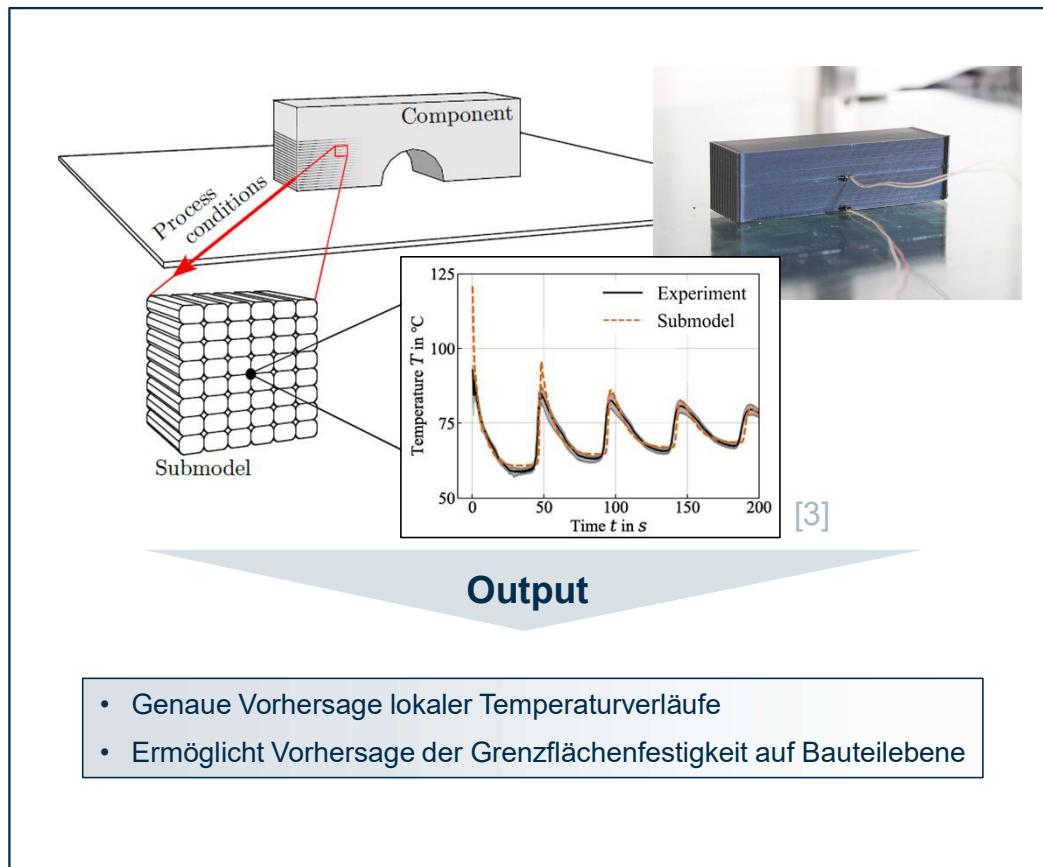


[1] Knirsch et al. pyGCodeDecode: A Python package for time-accurate GCode simulation in material extrusion processes, 2024. Journal of Open Source Software, 9(99), 6465. <https://doi.org/10.21105/joss.06465>  
[2] Frölich et al. Evaluation of mechanical properties characterization of additively manufactured components. Prog Addit Manuf 10, 1217–1229 (2025). <https://doi.org/10.1007/s40964-024-00700-2>

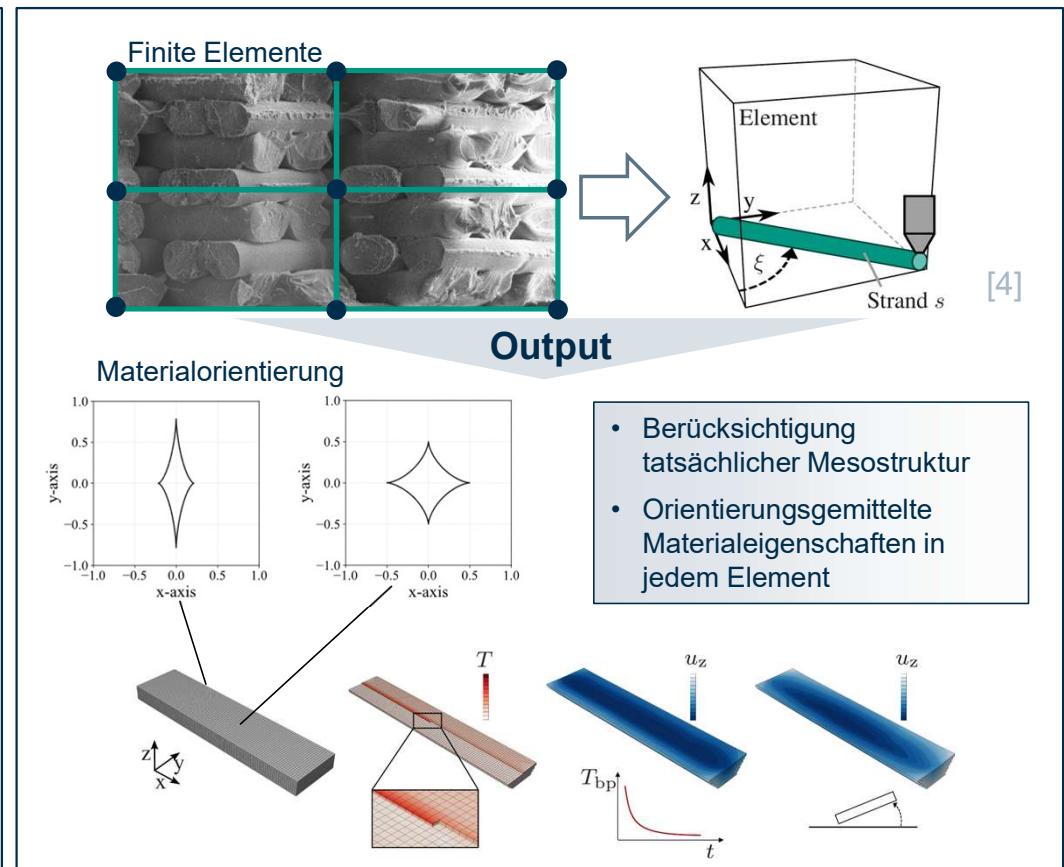
# Charakterisierungs-Guideline



# Multiskalenansatz zur Vorhersage lokaler Effekte



# Homogenisierungsansatz für Verzugssimulation



[3] Fröhlich et al. A submodeling approach for efficient prediction of local temperature profiles in component-scale additive manufacturing. *Int J Adv Manuf Technol* 136, 1561–1576 (2025). <https://doi.org/10.1007/s00170-024-14913-w>

[4] Fröhlich et al. An orientation-based homogenization approach for predicting process-induced deformations in extrusion-based additive manufacturing. *Additive Manufacturing*. (2025) [resubmitted after revision]

# Vielen Dank für die Aufmerksamkeit

Karlsruher Institut für Technologie (KIT)  
**FAST** Institut für Fahrzeugsystemtechnik  
**LB** Institutsteil Leichtbau

Rintheimer-Querallee 2, 76131 Karlsruhe, Deutschland

<http://www.fast.kit.edu/> | LinkedIn: Lightweight Engineering at FAST, KIT

Leitung: Prof. Dr.-Ing. Luise Kärger  
Prof. Dr.-Ing. Frank Henning

**Felix Frölich, M.Sc.**

[felix.froelich@kit.edu](mailto:felix.froelich@kit.edu)  
Tel.: +49 721 608 45361



<https://www.linkedin.com/in/felix-fr%C3%BClich-48112b201/>

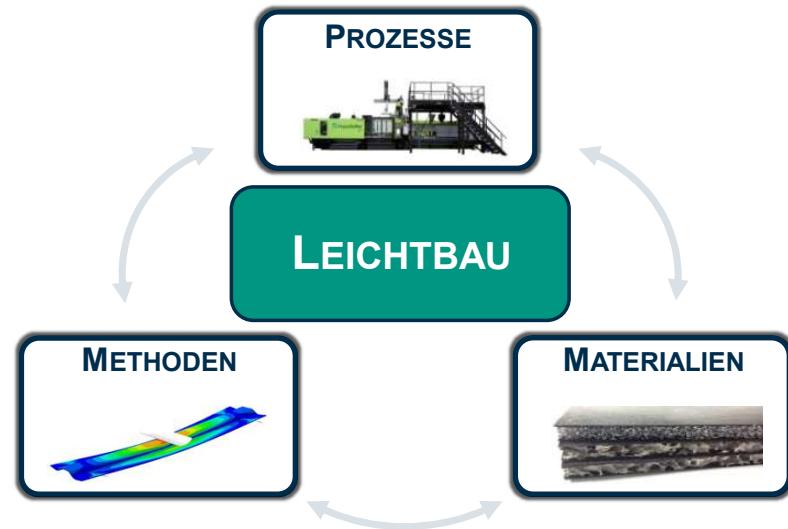


<https://www.researchgate.net/profile/Felix-Froelich>



<https://scholar.google.de/citations?user=U5zbqUMAAAAJ&hl=de&oi=ao>

## Leichtbaunetzwerk



[www.leichtbau.kit.edu](http://www.leichtbau.kit.edu)



**IAM**  
Institut für Angewandte Materialien



**FAST**  
Institute of  
Vehicle System Technology



**ITCP**  
Polymeric Materials



VERSUCHSANSTALT  
FÜR STAHL, HOLZ & STEIN

