**VI International Conference on Simulation for Additive Manufacturing, SIM-AM 2027**
**September 13-16, 2027, Weimar, Germany**

# SHAPE MEMORY BY DESIGN: BRIDGING THE GAP BETWEEN DESIGN, MANUFACTURING, AND NUMERICAL SIMULATION

**MAXIMILIAN BRODBECK[*], SEYED MORTEZA SEYEDPOUR[*]**
**AHU CELEBI[†] AND MOHAMAD ELAHINIA[†]**

[*]Institute of Structural Mechanics and Dynamics in Aerospace Engineering, Faculty of Aerospace Engineering and Geodesy, University of Stuttgart, Pfaffenwaldring 27, Stuttgart, 70569, Germany

[†]Mechanical, Industrial and Manufacturing Engineering Department, The University of Toledo, 2801 Bancroft St., Toledo, OH 43606, USA

## ABSTRACT

Additive Manufacturing has opened new possibilities for shape memory alloys: the design freedom of 3D printing enables complex, multifunctional structures and eneases their integration into smart, high-performance devices. This freedom, however, comes at a price. Reliable and affordable development of optimal designs requires advanced numerical modelling techniques specifically tailored to additively manufactured SMAs. On the one hand, classical material modelling is challenged by process-induced heterogeneity of the microstructure, porosity and local defects. On the other hand, the realisation of complex geometries with prescribed material and phase-transformation behaviour is currently limited by the non-trivial coupling of printing parameters, printed geometry and material response.

Overcoming these limitations calls for interdisciplinary research on manufacturing processes, constitutive modelling and numerical simulation, as well as the experimental characterisation of shape memory alloys. Contributions are therefore invited from both communities, working experimentally or numerically on shape memory alloys, with a focus on process-material relations in additive manufacturing, material modelling, robust numerical algorithms, and data-driven or hybrid simulation tools. Since the fabrication and optimization of 3D-printed shape memory components pose unique challenges, computational modelling is key to improving processability, enhancing material performance and ensuring structural reliability.