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

MESOSCALE MODELING AND SIMULATION APPROACHES FOR ADDITIVE MANUFACTURING

MAGDALENA SCHRETER-FLEISCHHACKER[*], CHRISTOPH MEIER[*], GREGORY WAGNER[†] AND BRUNO BLAIS[††]

[*] Technical University of Munich
Freisinger Landstraße 52, 85748 Garching b. München, Germany
{magdalena.schreter,christoph.meier}@tum.de, https://www.epc.ed.tum.de/sam

[†] Northwestern University
2145 Sheridan Road, Evanston, IL 60208-3109, USA
gregory.wagner@northwestern.edu, https://sites.northwestern.edu/wagnerresearch

[††] Department of Chemical Engineering, Polytechnique Montréal
2500 chemin de Polytechnique, Montréal, Québec H3T 1J4, Canada
bruno.blais@polymtl.ca, https://www.chaos-lab.ca/

ABSTRACT

Mesoscale simulations resolve local features such as powder particles, filaments, and melt pools to capture the physics underlying additive manufacturing (AM). This minisymposium focuses on recent advances in mesoscale modeling and simulation of AM, including experimental calibration and validation. Contributions on any AM process (e.g., laser powder bed fusion, electron beam melting, directed energy deposition, binder jetting, fused deposition modeling) and any material class (metals, polymers, ceramics, concrete, composites, biomaterials), as well as related processes such as laser or electron beam welding, are welcome. Topics include, but are not limited to:

- Mesoscale process simulations resolving individual powder particles, filaments, melt pools and deposition tracks.
- Heat transfer, fluid flow and powder phenomena, including powder spreading, melting, solidification, sintering, evaporation, melt–vapor–powder interactions, binder infiltration and filament deposition.
- Prediction of process-induced defects and material characteristics, including porosity, lack-of-fusion defects, solidification cracking, surface topology and composition.
- Multiphase and moving-interface modeling using mesh-free (e.g., SPH, DEM), moving-grid (e.g. ALE, PFEM) or fixed-grid approaches (e.g. level-set, VOF, phase-field, XFEM, CutFEM).
- High-fidelity energy absorption models for laser- or electron beam-based AM, including ray tracing and laser–material interactions.
- Advanced numerical methods, including adaptive spatial and temporal discretization strategies, efficient solvers, high-performance computing and model order reduction.
- Multiphysics and multiscale coupling as well as physics-based, data-driven and hybrid modeling approaches.
- Experimental validation and integration with in-situ monitoring for process understanding, optimization and qualification.