Modeling and Simulation of Metal Additive Manufacturing Processes

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Additive manufacturing (AM) has gained increasing popularity in the last decade, owing to the creation of processes and machines that extend its benefits to the traditional engineering materials. One of the main benefits of AM is its intrinsic ability to utilize existing stock feed materials to create parts with features spanning multiple length scales in manner that was not possible before via traditional manufacturing process. However, the excitement surrounding these processes has been tempered by the recognition of difficulties introduced by AM, including the inducement of undesirable residual stresses, undesirable microstructure, porosity, as well as the challenge of maintaining dimensional stability. Computational modeling is becoming a significant tool in addressing many of the challenges inherent in the process.

The purpose of this minisymposium is to provide a forum to discuss ongoing work in the modeling and simulation community as applied to AM, and in particular additive manufacturing of metal parts. Presentations regarding modeling of or numerical methods for any relevant process (e.g., directed energy deposition, selective laser sintering/melting, electron beam melting, binder jetting and inkjet, electron beam freeform, magnetojet printing) are welcome. A non-exclusive list of presentation foci includes:

- Simulation of a process to predict residual fields (stresses, deformations), and surface topology.
- Modeling of microstructure development and evolution during printing.
- Computational methods for correcting part distortion.
- Continuum and discrete analytical and numerical multiphysics methods for modeling the AM processes and the performance of the virtual “as-produced” parts.
- Modeling strategies and methods for representing the inherently multiscale nature of the problem, including any or all of the scales associated with the spatial, temporal, and/or material domains.
- Modeling of novel material systems.
- Coupled process-part optimization for design of functionally tailored and lightweight parts.
- Integration of feedback and/or feedforward control methods and process maps for minimizing the presence of undesirable features such as defects and residual stresses in as-built parts.
- Simulation of the manufacturing process for smart materials, sensors, and nano-devices.
- Modeling and prototyping of non-traditional AM processes enabling 2D and 3D material activation by breaking the point-by-point, line-by-line, layer-by-layer paradigm.