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SIMULATION-BASED PROCESS OPTIMIZATION OF METAL ADDITIVE MANUFACTURING

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ABSTRACT

Additive manufacturing (AM) provides unprecedented capability for manufacturing complex components, but consistent part quality, dimensional accuracy, and desired material properties depend on effective control and optimization of the manufacturing process. Process conditions, thermal histories, melt-pool behavior, and scan/toolpath strategies strongly affect residual stress, distortion, defects, microstructure, and final component performance. This mini-symposium will bring together researchers developing predictive process optimization for AM. The symposium will emphasize the integration of physics-based modeling, experimental characterization, real-time process monitoring, machine learning, and closed-loop control to improve repeatability, reduce defects, and enable reliable production of high-performance AM components. Contributions addressing all AM modalities (e.g., powder bed fusion, laser DED, wire-arc AM, binder jet) and material systems are welcome.

Target Areas:

- Predictive optimization of AM process parameters, including energy input, scan speed, layer thickness, and deposition conditions.
- Prediction and minimization of residual stress, distortion, warping, and other thermally induced defects.
- Scan-path, toolpath, slicing, build-orientation, and thermal-management optimization.
- Process–structure–property modeling for microstructure control, defect mitigation, and tailored material performance.