EMERGING FRONTIERS AND METHODS IN DIGITAL MANUFACTURING: MODELING, SIMULATION, AND BEYOND

Alec Kucala[1] and David Noble[2] and Marek Behr[3] and Rekha Rao*[2] and Patrick Anderson[4] and Stefanie Elgeti[5] and Elie Hachem[6]

[1]Sandia National Labroatories
[2]Sandia National Laboratories
[3]RWTH Aachen University
[4]Eindhoven University of Technology
[5]Vienna University of Technology
[6]MINES ParisTech PSL

MINISYMPOSIUM

Given the increasing potential for unforeseen or disruptive technologies, evolving risk to supply-chains, and other environmental, health, and global uncertainties, we are faced with the need for a more competitive, adaptive and resilient manufacturing infrastructure. At the same time, there is burgeoning desire for "faster-better-cheaper" complex parts as well as on-demand bespoke (i.e., small-lot) products. These drivers have motivated renewed efforts to understand, predict, and control manufacturing processes leveraging a hierarchy of physics-based modeling and simulation approaches integrated with digital technologies, and data analytic tools. In particular, the advent of new manufacturing techniques based on additive manufacturing process routes, the potential of functionally graded composite, nano-structured and novel materials by design. Additionally, the potential for leveraging data via the "network of things" and machine-learned models for integrated AI controls and process optimization hold out promise for a new era of industrialization that is robust, responsive, and "smart". This Minisymposium seeks to boost modeling and simulation efforts for improved physical insight, to guide experimentation, and to reduce build-test cycles in reasearch labs and in the industry. It aims to provide a forum to present recent advances in model-based and digital manufacturing methods and approaches. Topics include but are not limited to:
• Multiphysics modeling and simulation of manufacturing processes
• Fluid, thermal, and solid computational models
• Models and to gain physical insight into microstructure and defect formation processes and mechanisms
• Data-centric and machine-learned/Artificial Intelligence models for automation
• Physics-informed neural networks
• Reduced-order models for process control
• Digital twins
• Image-based simulation for digital inspection and acceptance
• Experimental validation of simulations
• Experimental investigation of process monitoring and control
• Fundamental investigations on the structure–process–property relations
• Hierarchical coupling of process models for digital design, control, and qualification of manufacturing process-structure-property relationships of as-built parts