

MODEL-BASED APPROACHES AND DATA-CENTRIC MODELS FOR DIGITAL MANUFACTURING

TRACK NUMBER (1000, 2000, 5000 & 7000)

REKHA RAO, JEREMY LECHMAN, KEVIN LONG, SCOTT ROBERTS^{*}
ELIE HACHEM[†] AND PATRICK ANDERSON[#]

^{*} Sandia National Laboratories
P.O. Box 5800, MS0836, Albuquerque, NM 87185-0836
rrao@sandia.gov; jblechm@sandia.gov; knlong@sandia.gov; sarober@sandia.gov

[†] MINES ParisTech
1 rue Claude Daunesse BP 207 06904, Sophia Antipolis, France
elie.hachem@mines-paristech.fr

[#] Eindhoven University of Technology
PO Box 513, WH 4.142,5600 MB Eindhoven, The Netherlands
P.D.Anderson@tue.nl

Keywords: Computational Fluid Dynamics, Computational Solid Dynamics, Machine Learning, Multiphysics Models.

ABSTRACT

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 Minisymposia seeks to increase modeling and simulation efforts for improved physical insight, to guide experimentation, and to reduce build-test cycles such that we accelerate engineering at the lab. 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 twin
- 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