



Multi-scale multi-physics modeling of additive manufacturing

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Abstract:

Metallic powder-based additive manufacturing (AM) technologies show promising potentials to reshape manufacturing industries. However, the wide adoption is hindered by the lack of understanding of physical mechanisms and uncertainties due to numerous influential factors. To this end, we have developed a variety of multi-scale multi-physics models to achieve comprehensive understanding, including: physically-informed heat source models, specifically, for an electron beam from micro-scale simulations of electron-atom interactions, and for a laser incorporating multi-reflection and Fresnel absorption; high-fidelity powder-scale Discrete Element Method-Computational Fluid Dynamics (DEM-CFD) models to simulate powder being spread and then melted; and an efficient Finite Element (FE) model to simulate thermal stress and distortion at part-scale. We also realized the seamless linking of Process-Structure-Property models to predict mechanical properties from process parameters, which has the potential to replace most of trial-and-error experiments. These models have proven to agree well with experimental observations and are powerful in revealing the physical mechanisms.

Bio:

Dr. Wentao Yan is an assistant professor at the Department of Mechanical Engineering, National University of Singapore (NUS). Prior to this, he was a postdoctoral fellow at Northwestern University and also a guest researcher at the National Institute of Standards and Technology (NIST), in the USA. He finished his PhD work jointly between Tsinghua University and Northwestern University, and obtained his bachelor's degree in Tsinghua University. His research is focused on employing computational modeling to understand the mechanics and physics in advanced manufacturing and to improve the manufacturing quality in a "smart" way instead of trial-and-error experimentation.

Monday, October 5th, 2020 4:00 – 5:00 p.m. (CDT)

RSVP: https://illinois.zoom.us/meeting/register/tZUpceqpqzMrG92wjiucjx_SsnPfFsmszz8