SEMINAR SERIES

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M4AM: MODELING, MONITORING, MATERIALS, AND MACHINE LEARNING FOR FLAW-FREE ADDITIVE MANUFACTURING

Featuring Dr. Prahalada Rao

University of Nebraska at Omaha

January 22, 2021 | 12:00 - 1:00 pm

Zoom Link: https://unomaha.zoom.us/j/97520904053

ABOUT DR. RAO

Prahalada Rao is an Associate Professor in the Mechanical and Materials Engineering Department, University of Nebraska-Lincoln. His scholastic passion is captured in three words: Manufacturing, Sensing, and Analytics. He was awarded the 2018 NSF CAREER grant for sensor-based monitoring and control of additive manufacturing processes. He earned the 2017 Society of Manufacturing Engineers, Yoram Koren Outstanding Young Manufacturing Engineer Award. He has close to 50 peer-reviewed publications in flag-ship journals, such as the ASME Transactions, IEEE Transactions, IIE Transactions.

PRESENTATION ABSTRACT

The goal of my research is to realize the industrial-scale production of metal parts using additive manufacturing (metal AM/3D printing). In pursuit of this goal, I aim to deliver the scientific insight to answer two fundamental questions. First, what causal phenomena lead to flaw formation in metal AM parts, and why. Second, what processing strategies can prevent flaw formation.

Despite considerable cost and time advantages safety-critical industries, such as aerospace and biomedical, are hesitant to use metal AM processes due to their tendency to create flaws, e.g., porosity and non-uniform microstructure. The root cause of flaw formation in metal AM is attributed to the temperature distribution in the part as it is being printed. The temperature distribution, also called thermal history, is a complex function of over 50 processing parameters and the shape (design) of the part. Hence, to mitigate flaw formation it is essential to understand, predict, and control each link in the following metal AM process chain.

Process Parameters + Part Design → Thermal History → Process Signatures → Flaw Formation.

To create this end-to-end understanding of flaw formation in metal AM, my research integrates four aspects: (1) ultrafast computational modeling to predict the effect of processing parameters and part design on the thermal history, (2) materials characterization to understand the link between thermal history and flaw formation (porosity and microstructure), (3) monitoring (tracking) the process signatures symptomatic of flaw formation using in-situ sensor arrays, (4) machine learning models that combine thermal history predictions with in-situ sensor data to detect and prevent flaw formation. In my talk I will exemplify the integration of these four aspects based on results from ongoing collaborations with industrial partners.

more info at **cobre.unomaha.edu**

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