



Mechanical Engineering Seminar Series

Digital Twins in Additive Manufacturing – concepts, building blocks, and applications

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VIRTUAL SEMINAR

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4:00 p.m.

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Abstract

A digital twin of additive manufacturing is a virtual replica of the manufacturing process and is gaining increased interest in industry because of the scientific, technological, and commercial benefits it provides. This presentation seeks to provide a basic understanding of digital twins in additive manufacturing for a wide audience by explaining the building blocks of a digital twin and its operation. The roles of mechanistic models, machine learning, statistical models, sensing and control, and expanding volume of data will be explained. The digital twins can avoid the current practice of qualifying metallic parts by trial and error with expensive printing equipment and feedstock materials. Detection and prevention of defects and diagnostic closed-loop process control using sensors that monitor predetermined features such as deposit geometry or peak temperature will be discussed. Unlike closed-loop control, offline uses of digital twins for process planning can narrow the optimum process parameter window to obtain a predetermined outcome, thus reducing the likelihood of extensive corrective actions during manufacturing. Finally, the need for further work and outlook will be discussed based on evidence.

Bio

Tarasankar DebRoy is a Professor of Materials Science and Engineering at Penn State, a Founding Editor of the journal Science and Technology of Welding and Joining, and an Honorary Member and Fellow of the American Welding Society. His papers on additive manufacturing and welding have been cited over 29,000 times, and his 2021 book on Innovations in Everyday Engineering Materials has been downloaded over 6900 times from Springer's bookstore. He was a Fulbright-FACEPE Distinguished Chair in Brazil, a Distinguished Visiting Fellow of the Royal Academy of Engineering at Cambridge University, and a Distinguished Visiting Professor at IIT Bombay. He received many awards for his research, including Penn State's highest scholastic award, the Faculty Scholar Medal. In 2017, the American Welding Society held the "Professor DebRoy symposium" at McCormick Place, Chicago, to honor his research contributions.

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