

# Modeling, machine learning, and experiments to control structure, properties, and defects of additively manufactured parts

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## **Abstract:**

Unlike welding and casting technologies that matured largely through many decades of trial and error testing, additive manufacturing is uniquely positioned to benefit from the powerful emerging digital tools such as mechanistic modeling and machine learning. Grain structure, mechanical properties, and defects such as cracking, lack of fusion, distortion, residual stress, and surface roughness are difficult to control using empirical testing. The expensive machines and feedstocks and the wide range of values of additive manufacturing process variables make a large volume of physical testing expensive and time-consuming. In contrast, experiments supported by mechanistic modeling and machine learning can control structure, properties, and defects based on scientific principles. The synergy between physical and virtual experiments improves scientific rigor, accelerates the pace of development, and makes manufacturing cost-competitive. Research in the virtual world using emerging digital tools has the potential to make the world a more inclusive and welcoming place for all.

## **Biography:**

Dr. Tuhin Mukherjee is a Postdoctoral Researcher at the Pennsylvania State University. He received his Ph.D. from The Pennsylvania State University and a master's degree from the Indian Institute of Technology, Bombay. His research interests include additive manufacturing, machine learning, multi-physics modeling, welding, heat and mass transfer, thermal distortion, residual stress, and composition change. He has published several papers in leading international journals including Nature Reviews Materials, Nature Materials, Progress in Materials Science, Applied Materials Today, Acta Materialia, Nature group Scientific Report, npj Computational Materials. In addition, he has published an edited book entitled "The Science and Technology of 3D Printing". Recently, he has joined the editorial board of the "Science and Technology of Welding and Joining" journal. He has served as a Guest Editor for the journals "Computational Materials Science", "Materials", and "Science and Technology of Welding and Joining". He is a member of the technical paper committee of "Welding Journal" published by the American Welding Society. He is also a reviewer of 30 international journals. He was awarded the American Welding Society Research Fellowship and Robert E. Newnham Research Excellence Award by Penn State University.

**\*This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.**

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