

Effects of Advanced Manufacturing Processes on the Mechanical Properties of 3D Metal Printing

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Abstract

Additive manufacturing (AM) is an innovative technology that offers new manufacturing possibilities across various industries. However, its integration into conventional manufacturing systems remains limited due to insufficient quality assurance for the parts produced. Machine learning (ML) has recently gained widespread adoption in numerous fields, offering significant advantages in cost reduction and processing efficiency. By applying ML, manufacturers can predict and ultimately control the mechanical properties of AM-fabricated parts, taking into account variations in printing parameters such as temperature and speed. This study reviews the current technologies employed in 3D metal printing, focusing on optimizing parameters to produce high-quality prototype parts. In the automotive sector, where reducing the number of prototypes is a priority due to high tooling costs, metal 3D printing presents a promising alternative. However, testing and validation protocols for AM parts remain limited. This study provides a critical examination of the subject, with the potential to significantly reduce product development timelines.

Biographies

Ahad Ali is an Associate Professor and Director of Industrial Engineering Program in the A. Leon Linton Department of Mechanical, Robotics and Industrial Engineering at the Lawrence Technological University, Southfield, Michigan, USA. He earned B.S. in Mechanical Engineering from Khulna University of Engineering and Technology, Bangladesh, Masters in Systems and Engineering Management from Nanyang Technological University, Singapore and PhD in Industrial Engineering from University of Wisconsin-Milwaukee. He has published journal and conference papers. Dr Ali has completed research projects with Chrysler, Ford, New Center Stamping, Whelan Co., Progressive Metal Manufacturing Company, Whitlam Label Company, DTE Energy, Delphi Automotive System, GE Medical Systems, Harley-Davidson Motor Company, International Truck and Engine Corporation (ITEC), National/Panasonic Electronics, and Rockwell Automation. His research interests include manufacturing, simulation, optimization, reliability, scheduling, manufacturing, and lean. He is member of IEOM, INFORMS, SME and IEEE.

Takiyah Ali is a third-year student pursuing a Bachelor of Science in Mechanical Engineering at the University of Michigan-Ann Arbor. Her experience with classes like Design and Manufacturing and Mechanics of Materials have allowed her to learn the wide applications of an engineering degree. Furthermore, her internship experience at automotive suppliers ZF and Adient have allowed her to actualize my passion for the automotive industry specifically

within the applications of safety and actively working on preserving human lives. Takiyah completed her high school at Michigan Islamic Academy in Ann Arbor, Michigan. She has previously published a paper in participated in the 5th NA International Conference on Industrial Engineering and Operations Management and 12th Annual IEOM Conference in Istanbul. She has participated in the 63rd and 64th Science and Engineering Fair of Metro Detroit.