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Mechanically Integrous and Cost-Effective Additive Manufacturing

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Abstract

Additive Manufacturing (AM), commonly known as 3D printing, has been increasingly utilized in industries lately. A great leap from producing prototypes to manufacturing final products has been seen in the last few years. However, one of the major drawbacks of this technology is the low production rate. In addition, energy consumption is also a concern when it comes to high-performance materials requiring higher processing temperatures. One of the major elements that control the printing time as well as the material usage is infill density. It represents the enclosed structure built within the printed object for strengthening purposes. Here, the possibility of enhancing 3D printing products by manipulating the infill density within the printed object is proposed. Smart enhancement is achieved via FEA mechanical numerical simulations emphasizing areas with high-stress concentration to be fortified. Reinforcement is achieved through the spatial variation of infill density. This technique allows for enhancing the mechanical integrity of the product while minimizing the printing duration, material waste, and energy consumption. This could lead to a breakthrough in reducing the printing time, which is a major weakness of the AM industry. Numerical simulations will act as a guide for failure-prone areas. Hence, G-Code manipulation will be implemented accordingly to achieve the optimum weight-to-strength ratio. Finally, the expected outcome could pave the way to the implementation of an Artificial Intelligent model with the purpose of optimizing the 3D printing manufacturing process without user interference.

Keywords
FDM, Additive Manufacturing, Polymer, Infill, Mechanical

Biography
Hussam Noor is an Assistant Professor of Mechanical Engineering at Taibah University of Madinah, Saudi Arabia. He received his BS in Mechanical in Engineering from Wilkes University, USA, an MS and Ph.D. both in Mechanical Engineering from Lehigh University, USA. His teaching expertise spans Numerical Methods, Manufacturing, Material Science, and Additive Manufacturing. His research focuses on metal and polymer additive manufacturing industries.