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CHARACTERIZATION AND ENHANCEMENT OF MECHANICAL PPROPERTIES IN THERMOPLASTIC FFF PARTS USING IN-SITU ANNEALING

By

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Abstract

Fused filament fabrication is one of the most common and widely used additive manufacturing techniques. Owing to its ease of use, availability and cheap feedstock it provides a significant advantage over other AM techniques. But these advantages are overshadowed by the fact that FFF parts show high anisotropy and reduced mechanical properties as compared to conventional manufacturing techniques. In this project an optimized print head assembly has been developed to improve the mechanical properties of FFF parts which addresses the limitations of the previous works while optimizing the mass of the block and other process parameters to provide maximum enhancement of mechanical properties while reducing geometric distortions. A design of experiments approach has been used to identify the main effects and interaction effects between the two factors (Plate thickness and nozzle height) with three levels each. The response variables studied were Ultimate tensile strength, toughness, and Fracture toughness. The factor effects on the mechanical properties have further been explained with the help of a finite volume simulation model for the different levels of testing. The optimized parameters have been used to fabricate a nozzle with an integrated plate in it, this increases the ease of assembly while reducing the time required for the nozzle to heat up. A cooling mechanism has been provided to the upper sections of the print head to prevent premature filament softening, also a steady state simulation has been conducted along with relevant experiments to check the efficacy of the cooling mechanism. Parts printed with the optimized print head show good correlation with the DOE analysis with major improvements in ultimate tensile strength, toughness, fracture toughness and stiffness of the FFF parts.