FDM print parameter optimization to improve PLA parts mechanical properties

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Rapid prototyping machines have advanced in recent years, such that typical FDM (Fused Deposition Modelling) desktop printers can be used to manufacture functional parts for industrial use. One major issue preventing widespread use of FDM printers is the lack of consistency in parts quality. The quality of the material being used, and the print conditions or parameters of the printing process can cause changes to the mechanical properties of the printed parts and subsequently calls into question the reproducibility of parts. This paper seeks to factorize printing parameter effects for additive manufacturing of parts, the effect of the material quality on the mechanical properties of the printed parts, and possible optimization routes for printing parameters. The material selected for study is PLA (Poly Lactic Acid), an increasingly utilized bioplastic polymer owing to its biocompatibility, degradability, and sustainability. Using a design of experiments (DOE) approach, the print parameters of FDM printer, raster orientation and layer thickness were systematically varied to determine effect on mechanical properties. Thermal analysis using Differential Scanning Calorimetry (DSC) was performed on the filament before printing at different points in the spool, and of the printed parts after printing to study crystallinity and structural changes produced by the printing process, and to quantify material differences prior to printing. The results from the subsequent analysis will be used to optimize print parameters to ensure quality of the printed parts in terms of mechanical properties, by deducing a correlation between print parameters and mechanical properties of PLA and predicting reproducibility of parts in terms of mechanical properties.

Speaker Biography

Noha Peter is currently pursuing his Masters in Mechanical Engineering at the University of Florida. He is working as a research assistant in the field of additive manufacturing under the guidance of Dr Nancy J Ruzycki of Material Science and Engineering. He has worked for 3 years as an equipment engineer, engineering various kinds of rotating and packaged equipment for clients across the world.

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