# DETERMINING OPTIMAL CHARACTERISTICS OF FILAMENT FOR FUSED FILAMENT FABRICATION (FFF) 3D PRINTING TECHNOLOGY

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Filament Fused Fabrication (FFF) is a 3D printing method that uses a heated nozzle to deposit partially melted material (i.e. thermoplastic filament) under software control that form layers to create a 3D part. This study analyzes optimal characteristics of filament for FFF 3D printing. Commercial filament suppliers, 3D printer manufacturers, and end-users regard filament diameter tolerance as an important indicator of 3D print quality. Despite the important role of the diameter consistency in the FFF process, few studies have addressed acceptable tolerance levels to achieve the highest 3D printing quality. The objective of this study is to investigate the impact of filament diameter tolerance on 3D printing quality. Drive gears bite into filament and force it into the heated nozzle and produces a pressure responsible for filament flow rate. Physic's demonstrates that varying a cross sectional area (i.e. filament diameter) under a force will affect pressure. Previous studies have shown flow rate can impact surface quality, printer performance, and the mechanical properties of 3D parts. This study hypothesizes a consequence of robust nozzle designs capable of handling diameter variance do so at the expense of 3D printing quality. A pellet-based extruder is utilized to fabricate acrylonitrile butadiene styrene (ABS) filament samples using a nozzle of 1.75 mm in diameter. Temperature and extrusion rate are controlled parameters. An optical comparator and an array of digital calipers are used to measure and select fabricated samples based on filament diameter. A Self-Replicating Rapid Prototype (RepRap) 3D Printer is used and under software control print test samples into pre-defined line widths sensitive to flow rate fluctuation. The anticipated outcome of test sample line width error against its respective filament diameter tolerance will determine the acceptable filament tolerance on 3D printing quality.

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