Structure-Property Relationships for Material Extrusion 3D-Printing of Stainless-Steel for Orthopedic Applications

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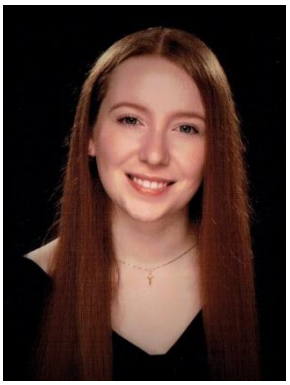
Abstract

Conventional methods for manufacturing orthopedic implants cannot replicate human bone's structural and mechanical properties. The mismatch of these properties stresses the implant area, which can cause inflammation and stability loss during implant integration. This project aims to use material extrusion 3D-printing of 316L stainless steel to create 25, 50, and 100% infilled test coupons, and their designs had a solid fill on the circumference while having porosity on the inside. This style of infill pattern and its variation was performed to mimic a bone structure and hypothesize that such structures can enable designing structures with mechanical properties similar to that of human bone. This structure design and process combination was performed to break the current pattern of structure-property-manufacturing tradeoff in implant design. In order to compare the mechanical properties of the 3D-printed stainless-steel parts to human bone, the flexural and tensile strength of sample parts of various infill densities were measured using three-point bend and tensile testing. As a case study, a human femur bone model was designed, and 3D printed to identify the feasibility of the material extrusion 3D printing process to print such structures.

Biography of Presenter

Lauren is currently an undergraduate student at the University of Kentucky studying biosystems and agricultural engineering. She is also a part of the Scholars in Engineering and Management pathway through the Lewis Honors College.



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