Master's Thesis Defense Announcement
Mechanical and Aerospace Engineering Department
University of Texas at Arlington

Mechanical and Thermal Performance of Additively Manufactured Digital Materials

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Abstract:

Over the past decades, additive manufacturing has become a critical material processing tool. All ranges of materials including polymers, composites, metals and ceramics can be used to fabricate structures with complex geometries that are nearly impossible to build using conventional fabrication process. Recently, additive manufacturing methods to build polymeric structures have been advanced significantly. In particular, the emergence of multi-material printers has made it possible to seamlessly print hybrid and digital materials where materials components and compositions are digitally varied to construct fully tailored material system. In this work, using a commercially available polyjet printer (Stratasys J850 Prime 3D printer), digital materials with varying concentrations of viscoelastic Agilus30 and Vero plastic materials are created. Digital and hybrid materials with varied Shore A hardness values of 30, 60, and 95 are produced by mixing Agilus30 Black with VeroMagentaV. Then their mechanical and thermal damage behavior have been studied. Dog-bone and rectangular specimens are used for tensile testing at different strain rates, with the latter having an elliptical defect in the center. Due to its higher stiffness and fracture stress, the hybrid material SH95 material behaves plastically, while the hybrid material SH30 and hybrid material SH60 materials respond similarly and are characterized by elongation and flexibility. Testing the materials' capacity to absorb dynamic energy using drop tower impacts reveals a nonlinear link between material composition and acceleration decrease. Additionally, Agilus30 Black is subjected to laser heating studies to examine its thermal damage characteristics and behavior when exposed to heat, providing insights into heat transmission and thermal stability characteristics. This study contributes valuable knowledge to the properties and performance of hybrid materials, paving the way for future research in material selection and optimization.