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Effect of Print Orientation on the Mechanical Properties of Multi Jet Fusion Additively Manufactured Polyamide-12

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Abstract : The advancement of additive manufacturing, in both research and commercial realms, is highly dependent upon continuing innovations and creativity in materials and designs. Additive manufacturing shows great promise towards revolutionizing various industries, due largely to the fact that design data can be used to create complex products and components, on demand and from the raw materials, for the end user at the point of use. However, it will be critical that the material properties of additively-made parts for engineering purposes be fully understood. As it is a relatively new additive manufacturing method, the response of properties of Multi Jet Fusion (MJF) produced parts to different printing parameters has not been well studied. In this work, testing of mechanical and tribological properties MJF-printed Polyamide 12 parts was performed to determine whether printing orientation in this method results in significantly different part performances. Material properties were studied at macro- and nanoscales. Tensile tests, in combination with tribology tests including steady-state wear, were performed. Results showed a significant difference in resultant part characteristics based on whether they were printed in a vertical or horizontal orientation. Tensile performance of vertically and horizontally printed samples varied, both in ultimate strength and strain. Tribology tests showed that printing orientation has notable effects on the resulting mechanical and wear properties of tested surfaces, due largely to layer orientation and the presence of unfused fused powder grain inclusions. This research advances the understanding of how print orientation affects the mechanical properties of additively manufactured structures, and also how print orientation can be exploited in future engineering design.

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