Strength analysis and modeling of cellular lattice structures manufactured using selective laser melting for tooling applications - DTU Orbit (09/11/2017)

Strength analysis and modeling of cellular lattice structures manufactured using selective laser melting for tooling applications

Additive manufacturing is rapidly developing and gaining popularity for direct metal fabrication systems like selective laser melting (SLM). The technology has shown significant improvement for high-quality fabrication of lightweight design-efficient structures such as conformal cooling channels in injection molding tools and lattice structures. This research examines the effect of cellular lattice structures on the strength of workpieces additively manufactured from ultra high-strength steel powder. Two commercial SLM machines are used to fabricate cellular samples based on four architectures— solid, hollow, lattice structure and rotated lattice structure. Compression test is applied to the specimens while they are deformed. The analytical approach includes finite element (FE), geometrical and mathematical models for prediction of collapse strength. The results from the the models are verified with experimental data and it is shown that they agree well. The results from this research show that using lattice structures significantly reduces the strength of material with respect to solid samples while indicating no serious increase of strength compared to hollow structures. In combination with an analysis of microstructures, a description of strength analysis is obtained with respect to process parameters.

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