Modelling & Simulation of Ti6AL4V Micro-lattice Structures for Additive Manufacturing

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Abstract

The lattice structure are widely used in many engineering fields as their geometrical feature can be easily regulated according to functionality, in addition they also possess light-weight and have excellent energy absorption capacity. Additive manufacturing technology has enabled fabrication of such lattice structures with arbitrary structural geometries. The study compares compressive behavior of five distinct Ti6Al4V (Grid, X, Star, Cross, and Tesseract) micro-lattice structures using commercial CAD and CAE software. Initially, for all lattice structures the unit cell geometry size and their configuration (5x5x5 array) was kept as same. Here, both 1D beam and 3D continuum elements were used for finite element (FE) modeling of the lattice structures. The FE results are validated with the previously reported experimental data and well comprehended. The elastic and elasto-plastic simulation results demonstrate that, Star has high stiffness and low Young's modulus values with low porosity among all lattice structures.

Keywords: Unit cell, Additive manufacturing, Microporous lattice material, Finite element, Taguchi method, linear regression, GA and PSO algorithm.