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PERIODIC CELLULAR TO SOLID MATERIAL TRANSITIONS: A METHOD FOR MANAGING STRESS CONCENTRATIONS IN DESIGN FOR ADDITIVE MANUFACTURE

Abstract

Periodic open-cellular structures manufactured with selective laser melting (SLM), commonly referred to as lattice structures, are attractive candidates for applications that require high specific strength and tailored elastic modulus. Integrating lattice structures into new component designs is of great interest in the aerospace industry, as they allow for tailored mechanical and thermal performance in specific applications. However, most of the existing studies and industrial applications utilised lattice structures with constant densities and very little attention has been paid to the integration of lattice structures into larger components, considering the boundaries between solid and lattice sections.

As a direct result the interfaces between lattice and solid components exhibit high stress concentrations, limiting its structural integrity and fatigue performance. The present study will discuss a novel method of designing a lattice-to-solid transition, based upon altering the cell size and density to allow a higher degree of connectivity at the interface, and thereby reducing stress concentrations. The developed concept was applied in manufacturing different lattice types using Titanium-6Al-4V, with the results of mechanical testing and computational modelling to be presented and discussed.