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Author: Mr. Tim Lewis
Airbus Defence and Space, Germany

DESIGN AND TESTING OF ADDITIVELY MANUFACTURED LATTICE STRUCTURES

Abstract

Additively manufactured lattice structures are only able to be manufactured through recent advance in additive manufacturing (AM). Also, the design of these lattice structures is a capability that traditional CAD software does not usually include. The application of lattice structure components in space flight hardware is the long term objective of this project. Lattice structures bring several useful properties. These are for instance a large surface area (useful for heating/cooling) and metallic parts with high stiffness and relatively low mass. Also the application as crushable structures (e.g. lander) is promising. Lattice components may consist of only one material and will not require any adhesives in comparison to honeycomb structures.

Utilising an AM design optimisation software, different variations of tensile test specimens were created to assess mechanical properties of lattice structures. The test pieces were manufactured with the selective laser melting method (SLM) using aluminium alloy AlSi10Mg as material. The machines used were an SLM 280 HL (at Airbus Defence and Space site Stevenage, UK) and an SLM 500 HL by an external manufacturer. In parallel inspection methods were assessed and CT-Scanning was found to be suitable for inspecting metallic lattice structure components.

To receive reliable data a transition between solid parts and lattice parts of a component needed to be identified. During tensile testing the method of gradually thickening the lattice beams in the transition area was found to be suitable. In several batches of manufacturing and testing design variations of lattices were evaluated. These vary in the used type of unit cell, the size and orientation of the cells, the diameter of the lattice beams and the transition type between the solid and lattice structure. Three different unit cells were compared, beam diameters between 0.8 and 2.3 mm were examined and the cell size varied between 3 and 12 mm.