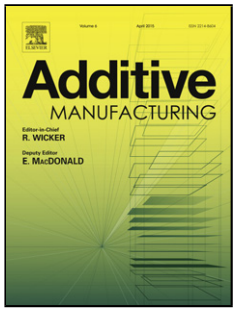

Title: Strategies for functionally graded lattice structures derived using topology optimisation for Additive Manufacturing

Authors: Ajit Panesar, Meisam Abdi, Duncan Hickman, Ian Ashcroft

PII: S2214-8604(17)30115-X
DOI: https://doi.org/10.1016/j.addma.2017.11.008
Reference: ADDMA 248

To appear in:

Received date: 5-4-2017
Revised date: 26-9-2017
Accepted date: 13-11-2017

Please cite this article as: Ajit Panesar, Meisam Abdi, Duncan Hickman, Ian Ashcroft, Strategies for functionally graded lattice structures derived using topology optimisation for Additive Manufacturing (2010), https://doi.org/10.1016/j.addma.2017.11.008

Strategies for functionally graded lattice structures derived using topology optimisation for Additive Manufacturing

Ajit Panesar [a,b,*], Meisam Abdi [a,c], Duncan Hickman [a] and Ian Ashcroft [a]

[a] Additive Manufacturing and 3D Printing Research Group, University of Nottingham, NG7 2RD, UK

[b] Department of Aeronautics, Imperial College London, SW7 2AZ, UK

[c] Faculty of Technology, De Montfort University, LE1 9BH, UK

* email: a.panesar@imperial.ac.uk

ABSTRACT

A number of strategies that enable lattice structures to be derived from Topology Optimisation (TO) results suitable for Additive Manufacturing (AM) are presented. The proposed strategies are evaluated for mechanical performance and assessed for AM specific design related manufacturing considerations. From a manufacturing stand-point, support structure requirement decreases with increased extent of latticing, whereas the design-to-manufacture discrepancies and the processing efforts, both in terms of memory requirements and time, increase. Results from Finite Element (FE) analysis for the two loading scenarios considered: intended loading, and variability in loading, provide insight into the solution optimality and robustness of the design strategies. Lattice strategies that capitalised on TO results were found to be considerably (~40-50%) superior in terms of specific stiffness when compared to the structures where this was not the case. The Graded strategy was found to be the most desirable from both the design and manufacturing perspective. The presented pros-and-cons for the various proposed design strategies aim to provide insight into their suitability in meeting the challenges faced by the AM design community.

Keywords: Lattice structures; Functional Grading; Topology Optimisation; Design for Additive Manufacturing; Finite Element Analysis