

Bespoke Additive Manufacture: Low-Cost, High-Value Product Design.

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Additive Manufacture (AM) provides a disruptive opportunity for the design of a new generation of engineered structures. These structures are manufactured on-demand, topologically optimised and algorithmically generated according to fundamental technical requirements. To accommodate the technical opportunities enabled by AM lattice structural design requires that the associated design opportunities and challenges be formally identified. This research systematically characterises these challenges, particularly those associated with topology optimisation, digital design workflows and the generative (algorithmic) design of AM lattice structures, specifically:

- Topology optimisation provides a profound opportunity for the robust identification of highly efficient structural systems. The ensuing geometries are organic, curvilinear and incompatible with traditional manufacturing methods. AM provides an opportunity to enable the commercialisation of optimised structural designs, however, such designs are incompatible with commercial tolerancing and parametric optimisation methods.
 - Digital design workflows enable low-cost bespoke design by avoiding manual inputs and allowing the workflow to progress at computational speeds; this outcome also allows formalised design outcomes as opposed to *ad hoc* design. This opportunity is stymied by several discontinuities in the digital workflow that require human intervention or incur undue computation demands.
 - Generative design enables a sophisticated digital AM design including aspects of topology and process optimisation to be integrated with AM manufacturability constraints; however, this requires that the design be mathematically definable.
- Based on this systematic review, this research presents a strategic summary of the commercial and research opportunities associated with the development of Design for AM (DFAM) capabilities for the commercialisation of bespoke AM technologies.