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Layout optimization of components suitable for additive manufacture

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Abstract

Structural optimization techniques offer great potential for designers wishing to realise minimum mass components, and in the past decade developments in the field of additive manufacture (3D printing) appear to make such techniques more relevant than ever. However, to date relatively little research has been undertaken on the development of design optimization techniques tailored for additive manufacture. In this contribution layout optimization is used to generate truss-like component designs, which are then realised via additive manufacture and verified via load testing. The process of transforming layout optimization output into a 3D CAD model ready for additive manufacture is discussed in detail. The Electron Beam Melting (EBM) process was used to fabricate the components using titanium Ti-6Al-4V, an alloy commonly used in the aerospace and automotive industries for lightweight components. Although capable of producing strong and complex structures it was found that the truss structures produced often had undersized members, which adversely affected the structural performance of the specimens. However, means of compensating for this were developed, and physical load tests demonstrated that the layout optimization design approach adopted was capable of generating strong and light components, able to successfully carry their specified design loads.

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