Trade-off between topology optimisation and infill for cost efficient manufacturing of plastic aerospace parts

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ABSTRACT

Thermoplastics such as PEEK, Nylon, ULTEM are commonly used to manufacture high strength parts using material extrusion based 3D printing. In order to save the material, the plastic parts are made hollow or made with an infill structure because the parts are often visual not meant for mechanical loading [1]. Whereas for the structural parts in aerospace industry, the trade-off between low weight and desired strength is achieved by topology optimization [2]. The present work describes the systematic approach to design the aerospace parts considering both topology optimization and infill structures by 3D printing technique. Topology optimization has been implemented through the use of finite element methods for the targeted mass elimination. Infill percentage and patterns were varied using open source slicing program [3,4]. The performance of the part depend on both optimised part topology and infill pattern. The complete sequence of steps for conducting topology-infill optimization study is shown, taking into account the constraints arising from the functionality and the method of 3D printing. Conclusions on the use of the novel hybrid optimization approach shows potential directions for further development of aircraft structural components.

Keywords: topology optimization; infill structure; finite element analysis; 3D printing

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