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Design and fabrication of periodic lattice-based cellular structures

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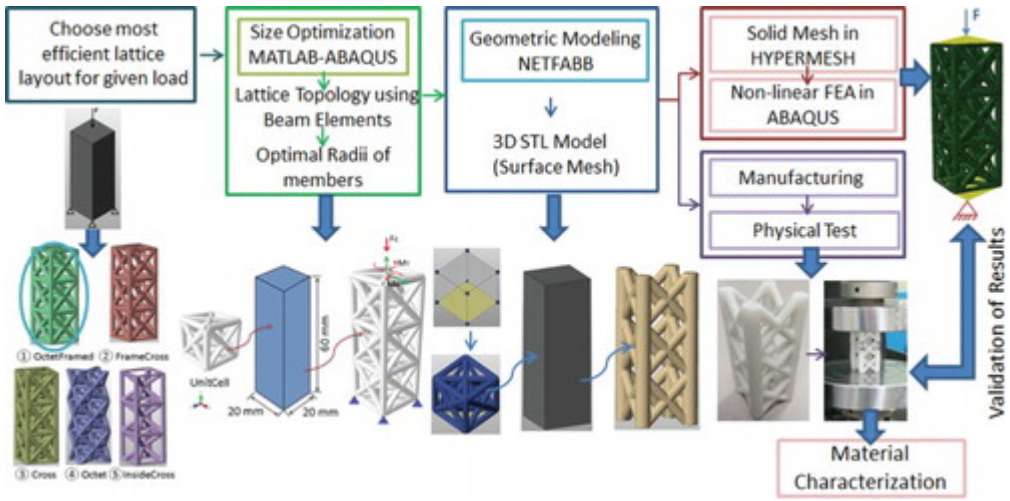
ABSTRACT

A methodology, which consists of design, optimization and evaluation of periodic lattice-based cellular structures fabricated by additive manufacturing, is presented. A user-friendly design framework for lattice cellular structures is developed by using a size optimization algorithm. A 3D modeling process for the lattice-based cellular structures is introduced for non-linear finite element analysis and production. The approach is demonstrated on compression block with periodic lattice-based unit cells. First, based on loading condition, most appropriate lattice layout is selected. Then, for the selected lattice layout, the lattice components are modeled as simple beam and size of the beam cross sections is optimized using in-house optimization approach for both yield and local buckling criteria. The 3D model for the optimized lattice structure is built and non-linear finite element study is conducted to predict the performance. Physical parts are 3D printed and tested to compare with the simulations. Material

properties for the 3D printed parts are determined for the finite element study using reverse engineering of actual measured data.

GRAPHICAL ABSTRACT



KEYWORDS:

Additive manufacturing | 3D Printing | lattice-based cellular structure | topology optimization

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