Optimal infill design for AM

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ABSTRACT

Porous infill in AM parts may serve many purposes. Fundamentally, porous infill may save material, manufacturing time and weight, however, it may also be introduced for aesthetic reasons (open cell lattice structures), to achieve higher flexibility (sport shoes) or for multiphysics purposes such as for satisfying simultaneous stiffness and fluid permeability requirements.

Porous open-walled lattice structures are often mistakenly believed to provide extreme stiffnes-to-weight ratio. In fact, however, open-walled infill has up to a factor of 3 lower stiffness than their closed wall counter parts. Only in extreme aniostropic cases (uni-axial loading) do truss-like microstructures have stiffness similar to plate-like microstructures [1]. On the other hand, closed-walled lattice structures may exhibit lower buckling strength compared to their open-walled counterparts. Hence, there is an intricate trade-off between stiffness and strength that needs to be considered when designing AM structures with infill. This trade-off also provides challenges that can be studied or overcome by systematic optimization approaches as e.g. seen in [2].

The talk will review our recent activities within isotropic and anisotropic infill design [3, 4, 1], single scale microstructure design [5] and latest developments within 3D infill design and optimization of microstructures for simultaneous stiffness and buckling resistance.

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