

OPTIMIZATION OF INFILL STRUCTURES WITH COUPLED HOMOGENIZATION AND LEVEL-SET METHODS

Perle Geoffroy Donders

Safran Tech, France
perle.geoffroy@polytechnique.edu

Keywords: Infill structures, Topology optimization, level-set, homogenization

Abstract: Lattice structures are becoming increasingly popular in the context of additive manufacturing. Thanks to the homogenization method, the topology optimization of such designs is reduced to a more manageable parametric optimization problem. Since the resulting optimized solution remains theoretical, several post-processing methods have been proposed to generate an actual shape. However, the external border of these structures is generally ill-defined, which is a strong limitation for industrial applications. Besides, in order to obtain a functional part, designs featuring a protective external skin would often be privileged. Modeling such structures involves to define on the one hand the global external shape, which can be implicitly described by a level-set function, and on the other hand the inner distribution of the lattice, classically represented by a homogenized material. We propose here to optimize simultaneously the distribution of the inner lattice material and the external shape. The proposed strategy relies on coupling two well-known methods in topology optimization, level-set and homogenization, while taking into account the interface between the skin and the infill of the structure. We present several results in elasticity, in the case of minimization of the compliance. Moreover, we emphasize the fact that this method enables to consider a new range of loads on lattice structures, as hydrostatic pressure.