

A Preliminary Study of Conformal Lattice Cells for Axisymmetric Problems Using a Surrogate Approach

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Abstract. In recent years, lattice structures have been extensively studied due to their high specific mechanical properties and their potential for tailored, application-oriented design. The advent of additive manufacturing technologies has further enabled the fabrication of highly complex geometries with minimal material waste. However, filling arbitrary or irregular domains through the simple periodic repetition of a standard unit cell is often not feasible, since this approach may lead to boundary-truncated cells and discontinuities in the lattice architecture. To overcome this limitation, conformal lattice structures employ deformed, stretched, and bent unit cells that adapt to the target geometry while preserving cell connectivity and structural continuity. Nevertheless, the optimisation of unit-cell topology parameters in conformal configurations introduces additional challenges, as the mechanical response becomes dependent not only on the local cell geometry but also on the mapping-induced deformation. In this work, a preliminary study is presented on a standard body-centered cubic unit cell adapted by means of a conformal mapping strategy for axisymmetric problems. To evaluate and optimise the relevant topological parameters, a Kriging-based surrogate model is developed and trained on a dataset of finite element simulations. The proposed approach is then assessed on a representative test case, in which the mechanical performance of the conformally mapped lattice structure is compared with its regular lattice counterpart at same relative density.

The results show that the conformal lattice configuration provides an improved mechanical response compared with the regular counterpart, highlighting the potential of conformal mapping combined with surrogate-based modeling for the design of efficient lattice structures in complex geometries.