

EXTENDING THE SERA METHOD TO AUXETIC MATERIAL DESIGN

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Abstract

Auxetic metamaterials, characterised by a negative Poisson's ratio, are particularly attractive for applications such as surface coverings and energy absorption. This work extends the Sequential Element Rejection and Admission (SERA) method to the design of negative Poisson's ratio metamaterials. The relationship between microstructural features and homogenised material properties is established through an energy-based homogenisation approach, and the resulting homogenised elasticity tensor is employed as the objective function to promote auxetic behaviour. The discrete nature of the SERA method enables an improved analysis of flexural pivots, and the resulting designs exhibit both sufficient stiffness and high compliance for effective kinetic energy absorption. These results demonstrate that the SERA method constitutes a competitive approach for auxetic material design optimisation, even when compared with conventional re-entrant structures.