

CONTINUOUS OPTIMIZATION OF FUNCTIONALLY GRADED AUXETIC BEAMS USING METAHEURISTIC ALGORITHMS

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Abstract

This work addresses the optimal design of through-thickness functionally graded composite beams with auxetic re-entrant cells, via continuous optimization techniques. Single-objective optimization problems are formulated considering both unconstrained and constrained settings to enhance structural performance. The objective functions may, for example, be defined in terms of the minimization of the structures' maximum transverse deflection or the maximization of their natural frequencies. The design space is characterized by continuous variables, including parameters governing the material gradation profile through the thickness and the geometric descriptors of the auxetic topology.

A set of population-based and stochastic metaheuristic algorithms adapted to continuous domains is implemented, namely Simulated Annealing (SA), Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Shuffled Complex Evolution (SCE), and the Shuffled Frog Leaping Algorithm (SFLA). Their performance is systematically assessed with respect to convergence rate, robustness, solution optimality, and computational cost.

The results allow concluding on the relative efficiency and reliability of the different algorithms, thereby enabling the establishment of guidelines for the selection of suitable optimization strategies in the design of advanced functionally graded auxetic composite systems.