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Topology optimization of compliant structures and mechanisms using constructive solid geometry for 2-d and 3-d applications. (English) Zbl 1381.68283


Summary: This research focuses on the establishment of a constructive solid geometry-based topology optimization (CSG-TOM) technique for the design of compliant structure and mechanism. The novelty of the method lies in handling voids, non-design constraints, and irregular boundary shapes of the design domain, which are critical for any structural optimization. One of the most popular models of multi-objective genetic algorithm, non-dominated sorting genetic algorithm is used as the optimization tool due to its ample applicability in a wide variety of problems and flexibility in providing non-dominated solutions. The CSG-TOM technique has been successfully applied for 2-D topology optimization of compliant mechanisms and subsequently extended to 3-D cases. For handling these cases, a new software framework involving optimization routine for geometry and mesh generation with FEA solver has been developed. The efficacy of the approach has been demonstrated for 2-D and 3-D geometries and also compared with state of the art techniques.

MSC:

68T20 Problem solving in the context of artificial intelligence (heuristics, search strategies, etc.)
68U05 Computer graphics; computational geometry (digital and algorithmic aspects)
90C59 Approximation methods and heuristics in mathematical programming

Keywords:
structural and topology optimization; finite-element analysis (FEA); multi-objective genetic algorithms; compliant structures

Software:
topopt, multi; Python; Matlab; ToPy; ABAQUS

Full Text: DOI

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