A high-efficient topology optimization using a triple acceleration method

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Abstract

This paper presents a triple acceleration method (TAM) for the topology optimization (TO), which consists of three parts: multilevel mesh, initial-value-based preconditioned conjugate-gradient method (PCG) and local-update strategy. The TAM accelerates TO in three aspects including reducing mesh scale, accelerating solving equations and decreasing the number of updated elements. Three benchmark examples are presented to evaluate proposed method, and the result shows that the proposed TAM successfully reduces 35%-80% computational time with faster convergence compared to the conventional TO while the consistent optimization results are obtained. Furthermore, the TAM is able to achieve a higher speedup for large-scale problems, especially for the 3D TOs, which demonstrates that the TAM is an effective method for accelerating large-scale TO problems.

Keywords: Topology optimization; Triple acceleration; Multilevel mesh; Preconditioned conjugate-gradient method; Local-update.