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Topology optimization of steady-state heat conduction structures using meshless generalized finite difference method. (English) Zbl 1464.74366

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Summary: This paper proposes the topology optimization for steady-state heat conduction structures by incorporating the meshless-based generalized finite difference method (GFDM) and the solid isotropic microstructures with penalization interpolation model. In the meshless GFDM numerical scheme, the explicit formulae of the partial differential equation are expressed by the Taylor series expansions and the moving-least squares approximations to address the required partial derivatives of unknown nodal variables. With the relative density of meshless GFDM node as the design variable, the implementation of the topology optimization is formulated involving the minimization of heat potential capacity as the objective function under node number constraint. Moreover, sensitivity of the objective function is derived based on the adjoint method, and sensitivity filtering subsequently suppresses the checkerboard pattern. Next, the update of design variables at each iteration is solved by the optimality criteria method. At last, several numerical examples are illustrated to demonstrate the validity and feasibility of the proposed method.

MSC:

74S20	Finite difference methods applied to problems in solid mechanics
65N06	Finite difference methods for boundary value problems involving PDEs
49Q12	Sensitivity analysis for optimization problems on manifolds
74P15	Topological methods for optimization problems in solid mechanics
80A19	Diffusive and convective heat and mass transfer, heat flow

Keywords:

topology optimization; meshless method; generalized finite difference method; steady-state heat conduction; solid isotropic microstructures with penalization

Full Text: DOI

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