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A New Method for Maximum Dynamic Response Topology Optimization in the Time Domain

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Abstract

The widely used static topology optimization methods try to find optimal design of structures under loads that are static or vary slowly. However, when the loads change rapidly, their time-dependent characteristic and the inertia effect must be taken into consideration, and therefore dynamic response topology optimization methods should be employed. Two difficulties in solving such problems are the treatment of time-dependent responses and sensitivity analysis. This paper proposes a one-parameter functional to approximate the extreme value of time-dependent response. The accuracy of the approximation can be controlled by the parameter and some of its important properties are discussed. The proposed functional is incorporated into topology optimization problem to minimize the maximum value of time-dependent response at prescribed material volume. The displacement of a specific point of the structure is considered. The density-based approach is used to solve the topology optimization problems and the adjoint variable method is employed to perform sensitivity analysis. The design variables are updated by the Method of Moving Asymptotes. Two numerical examples are conducted to demonstrate the effectiveness of the proposed method and the time-dependent characteristic of the dynamic loads and inertia effect on the topology optimization results.