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Topology optimization of plate structures subject to initial excitations for minimum dynamic performance index

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Abstract

This paper studies optimal topology design of damped vibrating plate structures subject to initial excitation. The design objective is to minimize an integrated square performance measure, which is often used in optimal control theory. The artificial density of the plate element is the topology design variable. The Lyapunov's second method is applied to reduce the calculation of performance measure to the solution of the Lyapunov equation. An adjoint variable method is developed in our study, which only needs to solve the Lyapunov equation twice. However, when the problem has a large number of degrees of freedom, the solution process of Lyapunov equation is computational costly. Thus, the full model is transform to a reduced space by mode reduction method. And we propose a selection method to decrease the number of eigenmodes to further reduce the scale of reduced model. Numerical example of optimum topology design of bending plates is presented for illustrating validity and efficiency of our new algorithm.

Keywords: Adjoint method, vibration control, topology optimization.