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On Shape Optimization for Eigenvalue Problems

Pauli Pedersen[(1)], Niels L. Pedersen[(2)]

(1) *Technical University of Denmark, Denmark*
(2) *Aalborg University, Denmark*

In shape optimization we change the reference domain of a structure, say the axis of a beam/bar or the mid-surface of a plate. The changes are continuous and thus cannot lead to topology optimization. For a broad class of static problems an optimality criterion of constant energy density along the designed boundary is proved earlier. In the present paper we prove a similar criterion for eigenvalue problems. Although most practical problems must be solved with the application of mathematical programming, the optimality criterion serve as the tool for more basic understanding and for idealized reference cases also as the basis for recursive procedures. Especially the evaluation of the optimality criterion for designs obtained by restricted/penalized parametrization or with geometrical constraints gives valuable information. As numerical verifications we solve finite element models of plate problems, optimizing the eigenfrequencies for in-plane vibrations as well as out-of-plane vibrations.

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