Structural eigenfrequency optimization based on local sub-domain “frequencies”

The engineering approach of fully stressed design is a practical tool with a theoretical foundation. The analog approach to structural eigenfrequency optimization is presented here with its theoretical foundation. A numerical redesign procedure is proposed and illustrated with examples. For the ideal case, an optimality criterion is fulfilled if the design have the same sub-domain “frequency” (local Rayleigh quotient). Sensitivity analysis shows an important relation between squared system eigenfrequency and squared local sub-domain frequency for a given eigenmode. Higher order eigenfrequencies may also be controlled in this manner. The presented examples are based on 2D finite element models with the use of subspace iteration for analysis and a recursive design procedure based on the derived optimality condition. The design that maximize a frequency depend on the total amount of available material and on a necessary interpolation as illustrated by different design cases.

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