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Publication date: 2016

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):
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ABSTRACT

For many applications in dynamics and vibrations it is desirable to increase the linear operation range of a device to higher loads without sacrificing the performance in other respects. One example is small loudspeakers, eg. in mobile phones or hearing aids, that require a high acoustic output for small power consumption, preferably without introducing excessive nonlinear distortion of the signal. Keeping nonlinearities at a manageable level while controlling the mechanical and/or acoustical performance is a nontrivial design problem, which calls for the use of numerical optimization techniques.

However, design and particularly topology optimization based on full nonlinear dynamic simulations is a very demanding computational task and one normally has to resort to simplified models such as the use of equivalent static loads [1] or a steady-state assumption using eg. the incremental harmonic balance method [2]. As a promising and computationally efficient avenue, the direct computation of nonlinear coefficients, recently applied to simulate nonlinear dynamics of reduced-order shell models [3], has been adapted to tailor the nonlinear dynamics of beam structures using shape optimization [4].

In this work we extend the methodology introduced in [4] to topology optimization of plane vibrating continuum structures in order to control the nonlinear dynamic behavior. Promising preliminary results have been obtained for the case of minimizing the cubic nonlinear coefficient in the reduced-order model while keeping the fundamental natural frequency at a fixed minimum level.

References