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Topology optimization of piezo modal transducers with null-polarity phases

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Abstract

Piezo modal transducers are those which isolate a specific eigenmode of a structure, but also remain insensitive to the rest i.e., they behave as spatial filters (also called modal filters) in the frequency domain. They can be designed theoretically by tailoring polarity of the surface electrodes.

However, it is also necessary to include null-polarity phases of known width separating areas of opposite polarity in the manufacturing process in order to avoid short-circuiting. Otherwise the performance of such devices could be spoiled.

In this work, we propose an appropriate interpolation function for the electrode profile such that the effect of this new phase (hereafter gap-phase) is included in the formulation of the design problem. The approach is density-based, where the interface is controlled by including the gradient norm in the electrode profile interpolation.

Through a detailed case study in 1d, conclusions on how to control the width of this gap-phase are extracted, and subsequently extended to the 2d case.