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PROCEEDINGS

Frequency-Multiplexed Acoustic Metasurfaces Based on Multiobjective Topology Optimization

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ABSTRACT

With their thin thicknesses and unprecedent wave manipulation capabilities, acoustic metasurfaces have a great potential to be applied in a wide range of applications. Most existing metasurfaces are passive devices. Although passive devices are easy to implement and consume no energy, one major shortcoming of passive devices is their fixed and limited functionality, which greatly limits their application scope. To increase the functionalities of a metasurface and yet still maintain its passivity, we propose to use the wave frequency as a tuning freedom to realize multiple functionalities in one single passive device. Specifically, the passive metasurface will be designed to possess different functions at different operation frequencies. By changing the wave frequency, the metasurface will switch its functionalities. In this talk, we will present the general design methodology, which is based on multi-objective topology optimization and genetic algorithm. Several frequency-encoded multifunctional acoustic metasurfaces, for example, a metasurface that can perform wave focusing and beam steering, designed using the methodology will be demonstrated. Both simulation and experimental results will be presented and compared. In addition, the underlying mechanisms of multifunctional characteristics will be discussed.

KEYWORDS

Topology optimization; multiobjective optimization; acoustic metasurfaces; wave manipulation; frequency multiplexing

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