Designing Meta Material Slabs Exhibiting Negative Refraction Using Topology Optimization

This paper proposes a topology optimization based approach for designing meta materials exhibiting a desired negative refraction with high transmission at a given angle of incidence and frequency. The approach considers a finite slab of meta material consisting of axis-symmetric designable unit cells subjected to an exterior field. The unit cell is designed to achieve the desired properties based on tailoring the response of the meta material slab under the exterior field. The approach is directly applicable to physical problems modeled by the Helmholtz equation, such as acoustic, elastic and electromagnetic wave problems. Acoustic meta materials with unit cell size on the order of half the wave length are considered as examples. Optimized designs are presented and their performance under varying frequency and angle of incidence is investigated.

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