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Engineering Negative Refractive Index Materials via Topology Optimization

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Abstract

The design and manufacture of electromagnetic "metamaterials" is a rapidly-emerging field. These composites can possess material properties not found in nature, such as negative Poisson's ratio, negative thermal expansion coefficient, and negative refractive index. Their realization on a practical scale will allow for such extraordinary applications as the perfect lens, super absorber and invisibility cloak.

The materials are notoriously difficult to design, owing to the un-intuitive nature of the physics (nano-photonics) involved. Here we show that the sensitivity information gleaned from topology optimization techniques can be used as an efficient design strategy, allowing high-performing metamaterial designs to evolve naturally from within the algorithms.