

A VOLUMETRIC NEGATIVE-REFRACTIVE-INDEX METAMATERIAL BASED ON UNIPLANAR TRANSMISSION-LINE LAYERS

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This talk will describe a new class of volumetric negative-refractive-index (NRI) metamaterials based on two-dimensional uniplanar transmission-line layers. The layers consist of the series interconnection of transmission lines loaded in a dual configuration and can alternatively be perceived as an array of loaded metallic rings. The effective medium response of the constituent layers is revealed through a periodic analysis, and an equivalent circuit is developed to produce the dispersion characteristics of the volumetric medium formed by stacking the layers. This equivalent circuit also yields the effective permittivity and permeability of the volumetric medium. Various volumetric designs employing both discrete and printed lumped loading elements, as well as different ring topologies, are proposed and studied for their dispersion and transmission properties using full-wave simulations. They are shown to exhibit a relatively broad NRI bandwidth that can be predicted well by the proposed equivalent circuit model. It is also shown that the volumetric layered medium can be designed for a closed stopband, or to be impedance-matched to free-space with a refractive index of -1 , thus meeting the requirements of Veselago's slab lens. We shall also discuss the possibility of scaling the proposed volumetric layered medium to terahertz frequencies and beyond.

References

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