

## DISPERSION CHARACTERISTICS OF GUIDED-WAVE STRUCTURES WITH ENZ MEDIA

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Materials with relative effective permittivity (or relative permeability) near zero (ENZ or MNZ) are a class of metamaterials with unusual characteristics in their interaction with electromagnetic waves. These materials have become the subjects of study in recent years (e.g., R. W. Ziolkowski, Propagation in and scattering from a matched metamaterial having a zero index of refraction, *Phys. Rev. E*, 70, 046608 (2004); N. Engheta, M. G. Silveirinha, A. Alu and A. Salandrino, Scattering and reflection properties of low-epsilon metamaterial shells and bends. ICEAA05, Torino, Italy, Sept. 12-16, 2005, pp. 101-104.; A. Alu, F. Bilotti, N. Engheta, and L. Vegni, How Metamaterials May Significantly Affect the Wave Transmission through a Sub-Wavelength Hole in a Flat Perfectly Conducting Screen, Workshop on Metamaterials for Microwave and (Sub) millimetre Wave Applications: Photonic Bandgap and Double Negative Designs, Components and Experiments, London, UK, November 24, 2003.) In such ENZ or MNZ materials, the refractive index can be near zero, and thus the phase variation inside such media can be slow; however, the intrinsic impedance of plane waves in such media can be significantly different from that in conventional media. In our previous work, we have shown how ENZ or MNZ properties can provide interesting features in reducing the total scattering cross section of objects, and how this type of materials can affect the guided wave propagation around a bend in a waveguide.

In the present work, we focus our attention on the more general problem of guided wave propagation in waveguides partially filled with ENZ media. Following our work on wave tunneling through ENZ sections of waveguides with ENZ-filled bends, here we study more general features of such waveguides, e.g., group velocities, phase velocities, and field singularities of modes in these structures. We will also discuss characteristics of tunneling and reflection properties due to the ENZ section of the guides. For the case of partially filled ENZ waveguides, modal distributions and dispersion properties will also be studied. In this talk, we will present some of our theoretical results in this area and we will discuss physical intuitions behind these findings.

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