

# Metamaterial-inspired Advances in Antennas and Propagation

**Richard W. Ziolkowski**

Litton Industries John M. Leonis Distinguished Professor  
Department of Electrical and Computer Engineering  
Professor, College of Optical Sciences  
University of Arizona, Tucson, AZ 85721



The introduction of metamaterials and metamaterial-inspired structures into the tool set of RF engineers has led to a wide variety of advances in discovery in the antennas and propagation research areas. The enhanced awareness of complex media, both naturally occurring and artificially constructed, which has been stimulated by the debut of metamaterials, has enabled paradigm shifts in terms of our understanding of how devices and systems operate and our expectations of their performance characteristics. These shifts include the trends of miniaturization, enhanced performance, and multi-functionality of antenna systems for wireless platforms; dispersion engineering to modify the properties, for example, of transmission lines and antennas; scattering mitigation (cloaking, active jamming, perfect absorbers) and enhancements (sensors, detectors); and the tailoring output beams (leaky wave broadside radiators, sub-diffraction limit resolution in remote sensing and highly directive beams for energy transfer and low probability of intercept systems). A variety of metamaterial-inspired constructs, which have led to useful improvements in antennas and the propagation of signals in the corresponding electromagnetic environments, and their practical applications from RF to THz to optical frequencies will be described.