

Novel Electrically Small Antennas and Metamaterial High Impedance Surfaces

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Project Summary:

In this research we propose to apply the mathematical concept of space-filling curves in design of electrically small planar antennas and in development of metamaterial high impedance surfaces (i.e., artificial magnetic conductors) for selected DoD applications in VHF, UHF and GPS frequency bands. The space-filling curves are attractive solution for miniaturization of antennas as well as inclusions in metamaterial surfaces since they offer a planar structure that may have a small footprint but resonate at a long wavelength. In particular, two research tracks are proposed. In the first track we will develop a class of electrically small antennas, patterned after Hilbert and Peano curves, which provide good radiation efficiency, low-cross polarization, and direct matching to standard transmission lines without complicated matching networks. We will develop various feeding schemes for these antennas and analyze their performances as radiating elements in selected array environments as well as their characteristics when printed or embedded in a dielectric substrate. Selected prototypes of proposed antennas will be fabricated and measured. In the second research track we will analyze the performance of high impedance surfaces made of Hilbert-curve and Peano-curve inclusions, and study their applications in enhancing the radiation characteristics of conformal dipoles and patch antennas, placed above such surfaces.