Grid-Graph Hamiltonian-Path Based Inclusions for Artificial Magnetic Conductors with Reduced Polarization Sensitivity

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Two dimensional arrays consisting of Peano and Hilbert space-filling curve inclusions have been shown to posses the properties of an Artificial Magnetic Conductor (AMC) near resonance when placed within close proximity to a conducting ground-plane [J. McVay, N, Engheta, A. Hoorfar., “Space-filling-curve high-impedance ground planes,” a chapter in *Metamaterials: Physics and Engineering Explorations*, (N. Engheta and R. W. Ziolkowski eds.), IEEE Press, Wiley Pub., 2006]. These AMC surfaces however, inherit the polarization dependent properties of the inclusions, which may be undesirable for many microwave applications. In this work we explore the possibilities of utilizing grid-graph Hamiltonian Paths (HP) as the basic inclusions to form an AMC surface with reduced polarization dependency.

Grid-graph HP are basically characterized by visiting *all* the graph vertices *exactly once*. Their geometrical representation in a Euclidean space yields a broad and versatile set of space-filling curves that contains as special cases the Peano and Hilbert curves. HP can be mapped to non-Cartesian grids with arbitrary boundaries and given topological constraints, and can have arbitrary endpoints (even coincident). A recent study of the polarizability of various HP inclusions has uncovered some interesting electromagnetic characteristics, and identified certain realizations which may have resonances nearly independent of the polarization of the illuminating field [V. Pierro et al, “Electromagnetic Properties of Space-Filling Wire Structures Based on Grid-Graph Hamiltonian Paths: Some Preliminary Results,” 2005 URSI National Radio Science Meeting, Washington, DC, July 3-8, 2005, p. 214].

As an illustration, the special HP shown in Figure 1 (from a 6×6 grid-graph, contained within a 5 mm x 5 mm footprint), was studied both as a single scattering element and as an inclusion to form an AMC surface. When illuminated with a normally incident uniform plane-wave, the single scatterer based on this geometry exhibits a RCS that depends fairly weakly on the field polarization. When used as the basic element in an infinite periodic arrangement close to and above a conducting ground-plane, AMC (null phase) behavior shows up in the reflection coefficient. It is shown that, for orthogonal incidence, the AMC response is nearly independent of the field polarization.

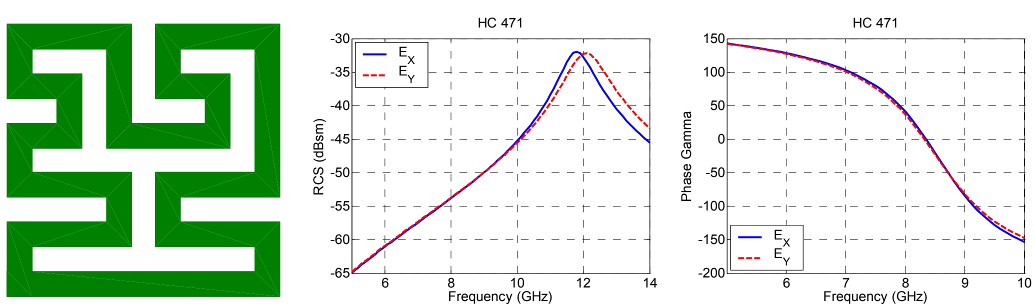

Figure 1: A Hamiltonian Path with Coincident End-Points, its Backscattered RCS for 2 Orthogonal Polarizations (normal incidence) and Phase Angle of the Reflection Coefficient for an Infinite Array of these Inclusions Placed 2.5 mm above a Conducting Ground-Plane.