Space-Filling Curve Antennas above Space-Filling Curve High Impedance Ground-Planes

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Recent interest in conformal, low profile antenna technologies has driven research in the design of electrically small and simultaneously resonant, radiating elements. When utilized as an antenna element, Hilbert and Peano Space-Filling Curves (SFC) have shown the potential to provide resonance at frequencies where the overall dimensions of the area containing the curve, can be considered electrically small [K. J. Vinoy, K. A. Jose, V. K. Varadan and V. V. Varadan, "Hilbert curve fractal antenna: a small resonant antenna for VHF/UHF applications," Microwave and Optical Technology Letters, May 2001; J. Zhu, A. Hoorfar, N. Engheta, "Peano Antennas", *IEEE* Antennas and Wireless Propagation Letters, December 2004]. These curves have also been utilized as inclusions to form High Impedance Ground-Planes (HIGP), also known as artificial magnetic conductors [J. McVay, N. Engheta and A. Hoorfar, "High-Impedance Metamaterial Surfaces Using Hilbert-Curve Inclusions," IEEE Microwave and Wireless Component Letters, March 2004; J. McVay, A. Hoorfar and N. Engheta, "Peano High Impedance Surfaces," Radio Science, September 2005]. In this work we study the potential of utilizing the electrically small SFC radiating elements, above the SFC-HIGP. In such a process, it may be possible to have an electrically small yet resonant, horizontal, dipole-like element within close proximity to a conductive ground-plane, while maintaining a matched system with gain values greater then that of the free-space counterparts. Such a scheme may particularly be useful when these antennas are used in RFID tagging of conducting objects. Figure 1 illustrates this potential in showing the geometry, and the return loss of a Hilbert curve antenna, of order 3, both with and without a small HIGP made of a 2x2 array of Hilbert curve inclusions. The results clearly indicate the ability of the HIGP to restore the match and the gain patterns for the Hilbert curve antenna. A detailed parametric study and other salient features of the proposed configuration will be given in the presentation.

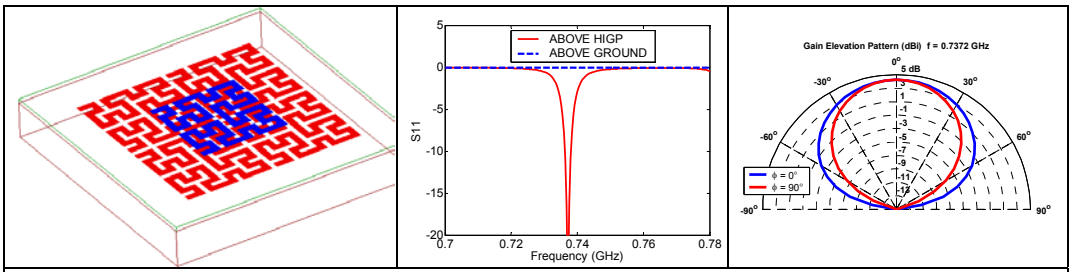

Figure 3: Hilbert SFC Antenna Above a Finite Hilbert HIGP, the Corresponding Return loss, both in the presence and absence of the HIGP, and Gain Patterns above the HIGP