Simulation and Experimental Results for a Crossed-Dipole over PEC and Ferrite Nanoparticle Composite Ground Planes

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An important antenna design goal is to have an antenna operating close to a metallic ground plane (structure or platform). Unfortunately, the characteristics such as radiation resistance and bandwidth reduce dramatically as the antenna approaches closely to the ground plane. However, if the antenna could be matched even to the low radiation resistance, the gain increases as the antenna gets closer to the ground plane assuming low antenna ohmic losses. For low-loss ferrite nanoparticle composite backed ground planes, completely opposite behavior occurs in that the radiation resistance and bandwidth increase as the antenna moves closer. In the practical world, an antenna should include a matching circuit to prevent serious mismatch loss to circumvent lower realized gain that would result for the unmatched case. In this paper the geometry of a low-loss ferrite nanoparticle composite backed ground plane is optimized for a crossed-dipole. The radiation resistance, gain, VSWR (Voltage Standing Wave Ratio), and bandwidth are investigated for this magneto-dielectric based antenna. Results are given for simulations involving the antenna in free space and at various heights over a PEC and over a low-loss ferrite nanoparticle composite medium. The same crossed-dipole was modeled with simulation software over a finite size PEC ground plane with the addition of a thin layer of specially formulated isotropic magnetic nanoparticle composite with low-loss characteristics. Experimental measurements were also obtained in an anechoic chamber and agreed with simulation results. Impedance, VSWR, gain, and bandwidth results will be presented for both the simulation modeling and the experimental measurements. This innovative and breakthrough ferrite nanocomposites backed antenna design will allow antennas to be very conformal to metallic groundplanes (vehicles and airborne platforms).