Simulation and Measurement of Low-Profile Antennas Realized with Isotropic and Anisotropic Magneto-Dielectrics

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The use of magneto-dielectrics is becoming increasingly popular in the development of low-profile antennas. Some of these materials are realized by using the rule of mixtures while others are more closely associated with the types of unit cells related to metamaterials. These magneto-dielectrics can be isotropic or anisotropic broadening the complexity and flexibility of potential antenna designs. The physical realization of such antennas tends to be a layered structure consisting of a ground plane, a magneto-dielectric layer just above the ground plane, and a planar antenna element at the top of the structure. Most design rules-of-thumb focus on the reflection coefficient such that radiation, from the standpoint of impedance matching, is enhanced. Often neglected in the analysis is the excitation of lateral waves and the potential impact on the antenna's performance. Isotropic magneto-dielectrics can mitigate, or utilize advantageously, such waves through varying the thickness or breaking up the magneto-dielectric sheet with air gaps. Anisotropic magneto-dielectrics afford additional degrees of freedom for mitigating lateral wave excitation by the nature of the material.

The presentation will discuss the analytical development of the surface wave excitation for both the isotropic and the anisotropic materials in an effort to identify the importance of the added flexibility of the anisotropic materials. Computer simulations for antennas developed with both types of materials will be presented as will measured results for antennas constructed with each. While direct comparisons between isotropic and anisotropic magneto-dielectrics are difficult to quantify, we will present various designs commenting on relative advantages and disadvantages.