Modeling and Experimental Validation of an Effective Permittivity of Materials Using Artificial Dielectric Structures

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Abstract.- For many decades theoretical Lorentz theory with local field correction also knows by Maxwell Garnett formulation was used developed based on homogenization theory [1,2]. This method is widely used to estimate the permittivity of this effective medium in terms of the permittivities and fraction volumes of the individual constituents of the complex medium. This formulation is simple to use it can be used many different applications. Atmospheric radar research use Maxwell Garnett formulation for the estimation of mix volume of water particles and air. Artificial dielectric materials (ADL's) are widely customized in microwave substrates for antennas and filters. Optimizing the permittivity properties of materials between 1 to 10 with loss tangent less than 0.001 is quite attractive for microwave devices that require high efficiency.

This paper presents the implementation and validation of artificial dielectric layers designed based on a modified Maxwell Garnet approach that enables the design of artificial dielectric layers for mm-Wave applications. A graphical interface implemented in MATLAB that includes different ADL unit cells facilitates the design of multiple artificial dielectric layers for microwave and millimeter applications. The results of four ADL materials protypes will be presented and compared with the proposed model and simulation in HFSS.

References:

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