A Comparison of Un-rotated Uniaxial and Rotated Uniaxial Parallel Plate Green's Functions

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Non-destructive evaluation of simple and complex media often requires a Green's Function to relate field applicator aperture currents to the material under test (MUT) region. In some cases, the MUT region is metal-backed. A parallel plate region is formed from the measurement system's metal flange which contains the aperture. Depending on the material tensors present in the parallel plate structure, the appropriate Green's function is needed to relate the equivalent aperture current provided by the field applicator to the fields in the parallel plate region. Previously, isotropic and uniaxial anisotropic parallel plate Green's functions have been implemented in both rectangular and coaxial waveguide-flange measurement techniques. These techniques use a Magnetic Field Integral Equation (MFIE) which is solved by the Method of Moments (MoM).

Expanding on previous works and accommodating unique transverse tensor elements, a Rotated Uniaxial Anisotropic Parallel Plate Green's function has been recently developed and successfully employed in a non-destructive rectangular waveguide-flange material measurement technique. In this paper, the Rotated Uniaxial Anisotropic Parallel Plate Green's function development is compared to the Un-rotated Uniaxial Anisotropic Parallel Plate Green's function development. The comparison discusses the difference in the parallel plate modal structure and provides a physical interpretation of the mathematical description for the principle, scattered and total Green's function solutions. Examples illustrate how different current configurations in each parallel plate region produce different field structures depending on the material tensor element arrangement, as mathematically described by the Green's function. Concluding remarks address how the field structure is impacted by the parallel plate boundary conditions on the rotated tensor elements.