ABSTRACT submitted for: FEM

Special Session titled:
Organized by:

An Efficient 2.5D Finite Element - Transformation Optics Approach to Morphed-BoR Objects

G.G. Gentili(1), M. Khosrnonejad(1), R. Nesti(2), G. Pelosi(3), S. Selleri(3)
(1) DEIB - Politecnico di Milano, Milano (Italy)
(2) INAF - Osservatorio di Arcetri, Florence (Italy)
(3) DINFO – University of Florence, Florence (Italy)

When an object exhibit some sort of symmetry, its exploitation in writing an ad-hoc formulation usually leads to greater efficiency with respect to a brute-force fully 3D approach. In particular, when an object exhibits a body-of-revolution (BoR) symmetry, its electromagnetic scattering properties can be analyzed by expanding the angular variation of the fields in harmonics and reduce the numerical FEM solution to the 2D half plane generating the structure, yielding a 2.5D formulations which is of course much more CPU and memory efficient than any full 3D solution. The same is also true for microwave waveguide devices exhibiting a BoR symmetry.

If the object, or the device, does not exhibit a BoR symmetry, but a coordinate transformation can be devised that morphs such an object into a true BoR then the object can be named *Morphed-BoR* (MBoR) and treated more efficiently. The key point is that the whole space around the object is subject to the same, continuous and differentiable, transformation. The way in which such a transformation reflects onto Maxwell's equations is known as Transformation Optics (TO - N. B. Kundtz *et. al.* Proceedings of the IEEE, vol. 99, no. 10, pp. 1622-1633, Oct. 2011). In TO the medium characteristic parameters transforms too with geometry according to relations containing the Jacobian matrix of the transformation. In general, the Jacobian leads to materials in the transformed system, which are anisotropic even if the original problem is in free space.

In this contribution a 2.5D BoR FEM code will be presented, allowing the analysis of MBoR structures immersed in a, possibly inhomogeneous, anisotropic material exhibiting tensor permeabilities and permittivities. This will be in particular applied to microwave two-port devices exhibiting nearly circular structures, and the approach validated via comparison with conventional fully 3D FEM simulations.