Electromagnetic Scattering by Mixed Conductor-Dielectric Objects of Arbitrary Shape

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OVERVIEW
Mixed conductor-dielectric objects are structures composed of both conductor surfaces and dielectric volumes. One approach to modeling such structures is the application of the method of moments to the electric field integral equation. Commonly, linearly varying basis functions are defined over tetrahedral cells in the dielectric and triangular cells on the conductor surface. The main problem with such an approach is that linearly varying basis functions defined over conductor-dielectric interface tetrahedra cannot simultaneously satisfy boundary conditions and model field variations within the tetrahedra. A new formulation, making use of a layer of prism elements at the conductor-dielectric interface, is developed with the following key features:

• Prism elements with non-equal area triangular faces are allowed.
• Linearly varying basis functions, capable of interfacing with tetrahedral basis functions, are defined over each prism.
• Simultaneous satisfaction of boundary conditions and modeling of field variations within each prism is possible.

BASIS FUNCTIONS
Normal Basis Functions:
• Defined by extending prism into tetrahedron.
• Designed for prisms with non-equal area triangular faces – case with equal area faces easily handled as special case.

Tangential Basis Functions:
• Associated with trapezoidal faces of prism.
• Two functions associated with each trapezoidal face, one to combine with normal basis function at conductor-dielectric interface in satisfaction of boundary conditions, one to model tangential fields near conductor-dielectric interface.

SCATTERING BY COATED SPHERE

• One layer of prisms used to model dielectric.
• Prisms have non-equal area triangular faces.

DIELECTRIC LOADED CAVITY RESONATOR

• Condition of system matrix used to detect resonant frequencies.
• Layer of prism elements used at conductor-dielectric interface.
• Tetrahedra used in remaining volume.
• Prism elements are skewed and made up of non-equal area triangular faces.

Example Mesh

Computed and measured impedance follow same locus.
Resonant frequency predicted within 1.1%.
Near field capabilities of formulation tested.

Cutaway view

Backscattering

Example Mesh


Example Mesh


Example Mesh