

NEW EXPRESSION OF APPROXIMATE TRANSITION BOUNDARY CONDITIONS FOR UNIAXIAL BIANISOTROPIC THIN LAYERS

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Approximations boundary conditions can be usefully employed to simplify a large variety of electromagnetic field problems involving complex geometries and materials. In any given case there may be several different approximate conditions that could be employed, each derived by considering a simplified (canonical) problem whose solution can be found. For uniaxial bianisotropic thin layers, a pair of differential vector equations relating the tangential components of the fields and their second-order tangential derivatives has been obtained for higher-order transition boundary conditions by using averaging method [1,2]. Although the boundary conditions are well approximated over a reasonably wide range of parameters and have been used to serve as the foundation for related electromagnetics problems, we believe that the potentialities of the conditions have not been fully exploited. By using the basic field equations and some manipulations of vectors, this paper presents a new expression of the approximate transition boundary conditions for the uniaxial bianisotropic thin layers.

The obtained boundary conditions contain only the first order polynomials in the normal derivatives, and the present results shall be referred to as the first-order conditions. The normal differential operators on the tangential field vectors can be used to better simulate the spatial variation of the fields since the influence of the uniaxial layers on the electromagnetic fields in the normal direction is more strong than ones in the tangential directions. For guided propagation in normal direction the obtained conditions can also be degraded into the forms of expression in which no derivatives of the fields are included. In addition, the new representation is now geometry independent (the coordinate-free vector formulation), therefore we can generalize its expression to a curved boundary.

[1] D. Y. Khaliullin and S. A. Tretyakov. IEE Proc. Microwaves, Antennas and Propagations, 145, 163-168, 1998.

[2] S. A. Tretyakov and A. S. Cherepanov. Radio Science, 26, 523-528, 1991.

Abstract Submission Form

2006 National Radio Science Meeting

Abstract: jiang8210

Date Received: September 18, 2005

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2. A - Electromagnetic Metrology

3. (a)

4. C - Contributed Paper

5. No special instructions