Abstracts

Reconstructing permittivity profiles using integral transforms and improved renormalization techniques

M.J. Akhtar and A.S. Omar. "Reconstructing permittivity profiles using integral transforms and improved renormalization techniques." 2000 Transactions on Microwave Theory and Techniques 48.8 (Aug. 2000 [T-MTT]): 1385-1393.

Some new ideas for reconstructing permittivity profiles in planar and cylindrical objects illuminated by TEM-, TE- or TM-polarized waves are presented in this paper. For a planar medium, an improved renormalization technique along with a revised version of the nonlinear Riccati differential equation describing the direct problem are introduced. A nonlinear Riccati-similar differential equation for the cylindrical case has also been derived here for the first time, which helps reconstructing radially varying permittivity profiles in a way parallel to that of the planar case. The above-mentioned renormalization technique has been used for the cylindrical case as well to solve the inverse problem making use of a Hankel transform. The method represents fundamental bases for a three-dimensional generalization, which is essential for microwave imaging used, e.g., in biomedical applications and for the diagnostic of diseases in trees and vegetation. A known permittivity profile has been taken to generate synthetic reflection-coefficient data by solving the nonlinear equations describing the direct problems using MATLAB. These data have been used in conjunction with the proposed technique to reconstruct the permittivity profile. About 50-100 data points over the wavelength range from a minimum value (ranging from one-tenth to one-fifth of a typical length in the structure) to infinity have been used for the reconstruction. Reconstructed profiles have been compared to the original ones for a number of cases. Deviations of less than 2% have been achieved.

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