Abstracts

The Accuracy of Finite-Difference Solutions of Laplace's Equation

J.W. Duncan. "The Accuracy of Finite-Difference Solutions of Laplace's Equation." 1967 Transactions on Microwave Theory and Techniques 15.10 (Oct. 1967 [T-MTT]): 575-582.

The cross sections of most TEM mode transmission lines have reentrant corners or edges where the potential gradient is singular. In this paper the accuracy of the finite-difference solution for the electric field normal to the conductor boundary at a right-angle corner and at the edge of a thin plate is examined. The accuracy of the finite-difference solution is related to the mesh length h, the magnitude of the lattice point residuals, and the finite-difference operator which is used in place of the Laplacian differential operator. The computing time required to solve the mesh equations by the method of successive overrelaxation is specified. The surface charge density in the neighborhood of the boundary singularity is expressed as a truncated series of circular harmonics. As a result, the integral of the surface charge can be calculated with very good accuracy. The paper concludes by using the harmonic series treatment to determine the capacitance per unit length of a square coaxial transmission line.

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