Spectral Domain Analysis of Coupled Microstrip Using Spheroidal Wave Functions with Edge Conditions

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An analysis of coupled microstrip transmission lines using spheroidal wave functions and the spectral domain method will be presented. In the spectral domain method, the electromagnetic field equations and boundary conditions are formulated in the spectral, or Fourier transform, domain. This formulation is used to derive an equation that expresses the Fourier transform of the electric field in terms of the current distribution on the microstrip. Galerkin's moment method is then applied to yield a system of equations that can be used to solve for unknown propagation constants as a function of frequency.

The current distribution on microstrip is modeled as an expansion of known basis functions with unknown coefficients. Walsh functions, sinusoidal functions, sinusoidal functions with edge conditions and Chebyshev polynomials with edge conditions have been utilized as basis functions in prior research. Functions that incorporate the microstrip edge conditions more effectively model the current on the microstrip and require fewer terms in the current expansion. Previous research at Stevens Institute of Technology has utilized spheroidal wave functions to model the current distribution on single microstrip transmission lines. These functions were shown to model the current over a broad frequency range and required fewer expansion terms than other previously used basis functions.

For this presentation, the work carried out utilizing spheroidal wave functions in the analysis of single microstrip lines is extended to coupled microstrip. A brief overview of the theory of spheroidal wave functions will be included but the primary focus will be on practical issues of computation related to their use in the analysis of both single and coupled microstrip. Chebyshev polynomials with edge conditions have previously been used to model the current on coupled microstrip over a large frequency range. Preliminary results demonstrate that fewer spheroidal wave functions than Chebyshev polynomials are needed to compute the propagation constant as a function of frequency. Propagation constants computed for a range of frequencies and strip separation values are investigated.