Novel Closed-Form Layered Medium Greens Function Approximation Via Discretization of the Scattered Field Formulation of the Spectral Differential Equation

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Evaluation of the multilayered medium Green's function is important in many practical applications of electromagnetic analysis including design on microwave circuits and micro strip antennas, modeling of high-speed interconnects, remote sensing, geoscience and others. Expansion of the layered medium dyadic Green's function components over cylindrical wave obtained through finite-difference solution of 1D differential equation governing their spectra has been shown to be an effective method to approximate the fields in the intermediate and far zones of the point source (Okhmatovski, et.al., IEEE TAP 2002). In the near vicinity of the point source, however, such approximation becomes inaccurate. This is due to spherical waves dominating the solution near the source and counted number of cylindrical waves becoming inadequate to their accurate description. In order to develop uniformly accurate approximation we decompose the spectrum of the total field into the incident and scattered field contributions. The 1D differential equation governing the spectrum of the layered medium Green's function is formulated with respect to the scattered field rather than the total field as it was done previously (Okhmatovski, et.al., IEEE TAP 2002). The boundary conditions at layer interfaces, based on the continuity of Green's function and the tangential component of electric filed flux are enforced. As a result, the pole-residual approximation of the scattered field spectrum is obtained which leads to accurate cylindrical wave approximation in the space domain in both the intermediate and far zones since singularity of Green's function resides in the incident field. The incident field is subsequently added in the analytic form and, hence, accurately describes the field near the source.