Fast Computation of Dyadic Green's function for Layered Media and Its Application in Interconnect Simulations

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In order to solve layered-medium problems such as interconnect simulations, various numerical methods have been developed. In this work, we are concerned with piecewise homogeneous objects embedded in the layered medium. As such, the surface integral equation (SIE) can be used to reduce the number of the unknowns with required in the volume integral equation. For the solution of the SIE, we first develop a fast method to evaluate the Sommerfeld integrals in the dyadic Green's function for a layered medium. Particular attention is paid to evaluate the Green's function (GF) when the source and observation points are on the same plane parallel to the layer interfaces. We note that typical numerical integration methods are not efficient for these integrals because of the slowly decaying and highly oscillating behavior of the integrand. Extensive research has been done to accelerate this process. The discrete complex image method based on surface wave subtraction, have previously been proposed; however, the pole extraction is not an easy task and is often unstable and unrealistic for geometries having many layers. Similar difficulties exist for the steepest descent path method. In this work, the primary and quasi-static field terms are subtracted from the integrand of the dyadic GF and their contribution is calculated analytically. This makes the integrand decay rapidly for large values of k_ρ. Since this is an exact method, the whole procedure is robust; the results of this method have been validated by comparison with many examples in literature, and the high efficiency has been verified. We then apply this dyadic GF in the solution of surface integral equations arising from interconnect simulations. Examples in interconnect simulations will be shown to demonstrate the application.

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