A Green's Function Approach to the Electrostatic Problem of Single, Coupled and Comb-like Metallic Structures in Anisotropic Multilayered Media

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Abstract- A unified approach for the computation of the static capacitance of single, coupled and comb-like metallic structures in anisotropic multilayered media is presented. The media can be electrically shielded on one or both sides. The geometry of the parallel strips may be arbitrary and not all the strips need to be driven electrically, i.e. they may float. An overview of the relevant methods is followed by a discussion of an efficient approach with a wide range of applicabilty. The method of analysis, a uniformly valid representation, is based on the concept of spectral domain representation and the method of moments, which are combined with an auxiliary quantity, the Green's function. First, closed-form formulae for the Green's function in the wavenumber domain have been derived for a variety of cases, which are of practical interest. Using the derived Green's function and the method of moments, the associated integral equation is replaced by a matrix equation, which can easily be solved by standard routines. Although the Green's function theory is by no means a new field, very recently it has found some important applications. The aim of this paper is to show that the advantages of the Green's function can be extended using the method of moments or a specialization of it, called point-matching or collocation method. Using the Fourier transform technique the boundary conditions are transformed into a set of algebraic equations. Therefrom a relation between the spectral components of the potential and charge distribution is derived , which immediately yields a closed-form expression for the Fourier transform of the Green's function. The unknown function, the charge distribution on the metallic strips is expressed in terms of basis or expansion functions. A set of weighting or testing functions and an appropriately defined innerproduct transform the original functional equation into a matrix equation. The elements of the resulting matrix are generally integrals, which must be evaluated numerically. However, for some cases of greatest practical interest they can be solved analytically. The inversion of the obtained matrix yields the unknown charge values on the metallic strips, and their capacitance consecutively. It should be emphasized, that the computation time for all cases treated here is of the order of some seconds.