An Efficient Approach for the Analysis of Printed Geometries with Multiple Vertical Metallization and their Optimization

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Introduction of the closed-form Green's functions into the Method of Moment (MoM) formulation results in a significant improvement in the computational efficiency of the MoM. However, the application of the MoM using the closed-form Green's functions to geometries consisting of vertical metallization is not as straightforward as its applications to geometries consisting only horizontal conductors. It is demonstrated that the computational cost of the approach does not increase with the number of vertical metallization, providing the vertical strips employ the same number of basis functions. This is because the MoM matrix entries corresponding to the basis functions on a vertical strip are obtained as a function of ρ and because the domains of the integrations along the vertical strips are the same. Once the relation between a basis and testing function on a vertical strip is found, the same expression can be used for different values of ρ where the other vertical metallization are located.

Since the closed-from Green's functions are generally obtained at fixed z points, to handle the integrations along the z axis encountered in the inner product terms, the spectral-domain Green's functions and vertical portion of either the testing or basis function or both are integrated along the z-axis analytically, then, the resulting function is approximated using the GPOF method. According to this scheme, the GPOF method is to be used as many times as the combinations of testing and basis functions along the vertical metallization. Therefore, to obtain efficient operation, the vertical strips are required to have the same number of basis functions, allowing less number of calls for the GPOF method. However, for general geometries, it may be difficult to have the same number of basis functions for each vertical strip. To improve its efficiency and eliminate its restriction of using the same number of basis functions, the number of GPOF call must be decreased and the integration along the z-axis should be performed accurately. This goal is achieved by obtaining the closed-form spatial-domain Green's functions at different z values and employing a numerical integration method for the integration along z-axis.

In this work, the operations of both techniques for different geometries involving different number of vertical metallization are studied, and comparative efficiencies are presented. Then, these approaches are combined with an optimization algorithm, Genetic algorithm, to optimize the performance of microwave circuits and antennas.