ABSTRACT

This dissertation presents the Multiple Sweep Method of Moments (MSMM) analysis of radiation and scattering from electrically large three dimensional (3D) bodies. The MSMM is an $\mathcal{O}(N^2)$ recursive method for solving the large matrix equations which arise in the method of moments (MM) analysis of electrically large bodies. In the MSMM, the body is split into P sections and the currents on these sections are found in a recursive fashion. although the MSMM is a frequency domain solution, it has a time domain interpretation. The first sweep includes the dominant scattering mechanisms an each subsequent sweep includes higher order mechanisms. Therefore, with the MSMM it is possible to identify the location and magnitude of points of current reflections. The MSMM has also the ability to analyze a small section of a radiating or scattering geometry in an isolated fashion, thus minimizing the CPU time for a parameter study to optimize the geometry of that section. Numerical results are compared with measurement data and with the exact Method of Moments (MM) solution to illustrate the accuracy and power of the MSMM for electromagnetic radiation and scattering problems.

A connection between the MSMM and the well-known classical iterative methods has been established in this dissertation. Under certain conditions, the MSMM is shown to be mathematically equivalent to a block Jacobi preconditioned system of equations that results from the moment method, and solved via the method of symmetric successive over-relaxation (SSOR) with relaxation factor $\omega = 1$. Based on this connection, certain convergence difficulties (such as that for the closed cylinder) can be explained by the inherent limitations of the corresponding stationary iterative method. In addition, the MSMM is compared with other recently used iterative methods for rough surface scattering problems both from theoretical and numerical points of view.

The MSMM analysis of electromagnetic (EM) scattering from 3D targets on ocean-like rough surfaces is also considered in this dissertation. The results obtained from this study demonstrate that the MSMM is a very reliable and efficient tool for the analysis of this class of problems. Moreover, to the author's knowledge, this is the first attempt to numerically solve 3D targets on ocean-like rough surfaces.