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EDITORIAL

Special Issue of *International Journal of Numerical Modelling: Electronic Networks, Devices and Fields on Wavelets in Electromagnetics*

The recently developed Multiresolution Analysis (MRA) has demonstrated its capability to impact Electromagnetics in many aspects. Among the application areas the most profound are computational electromagnetics and electromagnetic signal processing. The use of multiresolution analysis has led to dramatic savings in CPU time and memory requirements for complicated EM simulations. When the differential Maxwell's equations are discretized using multiresolution analysis, a new time domain algorithm is generated which runs ten times faster than the Yee's scheme and has memory requirements two orders of magnitude less than those of the conventional FDTD. This new scheme is approaching the Nyquist's sampling limit of two grid points per wavelength to achieve errors less than 0.5%. Furthermore, the use of multiresolution analysis to the frequency domain electric- and magnetic-field integral equations results in sparse matrices and provide CPU and memory savings which correspond to computer cost comparable and probably better than the multilevel Fast Multipole Method.

Wavelets, or more generally joint time-frequency representations, have recently also found useful applications in processing electromagnetic data. The joint time-frequency representation of a signal is a two-dimensional phase space that facilitates the visualization and interpretation of complex electromagnetic wave phenomenology. This can oftentimes lead to more insights into the complex electromagnetic wave propagation and scattering mechanisms than what is available in the traditional time or frequency alone. The wavelet transform is one of the multitude of tools for accessing the time-frequency space. It is unique, however, in that it utilizes multi-scale basis functions to provide multiresolution capability. For frequency domain electromagnetic data which consist of both small-scale natural resonances and large-scale scattering center information, the wavelet transform is well suited for resolving these multiscale events of frequency. Despite its capabilities, MRA has not reached the broad microwave community due to its recent mathematical development and the limited demonstration of applications. The purpose of this special issue is to introduce the microwave engineer to the concept of MRA and wavelets transforms through applications to practical microwave problems.

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