APPLICATION OF MOVING WINDOW FDTD TO MODELING THE PROPAGATION OF RADIO SIGNAL FROM ANTENNAS LOCATED NEAR THE GROUND

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Recently, there has been a great deal of interest in unattended ground sensors (UGS) for remote monitoring applications. These UGS are deployed in a variety of outdoor environment, and are equipped with wireless communication systems to transmit sensor data back to a remote operator. Because the UGS are required to be physically small, their antennas must operate at heights very near to the ground. Therefore, to support the design of UGS, accurate model of the propagation of RF signal very near to the ground is needed.

Because the antennas are located near the ground, interaction between the RF signal and the terrain can significantly affect the propagation of the signal. Some of these effects include scattering and back scattering from the roughness of the terrain surface, blockage of the signal by obstructions (rocks, shrubs, etc.) on the propagation path, and coupling to ground wave modes. In addition, the ground can also significantly affect the radiation pattern of the antenna. Because of these effects, many of the standard propagation models, such as TIREM and geometric optics methods, are inapplicable. Instead, a full-wave method is needed.

We have applied the moving window Finite difference time domain (MWFDTD) method to study near-the-surface propagation. The MWFDTD model is based on the full-wave finite difference time domain (FDTD) method. It takes advantage of the fact that when a pulsed radio wave propagates over the terrain, the significant pulse energy exists only over a small part of the propagation path at any instant of time. Therefore only a relatively small FDTD mesh on the order of the width of the pulse needs to be used. As the pulse propagates along the terrain, the computational grid moves along with the pulse.

Since MWFDTD solves Maxwell's equation directly, effects such as rough surfaces, ground waves, and the interaction of the antenna with the ground can all be included in a straight forward manner. In this talk we demonstrate the utility of MWFDTD for modeling the propagation of RF signals from very-near-the-ground antennas located in complex environments.

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