Numerical Studies of Ground Effects on EM Wave Propagation in the Proximity of Stand-Alone and Vehicle Mounted Sources

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Humvees and other military vehicles are equipped with a wide variety of antennas for various communication, radar, and electronic warfare systems. Unfortunately, many of these antennas are usually highly visible and can not only decrease mobility but also increase a tremendous danger for the soldiers in situations where a lower clearance is desired. By using vehicle-embedded antennas many of the above mentioned issues can be mitigated. For example, antennas closer to the ground would significantly decrease the vehicle's visibility. Additionally, there is a great need for the use of ground sensor networks which often require sensor to sensor or sensor to platform communications (and vice versa) via radiated electromagnetic waves.

This paper focuses on the effects on propagation near various lossy, predominantly smooth grounds from the High Frequency (HF) through Ultra High Frequency (UHF) range. Specifically, our study is organized as follows: first, we examine how the variations of the source's height above the ground affect the loss and depolarization throughout the studied frequency range. Both, homogeneous and inhomogeneous layered grounds are considered. Effects of a Humvee platform with integrated linearly and circularly polarized sources are determined next. Finally, we discuss the issues associated with the electromagnetic wave propagation modeling using the Method of Moments (MoM) and Finite Element Methods (FEM). These include limitations of the two methods, as well as associated computational cost and accuracy of the solutions. Results are compared to the available analytical solutions for appropriate cases. Results of this research can pave the way for the ubiquitous sensor networks and special purpose vehicles indistinguishable from their commercial counterparts.