Characterization of Side Mounted Vehicular Antennas

Timothy W. Samson, Maxim Ignatenko, and Dejan S. Filipovic
Department of Electrical, Computer, and Energy Engineering
University of Colorado, Boulder, CO 80309-0425

Abstract

Humvees are typically furnished with a wide range of antenna systems commonly mounted on the roof or bumper of the vehicle. While antennas mounted in these locations may have good performance, they both (roof and bumper) have limited room for additional antennas with new or expanded functionalities. Additionally, the roof- and bumper-based antenna systems may contribute to a large visual profile and may compromise both the mobility and safety of the vehicle. For this reason, it is fortuitous to mount antenna systems in alternative locations on a space constrained vehicle such as Humvee. This paper explores the vehicle and ground effects on the performance of antenna systems mounted on alternative vehicle locations. Moreover, we consider the antennas operating over very wide frequency range, classified under the frequency independent family such as spiral, log-periodic, and sinuous. These antennas are considered for a wide range of applications ranging from communications to jamming. Considering both, these antennas' utility, and ubiquitousness in the field, they make for a prime subject of study for side mounted antennas. This paper focuses primarily on the effects in the VHF/UHF/L-band regions for the mounted antennas over a variety of practical ground compositions. To properly characterize the performance in such a location and over diverse grounds, a variety of parameters are examined using commercially available software tools based on integral and partial differential equation methods. After the discussion of the low and high-complexity models, we evaluate first the vehicle/ground/antenna impact on the electric field at different distances from and around the vehicle in the close proximity to the vehicle itself. This study is especially important for jamming applications. The effect of ground losses on the propagation efficiency of the antenna systems is examined next. Impacts of antenna polarization, proximity to the ground, and pattern shaping are determined. Finally, the depolarization due to ground-based polarization variable losses, scattering from the vehicle body and the ground is explored. This paper shows that the vehicle sides may be considered for mounting various antenna systems operating over wide range of frequencies; however, the design needs to be carefully undertaken to insure that the diverse physics is properly and thoroughly accounted for.