Computational Study of Electromagnetic Exposure of Military Personnel in a Humvee

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Electronic Attack (EA) antennas in the HF-VHF range are quite large. Thus, having large visual and radar signatures. An interesting approach to conceal those antennas is to evaluate the bottom side of the vehicle as a suitable antenna location. The output power of vehicular antennas used for EA can be a few hundred watts, therefore they produce strong electromagnetic radiation which can be dangerous for vehicle crew members. Electromagnetic (EM) exposure can provoke physiological and thermal effects, and has recently been considered as possibly carcinogenic. The Federal Communication Commission (FCC) has set limits of exposure to assure the safety of the general population against harmful EM exposure. Thus, it is of interest to research if the military personnel exposure inside military vehicles is not exceeding those limits, what are the advantages of a bottom location of the antenna versus more common locations and if there are other ways to enhance their protection.

In this paper, we present the results of thorough computational studies of the EM exposure on vehicle crew caused by ideal point sources and more realistic antennas used for EA and communications. To do so, we calculate the electric field inside the vehicle and use FCC exposure limits in terms of maximum electric field intensity to assess the radiation effect. The modeling is based on method of moments, and results are validated with the finite element calculations. The studies consider antenna positions on top, rear and the bottom of vehicle. Also, four different types of flat grounds including PEC, asphalt, dry sand and wet soil are evaluated. Results show that at some frequencies the electromagnetic field couples well to the interior of vehicle. Moreover, it is seen that these frequencies are well correlated with the vehicle's eigen frequencies. Results also demonstrate that there is a frequency range where the coupling to the vehicle's interior is the lowest when the antennas are placed at the bottom side. This points to the potential usefulness of bottom side for EA antennas. The analysis of the near fields reveals that most of the energy concentrates near the windows and also points to the importance of using window bars and reduced window sizes for screening of the EM field from inside. Finally, we give an estimate of maximum accepted powers by the antennas that produce fields that fall under the FCC exposure limits at HF and VHF frequencies.