

Electromagnetic field interaction with modern vehicles: application of the Method of Moments

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Modern cars exhibit complex electrical and electronic systems. As a result, electromagnetic compatibility is becoming an important issue in vehicle engineering. The use of numerical simulation seems to be a powerful tool and a viable alternative for the further study of these phenomena. However, a practical difficulty in building simulation models of vehicles is the model complexity. Additionally, the detailed geometry of the car might not be available at the time when modeling is required. The aim of this work is to analyze the effect of the presence of a vehicle body-shell, at two levels of complexity, on a simple cable harness installed following an approximate path of the real car cabling. A further understanding of the effect of the geometry of the car and its complexity may lead to simpler simulation tasks and better protections for the onboard electronic equipment.

Experimental results:

The analysis is based on experimental results obtained using the VERIFY EMP simulator belonging to the Swiss Defense Procurement Agency (Spiez) which generates a vertically polarized electric field with a rise time of 0.9 ns and an FWHM of 24 ns. A simple vehicle model (essentially the body shell, with and without all doors) and a simple harness composed of single wires were used for the tests. Measurements of electric and magnetic fields within the vehicle, as well as induced currents on the harness were performed, considering two types of illumination (front and side) and different harness terminations. It is shown in particular that the vehicle body-shell does not represent a perfect shield, isolating cabling and electronic equipment installed from the action of external incident electromagnetic fields. The observation of experimental data shows in particular that the presence of the car may result in an enhancement of the induced current in the wiring system. In fact, the interaction of electromagnetic fields with the cable harness installed in the vehicle is a very complex problem, which requires significant quantities of data for further observation.

Numerical modeling:

Several numerical methods are available for solving electromagnetic problems. In this work, in particular, the Method of Moments is described and its implementation on parallel computers is tested for complex cases by the use of a parallel version of the software NEC (Numerical Electromagnetics Code) recently developed at the EPFL. The reasons that force to use a parallel approach for complex simulations are described in detail.