EMC Simulation Using Source Reconstruction

A. Bergqvist[1], P. Jacobsson[1]

[1]Volvo Cars, Gothenburg, Sweden

Abstract

Electromagnetic compatibility (EMC) is a growing issue in cars due to the increase in electrification of vehicles. Simulations can be useful for predicting issues at an early stage in the development cycle. This includes investigating EM stray fields that various components generate and are themselves exposed to. However, the situation is made more complicated by the fact that in many cases, component suppliers will not share such data as CAD models, excitations, or material properties. On the other hand, they can sometimes instead provide EM field values in a set of points, determined from either measurements or simulations. A possible way of utilizing this information in simulations would be to use the point cloud to set a magnetic field boundary condition, however this has two major drawbacks: It imposes major restrictions on how the points must be distributed and it does not take into account that other components in the vicinity can affect the magnetic field, making the boundary condition invalid.

In this work, we explore a different approach and use the fact that the field generated by coil currents, induced currents, magnetic materials, etc., can be represented by a set of magnetic dipoles. We can therefore use optimization techniques to determine the distribution of dipoles generating a magnetic field that best matches that of the point cloud. This technique is also used in medical applications such as magnetoencephalography. The set of dipoles can then be used as black box model of a component in COMSOL Multiphysics® in order to simulate the field it exposes other components to.

The best dipole distribution can be found using a tool such as MATLAB® or Python that supports optimization. The resulting set of dipoles can then be imported into COMSOL Multiphysics® where it is used as a source and can be combined with other objects for which a 3D model may be available. Simulations are typically done in the frequency domain with the Magnetic Fields physics interface. Thin metallic sheets are often present and their shielding effect conveniently handled with a dedicated surface boundary condition.

A test case has been set up using a wireless charger as example. A set of magnetic dipoles arranged on a grid was given and their respective dipole moments found from a least square fit to magnetic field values in a point cloud. Simulations using the dipole source are compared to results when using the actual 3D geometry, including coils, ferrite plates and aluminium shields.

Results show a reasonably good match and indicate that this is a viable method for performing EMC studies when detailed component data is unavailable.

Figures used in the abstract

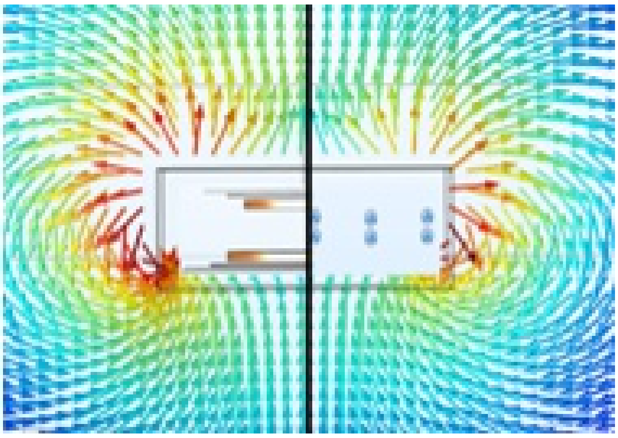

Figure 1: Magnetic field from full 3D geometry of wireless charger (left side) compared to field from grid of magnetic dipoles (right side).