A New 3-D MoM-Based Code for Solution of EMC Problems in Vehicle Design

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EMC problems have become recently one of the most important problems in vehicle design. This is due to the dramatic increasing of the number of antennas, electronic devices and cables in the modern vehicles resulting in extra EM radiation and interference between the signals. An examination of vehicle EMC performance has become therefore mandatory both to evaluate the proper operation of vehicle EM tools, and to protect the vehicle driver and passengers from undesired radiation and electronic fails.

Numerical simulation of EMC problems is nowadays the more and more realistic alternative to the expensive experiments. The Method of Moments (MoM) is now the most popular technique for EM treating of 3-D structures. However, the usual MoM-based 3-D EM packages, such as MININEC, NEC, ESP, CONCEPT, FEKO, are not specialized, or only partially oriented to analyze specific EMC problems, especially those for structures having combination of large and extremely small dimensions (i.e. car body and cable harness). In most such cases circuit-level considerations are also important to model realistic situations, and EM code should have interfaces for hybridization with circuit solvers.

In this contribution, a new 3-D MoM based code named TriD with both EM and EMC features is supposed to ensure EMC calculations in vehicle design, especially in those encountered in automotive industry. EM core of TriD is based on MoM solution of Electric Field Integral Equations (EFIE) for surfaces and wires using well-known Rao-Wilton-Glisson triangular basis functions on triangular patches, axial triangular basis functions on wire segments, modified transition basis functions on wire to triangles junctions, and special basis functions on grounded wire segments.

TriD EM features allow treating of arbitrary, in principal, 3-D geometry exposed by excitation sources, with accounting for finite conductivity of wire segments. TriD EMC features allow performing multi-frequency field calculations and MoM hybridization with Multi-conductor Transmission Line (MTL) technique using frequency decomposition/ assembling procedures and multi-frequency description of excitation amplitudes.

The created code has been validated both on experimental and comparison data with other codes for the particular EM problems on canonical and realistic geometries. The possibilities of TriD to effectively solve the fundamental EMC problems on the construction of the modern car will be demonstrated. The features of MoM hybridisation on car susceptibility (immunity), cross talk (coupling), radiation (emission), and antenna engineering problems will be discussed.