COMBINATION OF A 3D HYBRID TECHNIQUE AND A CABLE-NETWORK COMPUTER CODE TO MODEL EM COUPLING ON A COMPLEX WIRING

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In the past 10 years, multiconductor transmission-line (TL) models introduced in BLT-like cable-network equations have proved their efficiency to describe EM coupling on realistic cable harnesses (J.P. Parmantier and al., Interaction Notes 506, 1996). In addition field-to-TL theory provides a very suitable technique to handle complex multiconductor cables in 3D geometry through the combination of a 3D code (solving Maxwell's equations) and a cable-network computer code (J.P. Parmantier and P. Degauque, Modern Radio Science, 151-177, 1996). The interest is that the source terms introduced in the TL model come from the distributed incident fields, that is to say, the fields in the absence of the wires on the running path of the wires. This property has two main advantages. First, it allows one to consider multiconductor cables, which would not be possible with a 3D code alone. Second, since the fields are calculated without the wires, the time-consuming 3D calculation can be made once. Then, with the same equivalent generators, any kind of electrical modification can be applied on the wiring model (terminal loads, number and type of elementary cables …), provided that the running remains the same.

For 3D EM-coupling computations, FDTD techniques are widely appreciated for their robustness and capability to handle large size 3D geometry. However, applying field-to-TL with FDTD is tedious because of the intricacy to position the wiring paths in the imposed rectangular mesh. Especially in some situations where the surfaces of the 3D object does not follow the grid of the mesh, running wires close to the surfaces is sometimes impossible, even with field interpolation. An hybrid 3D technique where the FDTD calculation keeps being made in free space and a Finite Volume (FV) calculation is made around the surface of the object allows one to conciliate both the previously mentioned advantages of FDTD and the precise surface description of the 3D object requirement.

The European project called GEMCAR developed within the 5th framework growth (land transport) involves MIRA, FORD and QINETIQ (UK), ONERA, EADS CCR and CETIM (France), EPFL (Switzerland), HEVROX (Belgium) and VOLVO (Sweden). The final objective of the project is to build an EM modeling guideline dedicated to automotive industry. Therefore, different computer techniques are assessed and compared with measurements performed on increasing complexity of car geometry. ONERA applies the field-to-TL approach based on the combination of the EIVE FV/FDTD hybrid computer code and the CRIPTE cable-network computer code. Particularly, the use of Agrawal's model offers a very simple tool compared to Taylor's or Rachidi's since the equivalent generators are directly equal to the electric fields tangent to the wiring path. Figure 1 shows the exchange FD/FV hybrid mesh around a car model. Plots in figure 2 give a good idea of the accuracy one may expect from this approach up to 1 GHz.

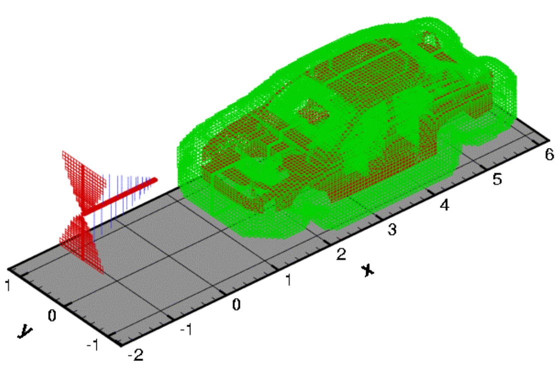

Fig. 1 : exchange mesh layers for the FV/FDTD hybrid calculation (credit GEMCAR)

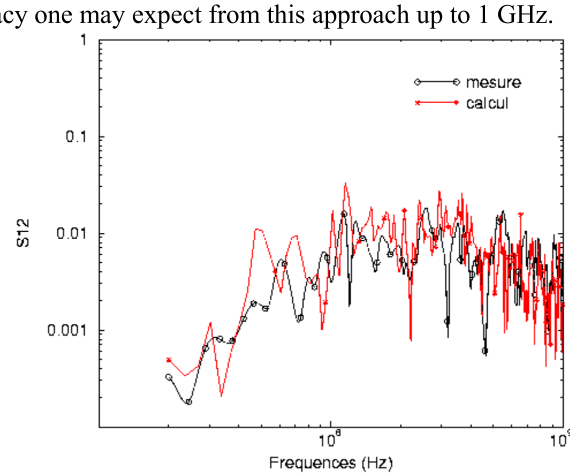

Fig.2 : measurement / calculation comparison of a wire response for a biconilog antenna illumination