A Strategy To Assess High Frequency Coupling Mechanisms in Complex Systems

I. Junqua*, J-P. Parmantier, F. Issac, L. Guibert, H-J. Mametsa
ONERA/DEMR/CDE
BP 4025, 2 avenue Edouard Belin
31055 TOULOUSE CEDEX FRANCE
E-mail: isabelle.junqua@onera.fr

Although the coupling of an electromagnetic (EM) wave with any system can be theoretically modeled thanks to Maxwell's equations, this brute force approach may become tedious in the case of high frequency incident electromagnetic environments. Even if applicable one day, deterministic methods are likely not to cope with the high sensitivity observed in real cases, due to the not fully controlled distribution of internal geometry configurations.
An alternative strategy to face the whole problem consists in splitting it into elementary problems as usually done in Electromagnetic Topology. Each elementary problem is solved with the most appropriate numerical methods which can either be full waves methods or semi-statistical methods:

- local external electromagnetic environment in the neighbourhood of potential points of penetration inside the structure is obtained thanks to asymptotic methods (H-J Mametsa, S. Laybros & Co, PIERS Conference, March 2004),
- the internal electromagnetic environment is derived from a macroscopic approach based on the analysis of transfer of energy inside the structure (I Junqua, J-P Parmantier, F Issac, Electromagnetics October 2005, pp 603-622),
- coupling with cables and equipment are evaluated by combining a full wave model and a statistical representation of internal electromagnetic environment through the theorem of reciprocity (C Fiachetti, F. Issac & Co, IEEE Symposium Montreal, August 2001).

The potentiality of this strategy will be shown through an example of application on a generic missile (GENEC). We will also discuss the application domain and prospects of this strategy.

The authors wish to thank the French Mod (DGA/CEG) for supporting part of this work.