FETD vs. FDTD : Application to a Large Building Illuminated by an EMP.

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***Abstract*— Maxwell's equations can be solved with the method of Finite Elements in Time Domain (FETD) based on the Discontinuous Galerkin (DG) principle. This method offers a very interesting alternative to the well-known technique of Finite Difference in Time Domain (FDTD), in particular the possibility to take local, spatial and time approximation which allows us a gain in CPU time and memory storage for large configuration. This new numerical technique is used to compute electromagnetic (EM) constraints in a large building illuminated by an EM pulse. The results are compared with the FDTD simulation. A critical review of advantages and drawbacks of both methods will be presented.**

Keywords- EMC; 3D Electromagnetic Code; FDTD; FETD; Materials, Discontinuous Galerkin Technique; EMI; EM Coupling, Building.

I. FETD METHOD

In this paper, the new FETD technique [1] using the Discontinuous Galerkin technique will be presented. The presentation is mainly focused on the different theoretical models used during this work, like materials, local time stepping and others different aspects (meshing accuracy, spatial and time local strategy for memory and CPU time gain, etc.).

II. FDTD METHOD

For many decades, the FDTD method [2] is widely used to compute EM fields or currents on wire inside structures illuminated by a plane wave (e.g. aircraft, buildings etc.). This numerical method is robust and simple. In addition, it is relatively CPU and memory efficient.

III. TIME DOMAIN RESULTS COMPARISONS

The FETD code is used to compute EM fields inside a building (≈ 10m x 9m x 11m). This building is made of concrete walls (20cm thick), thermo shielded glass, thin sheets of imperfectly conductive materials, metallic equipments and wires. It is illuminated by a plane wave. The same configuration is simulated with a FDTD method.

"Fig. 1" shows that the results provided by the two methods are very similar. *"Fig. 2"* is a more advanced output of the FETD, showing the electric field scattered by the walls, and equipments.

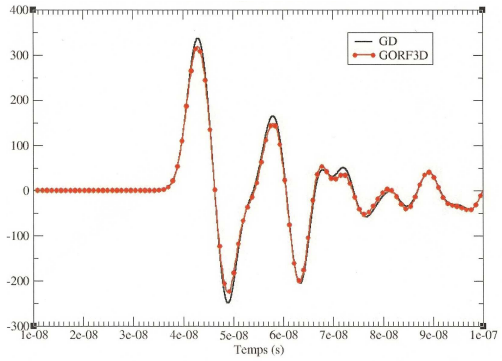

Figure 1. Electric field versus time computed in a point located at the third floor. GD of ONERA (FETD method) – GORF3D of CEA (FDTD method).

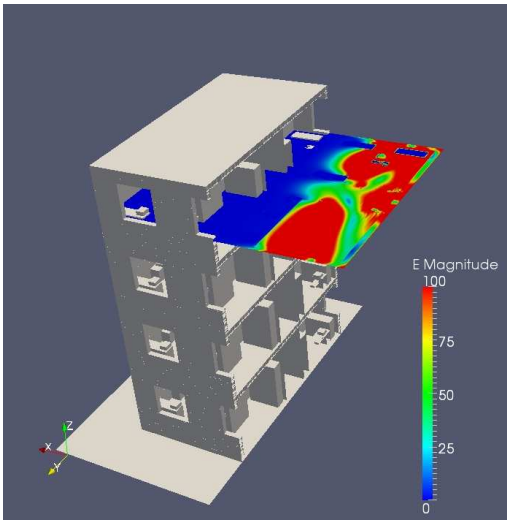

Figure 2. EM field 2D map.

REFERENCES

[1] G. Cohen, X. Ferrieres, and S. Pernet, "A Spatial High Order Hexahedral Discontinuous Galerkin Method to Solve Maxwell's Equations in Time Domain" Journal of Computational Physics, 217, pp. 340–363, 2006.

[2] A. Taflove, S. C. Hagness, "Computational Electrodynamics: The Finite Difference Time Domain Method – Third Edition" Artech House, 2005

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