EMC on Large Aircrafts: Computer Simulations to Assist a Full Scale Experiment

Jean-Pierre Adam, Stéphane Vauchamp
CEA, DAM, GRAMAT, F-46500 Gramat, France
jean-pierre.adam@cea.fr

Abstract— This paper presents the importance of computer simulations for an EMC experiment applied on large aircrafts. An FDTD simulation tool has been used to assist the design of the illumination system and to define how it could be used.

Keywords— EMC, aircraft, FDTD simulation.

I. INTRODUCTION

The system presented here is very similar to the Artemis facility presented in Ref. [1]. It meets the same requirement: estimate the EMC coupling of large structures to assess the environment of critical components located inside those structures. The elongated shapes of the fuselage and the wings of an airliner may significantly resonate at the lower frequencies of the spectrum, but mainly for a horizontally polarized illumination. However, the Artemis facility is limited to vertical polarization. That is why a new illumination system with a horizontal polarization was needed.

II. ILLUMINATION SYSTEM

As shown on Fig. 1, the illumination system uses two very common antennas. These antennas have been simulated with the Gorf3D solver, based on the Finite-Difference Time-Domain Method (FDTD).

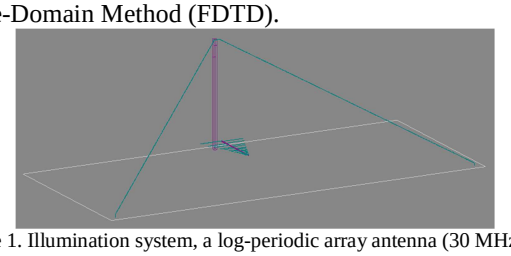

Figure 1. Illumination system, a log-periodic array antenna (30 MHz – 500 MHz) below an inverted V antenna (1MHz - 30 MHz).

III. SIMULATION OF THE ENTIRE EXPERIMENT

A test model of a particular jet has been deduced from publicly available data, common aircraft communication antennas and reasonable assumptions on cables paths and on doors joins. Fig. 2 presents the final FDTD meshed model. Two configurations have been simulated: first a plane wave illumination in free space which is the desired result, second the actual illumination system on the ground which is the measurable configuration.

This study has been carried out for the DGA.

The latter configuration required a large amount of computer resources. The mesh has to be fine enough to accurately simulate the highest frequencies. A total of about 6 billion of cells were needed. An example of output is presented in Fig. 3.

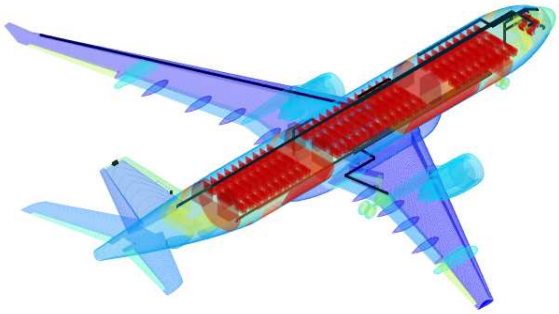

Figure 2. FDTD model including inner structures, materials, antennas, doors and cables.

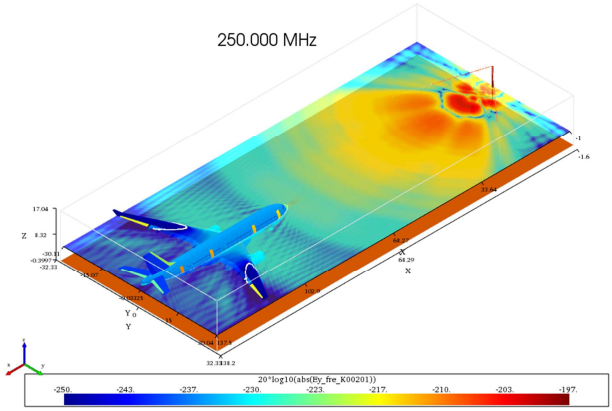

Figure 3. E field map at 5 m above the ground for the entire experiment where the aircraft is located at 80 m from the illumination system.

IV. CONCLUSION

The computer simulation of an entire EM coupling experiment including the illumination system and the target was possible thanks to the increase of computational power and to the improvement of software functionalities. This could be very helpful for the design and the post-processing (for example Ref. [2]) of an EMC study applied on large aircrafts in a short timeframe.

REFERENCES

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