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INTRODUCTION OF AN OBLIQUE THIN WIRE MODEL IN THE FINITE VOLUME SCHEME FOR LOW-FREQUENCY EMC APPLICATIONS WITH COMPLEX GEOMETRIES

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Precise methods for calculating the current on wire structures are essential in EMC simulations to assess systems struck by lightning. At present, Yee's method is the most popular scheme used to solve Maxwell's equations in the time domain to calculate EM fields while Holland's wire model [1] is used to calculate currents.

The fact that the Yee's scheme computes the fields on a Cartesian grid becomes problematic when dealing with curved geometries. Indeed, wires can have an oblique shape [2] in this scheme, however curved structures are always represented by a staircase mesh which can induce errors in the EM fields calculated in the vicinity of the materials' boundaries. In order to overcome this problem, an unstructured mesh is proposed to represent these structures. A few other selected techniques were designed to resolve this matter. These would include : the conformal FDTD method, the finite integral method (FIT), the finite volume scheme (FV) and the discontinuous Galerkin method (DG). The latter two have yet to be coupled with Holland's model.

At Onera, various strategies have been tried to solve our EMC problem. The coupling of the DG method with the thin wire model was attempted but the latter encountered computational difficulties that are yet to be handled efficiently. As a result, the finite volume scheme (FV) was chosen with the aim of simplifying the task. Until now, the scheme has been coupled with the thin wire model only for wires located along the edges of the mesh [3]. This model has a considerable constraint.

This paper proposes an oblique thin wire model that will be independent of the edges of any unstructured mesh for a FV scheme. The principles of the model will be given as the quality of its performance when comparing its results within various configurations with the FEM and FDTD approaches.

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