A free of parasitic solution implementation of Holland and Simpson thin wires in the FDTD grid

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The Thin Strut and Wire formalism published by Holland and Simpson (IEEE *Trans*. EMC, vol. 23, 1981) was a promising technique to account for arbitrarily thin wires in the FDTD method. This is a desired feature in many applications of the FDTD method. The formalism was presented with wires parallel to the axes of coordinates, but it had the potential of dealing with oblique wires. However, implementation of oblique wires has been a challenging question because of the presence of spurious parasitic solutions that may pollute the physical solutions. Three papers in the literature proposed implementations of oblique wires, but the question of the parasitic solutions was not analyzed, and why the proposed implementations do not suffer from this drawback, if they do, was not addressed.

In this paper the parasitic solutions will be analyzed. It will be shown that they originate in the distribution of the wire currents in the FDTD grid which may violate Physics, more precisely, the distribution may create artificial charges in the FDTD grid. From this, the solved problem is not the original physical problem, and consequently the computed solution is not the right one, a parasitic solution is added to the physical solution.

Once the origin of the spurious solutions was understood, a new implementation of oblique wires that does not violate Physics, i.e. that does not create artificial charge, has been encoded. Numerous experiments will be shown to demonstrate that the implementation is free of spurious solution, as expected, and that its accuracy seems similar to that of the previously published implementations.