**Benchmarking Full Wave Analysis of Periodic Structures: Non Perpendicularity at Periodic Boundaries**

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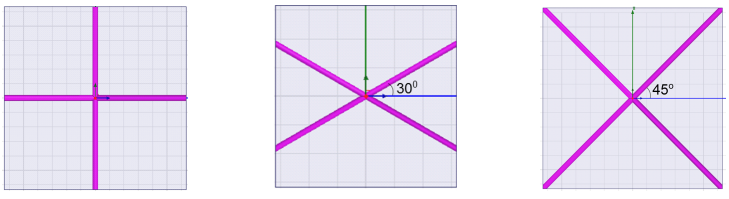
The floquet theory allows one to predict the behavior of a periodic structure by analyzing only a unit cell. This paper specifically focuses on a particular type of unit cell architecture, where the unit cell structure does not terminate perpendicular to the walls of the periodic boundary (for example, a cross shaped unit cell, as shown in Fig. 1b and 1c). Such situations commonly arise while analyzing periodic structures such as complex knit mesh for deployable reflector antennas, sophisticated Electromagnetic Band Gap (EBG) structures with connected elements, etc. Solving such problems is a computational challenge and can be a valuable tool for benchmarking existing and future EM softwares dealing with complex periodic structures.

As a representative example, we start by analyzing the simple wire grid model (Fig. 1a) in various solvers and compare it with the analytical Astrakhan's formulation. For this case, the unit cell structure terminates perpendicular to the walls of the periodic boundaries. Following this, we rotate the unit cell to make it diamond shaped, which results in non perpendicular contacts to the walls of the periodic boundaries. Representative cases are shown in Figs. 1b and 1c. It was observed that some codes cannot handle this diamond shaped unit cell directly. Adding small perpendicular stubs at the ends of the structure to ensure that the edge terminates perpendicular to the boundary is a possible solution. However, in case of periodic structures like complex knit models, this can be time consuming.

We provide an in depth analysis of this problem. Special attention is paid to the way different softwares handle the meshing of this structure, since it is critical for the master and slave boundary to match perfectly for floquet analysis. This work will provide EM solvers with viable and simple structures to benchmark their performance, making full wave simulations of complex periodic structures more reliable.




(a) (b) (c)

Figure 1: Representative cases to benchmark EM softwares. (a) Simple wire grid model (perpendicular termination at the periodic boundaries) (b) 30° rotated wire grid model (non perpendicular termination at the periodic boundaries) (c) 45° rotated wire grid model (termination at the corner of periodic boundaries).