Modeling of EBG Structures Using the Transmission Matrix Method

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Electromagnetic Band Gap (EBG) structures have been employed in noise suppression schemes for mixed signal applications [1]. The design and modeling of these structures typically requires the use of full-wave solvers to characterize their frequency response. However, this can be computationally expensive. In order to reduce the analysis time, the use of a model based simulation tool such as the Transmission Matrix Method (TMM) [2] has been suggested. TMM subsections a given structure into square 'unit cells' and develops an equivalent RLGC netlist. Modeling large plane like structures using this technique has been shown to be very accurate. However, for structures such as the Alternating Impedance (AI) EBG, it was found that simulation results from TMM showed discrepancies from measurement. This was attributed to the Fringe and Gap effects. Thus, accurate simulation of the AI EBG requires the inclusion of these effects into TMM.

The fringe effect can be modeled by adding a fringe capacitor, C_f, and a fringe inductance, L_f, to unit cells that lie along an edge. The fringe elements, C_f and L_f, are calculated by employing empirical formulas for microstrip structures. The Gap effect is modeled as a gap capacitance, Cg, which is added to nodes that lie on either side of an edge. Cg is extracted from the 2D field solver Ansoft Maxwell.

The model to hardware correlation, with and without inclusion of Fringe and Gap Capacitance is shown in Fig. 1. It is seen that the inclusion of Fringe and Gap effects leads to accurate prediction of bandwidth and isolation levels.

The fringe effect is especially pronounced when there are narrow connections between two plane patches. The gap effect becomes important as two separated patches get closer. Hence, both these effects become important to analyze an EBG structure. With a simple extension of TMM to include fringe and gap effects, such complicated structures can be analyzed very efficiently and accurately.

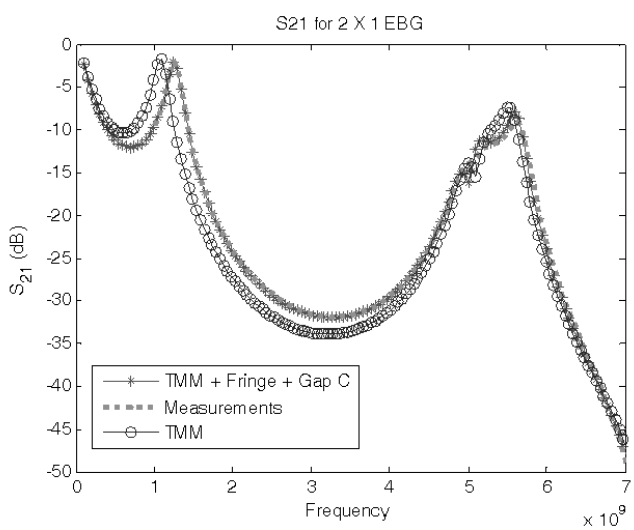

Figure 1: Model to hardware correlation.

REFERENCES

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