Analysis of Coupling Effect for Multi-Layered Composite Material with Periodic Structure

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***Abstract*— This paper brings efficient approaches for characterizing electromagnetic coupling into multi-layered composite material with periodic structure. In order to efficiently analyze the coupling effect, analytic method as boundary value solution, periodic structure analysis, and extraction method of material properties are combined together and implemented successfully. The accuracy of the proposed method is verified from the comparison of full-wave simulation result. It is shown that the proposed method is time and cost effective.**

Keywords-composite material; multi-layered structure; periodic structure; extraction;

I. INTRODUCTION

A composite material in aircraft structure is used in the form of a multi-layered structure such as composite material layer with core layer and combined with frequency selective surface (FSS), honeycomb, slot, and etc. These are difficult to define about dielectric properties and its analysis is also not easy because of different types of multi-layered structure. The multi-layered structure which is possible to know its dielectric characteristic of each layer, it can be mathematically performed with analytic method such as boundary value solution and recursive method [1],[2]. However, analytic method has certain limitations for multi-layered composite material with the arbitrary geometries. Limitations of numerical methods used in multi-layered structure, when each layer in the multi-layered structure is changed, mesh in numerical methods should be regenerated for the whole structure.

In this paper, we propose efficient approaches for the electromagnetic coupling into multi-layered composite material with periodic structure.

II. COUPLING EFFECT

Fig.1 shows the flow for analysis of multi-layered composite material with periodic structure. The boundary value solution, periodic structure analysis, and extraction method of effective permittivity and permeability of material are combined together. The accuracy of the proposed method is verified from the comparison of full-wave simulation result. As shown in Fig 2, good agreement was obtained from the full-wave simulation.

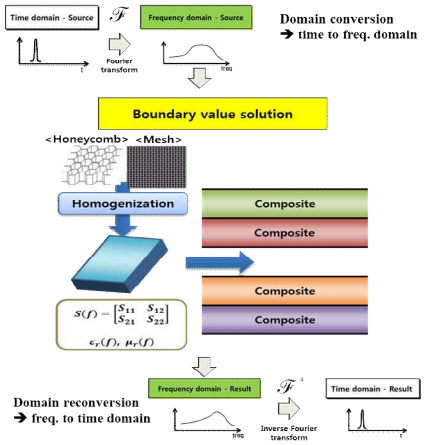

Figure 1. Flow for coupling effect analysis of composite material with periodic structure.

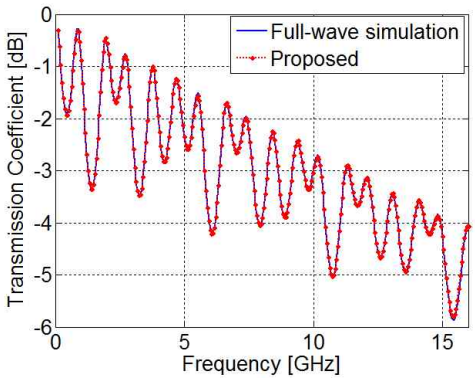

Figure 2. Comparison of proposed method with full-wave simulation.

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REFERENCES

[1] Dennis J. Kozakoff, "Analysis of radome enclosed antennas," Artech House, 1977.

[2] H. Cory and C. Zach, "Wave propagation in metamaterial multi-layered structure," Microwave and Optical Latters, vol. 40, No. 6, pp. 460-465, March 2004.