On the circuit modeling of stacked closely spaced aperture-like FSSs

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1. Extended abstract

The modeling of periodic structures by means of the equivalent circuit approach has a long history and has provided a very efficient methodology to study a wide variety of structures. Artificial dielectrics, frequency selective surfaces (FSS), polarizers, fishnet structures, artificial surface impedances, and metasurfaces are good examples of this kind of electromagnetic systems. Although many commercial softwares allow nowadays for the characterization of these structures without the need of developing sophisticated analytical or quasi-analytical tools, the advantages of using approximate analytical models are undoubtedly evident. Analytical models provide very fast solutions that can be incorporated into optimization algorithms in order to design specific devices within a reasonable time span. More importantly, they shed light on the physics behind the obtained electromagnetic responses, thus helping the designer to conceive new structures and understand the underlying reasons of their performance. Due to this fact, the development of equivalent circuits accounting for the behavior of many of these periodic structures has regained popularity in recent years [1]. Some of the circuit models have been obtained by means of an *ab initio* procedure coming out from a simplified integral equation formulation [2]. When structures of this class, sharing the same lattice constants, are stacked forming a finite pile or an infinite periodic (along the propagation direction) medium, simple circuit models have also been employed by simply adding transmission line sections. These sections connect the equivalent admittances associated with each individual periodic metal grid or FSS (periodic in the transverse plane, perpendicular to the propagation direction). However, this approach is valid provided the electrical distance between individual grids is large enough to allow for neglecting high-order harmonic interaction. In this work, recent advances on this topic will be presented; in particular the case of closely spaced metal grids or aperture-like FSSs (which does involve high-order harmonic interactions). A systematic method to derive the suitable equivalent circuits is proposed. The method is introduced considering the case of one-dimensional [3] strip-like gratings, and two-dimensional [4] aperture-like structures will be later considered. The consequences of the presence of asymmetries in the stacked structure (such as the existence of metal grids/FSSs with different patterns or laterally shifted grids) will also be briefly discussed. The analytical results obtained with the equivalent circuit will be compared with full-wave data obtained with a commercial electromagnetic solver in order to verify the suitability of the proposed models.

2. References

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