MODELING PERIODIC STRUCTURES BY SPECTRAL-FDTD METHOD

Nader Farahat, Abraham Diaz, Daniel Santiago
Polytechnic University of Puerto Rico

In this paper we use the Spectral-FDTD [1] method to analyze periodic structures used as frequency selective surfaces (FSS). This method shows a significant advantage over the split-field method [2] for simulation of the incident illuminations close to the grazing angles. In split-field method, for which the angle of incident is fixed in each simulation the stability condition becomes a function of incident angle and thus the large time steps must be chosen in order to maintain the stability. Therefore the technique becomes inefficient for wide angles of incident. In the spectral-FDTD method, on the other hand, the wavenumber is fixed instead of the incident angle. Consequently in a single simulation different frequencies are impinging on the FSS with different angles. This allows one to simulate the wide angles of incident efficiently. However in the end an interpolation is required to map the data for certain wavenumer solutions to the angles of incident over the entire band of frequency. We use each node of 32-node Beowulf PC cluster for one wavenumber simulation and in the end we map the data from wavenumber-frequency plane into the angle-frequency plane using the interpolation. It seems that this technique can be used without instability problem for any wavenumber and easily obtain the results for the desired angular domain. However it should be noted that if one needs the response to one or two angles (especially close to normal incident) it is more efficient to use the split-field technique. The impedance and reflection coefficient of several periodic structures for different polarizations and angle of incident will be presented and compared with other techniques.

References: 1-Amir Aminian, Fan Yang, and Yahya Rahmat-Samii, Surface Impedance Characterizations Using Spectral FDTD Method: A Unified Approach to Analyze Arbitrary Artificial Complex Surfaces, 2004 URSI International Symposium on Electromagnetic Theory, Pisa, Italy, May 23-27, 2004. 2- P. H. Harms, A. Roden, J. Maloney, M. Kesler, E. Kuster, and S. D. Gedney, ”Numerical Analysis of Periodic Structures Using the Split Field Update Algorithm”, The Thirteenth Annual Review of Progress in Applied Computational Electromagnetics, Monterey, CA, March 17-21,1997

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1. (a)
   Nader Farahat
   Polytechnic University of Puerto
   San Juan, PR
   00919 USA
   nader.farahat@gmail.co
   (b) 787-203-3950
   (c)
2. B - Fields and Waves
3. (a)
4. C - Contributed Paper
5. No special instructions