Numerical Analysis of Finite Antennas Over Two-Dimensional Infinite Periodic Structures Using Method of Moments

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Two-dimensional periodic structures have been widely applied to phased array antennas, frequency selective surfaces (FSS), radio wave absorbers, or reflectarrays [1-3]. Size of the two-dimensional periodic structures is often much larger than wavelength and they are modeled as infinite periodic arrays via Floquet theorem. It is well-known that numerical analysis of the two-dimensional infinite periodic arrays can be performed efficiently by Floquet theorem because the two-dimensional infinite periodic arrays are reduced to so-called unit cell owing to Floquet theorem.

Although Floquet theorem is a powerful technique for modeling the two-dimensional infinite periodic arrays, efficient modeling of the two-dimensional infinite periodic arrays is still challenging when finite antennas are with them simultaneously. In previous studies, a couple of techniques such as an array scanning method (ASM) and a surface impedance modeling have been proposed for efficient modeling of the two-dimensional infinite periodic arrays with the finite antennas (or sources) [4-7]. Both of the techniques are applicable to numerical analysis of the finite antennas over the two-dimensional infinite periodic arrays, their applicability is quite limited because of difficulty in modeling of arbitrary shaped antennas for the ASM and in modeling of arbitrary shaped scatterers for the surface impedance modeling, respectively.

In this paper, a novel method of moments (MoM) for numerical analysis of finite antennas over two-dimensional infinite periodic structures is presented [8]. The MoM models the two-dimensional infinite periodic structures via reflection coefficients. The reflection coefficients of the two-dimensional infinite periodic structures are numerically obtained by a periodic MoM using Floquet theorem. In a similar manner with a layered media Green's function, a dyadic Green's function of a space with the two-dimensional infinite periodic structures is formulated approximately. Self/mutual impedance expressions between source and observation points are formulated using the dyadic Green's function and Rao-Wilton-Glisson (RWG) basis function. Numerical simulation is performed and it is demonstrated that the MoM can deal with the finite antennas over the two-dimensional infinite periodic structures efficiently.

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