Accurate Evaluation of the Reflection Dyad for an Infinite Array of Microstrip Patches

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Analysis and design of reflectarrays generally employ an infinite array model based on the assumption of local periodicity. The infinite array excited by a plane wave is formulated in terms of an integral equation for the induced current in the unit cell patch. The integral equation is solved by the method-of-moments. Previously it was shown that for very accurate evaluation of the reflection dyad, especially for thin substrates, entire domain sinusoidal expansion functions with edge conditions in both directions were needed (S. R. Rengarajan, IEEE Antennas and Wireless Propagation Letters, 4, 47-50, 2005). However, when one uses the surface impedance boundary condition to account for conductor loss in the moment method, terms containing the intrinsic impedance times the inner product of an expansion function and testing function for the current diverge if the edge conditions approach infinity.

Recently it was found that the evaluation of diverging integrals may be stopped at a short distance from the edge (S. R. Rengarajan and R. E. Hodges, National Radio Science Meeting, Boulder, CO, Jan. 2018) in a manner similar to a previous work (L. Lewin, IEEE Transactions on Microwave Theory and Techniques, 32, 7, 717-719, 1984). The stopping distance is determined by comparing the computed results with experimental or other known results. Such a method is found to work well for a range of parameters of the reflectarray such as the substrate thickness, permittivity, unit cell size, the angles of incidence as well as the polarization.

Generally moment method solutions exhibit good convergence for a Galerkin techniques, i.e., when the expansion functions are the same as the testing functions. We made some simple changes in the testing functions by dropping the edge conditions in the direction across the current flow direction. With this choice all inner products containing expansion and testing functions converged. We were able to evaluate the magnitude and phase of the reflection dyad very accurately. We will present results for a wide range of values of reflectarray parameters and compare the results with the previous method using the stopping distance for the diverging integrals.