On the Convergence of Method of Moment and Mode Matching for 2-D Planar Phased Arrays

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Analysis of large phased arrays is usually carried out using infinite phased array concepts using a unit cell structure with phase shift boundaries. The problem is either formulated in terms of two coupled integral equations to be solved by the MoM method (N. Amitay, V. Galindo, C. P. Wu, Theory and Analysis of Phased Array Antennas) or utilizing the mode matching technique (G.V. Borgiotti, "Modal analysis of periodic planar phased arrays of apertures" Proceedings of The IEEE, vol. 56, pp. 1881- 1892, Jul 1968). In these particular numerical solutions, the question of convergence will always be of concern. There is a number of seemingly independent parameters that one could increase in order to improve the accuracy while observing the convergence of the solution. These parameters are the number of selected modes per modal type (TE and TM) in each region namely, the feed "waveguides" region and the space region "Floquet region". The convergence criterion that has been used and suggested by many authors (A. Bhattacharyya, "On the convergence of MoM and Mode Matching solutions for infinite array and waveguide problem," IEEE Trans. Antennas and Propagation, vol. 51, pp. 1599- 1606, Jul 2003) in the literature is that the number of modes in each region should be proportional to the respective area.

In this paper, a detailed study of the convergence of Method of Moment/Mode Matching technique for a 2-D planar phased array is presented with the aim of investigating the effect of mode selection criteria on the convergence and the possibility of speeding up convergence. The previously mentioned convergence criterion will be re-visited. In this paper, we will take a planar array of rectangular slots as our test case. Detailed analysis of the reflection coefficient and surface currents in conjunction with edge conditions will be presented in detail.