

# FDTD STUDY ON REFLECTED WAVE DUE TO THE MICROSTRIP REFLECTARRAY

Maifuz Ali (1), Subrata Sanyal(2)

Department of Electronics and Electrical Communication Engineering.

Indian Institute of Technology, Kharagpur-721302,

India. Email. [maifuzali@ece.iitkgp.ernet.in](mailto:maifuzali@ece.iitkgp.ernet.in)

Parabolic and shaped-reflector antennas have long been used for fixed satellite service applications, now they are replaced by flat microstrip reflectarray. The usual microstrip reflectarray consists of an array of microstrip patches or dipoles printed on a thin-grounded dielectric substrate. A feed antenna illuminates the array and the individual elements are designed to scatter the incident field with the proper phase to form a planar phase surface in front of the aperture. The patches of variable size are used to control the phase. D. M. Pozar, S. D. Targonski, and R. Pokuls [1], Tsai, F.C.E.; Bialkowski, M.E [2] and others assumed a plane wave incident perpendicular to the reflectarray surface but this is an approximation, as the feed is in practice is in the fresnel zone region, as well as the incidence is oblique. To design of reflectarray, first we have to analysis and characteristics the reflected and diffracted wave both amplitude and phase, however, requires sophisticated modeling techniques because of complicated geometries and inhomogeneities involved. Thus this area poses a challenge to researchers to analyze and characterize them and thereby derives the parameters to help understand their operation/functions completely.

In this work we consider a plane wave propagating in an arbitrary direction and incidence on an element of reflectarray. The phased of the reflected wave is calculated, and it is varied according to the sized reflectarray element. For the smooth phase reflection curve two or three layer reflectarray surface is used but if we used inhomogeneous substrate with variable size of patches then we can get smooth phase reflection curve. Here the study has done on the reflected phase and amplitude due to a plane wave incident in arbitrary direction on various sizes of reflectarray element on various substrates. We have used FDTD with Unsplit PML for the whole analysis. A free space plane wave is generating in the middle of the problem space and in front of a microstrip reflector. This plane wave propagates in both the directions towards and away from the reflectarray. We have to generate another plane wave such that it completely absorbed the away part and does no effect on towards part of the plane wave. Now away from the middle towards opposite to the reflectarray, problem space is associated with only reflected and diffracted wave and there is no incident wave. In this space we can calculated both phase and amplitude of the six components of the reflected and diffracted field. The result is compared for the perpendicular incident case.

## **References:**

1. D. M. Pozar, S. D. Targonski, and R. Pokuls, "A Shaped-Beam Microstrip Patch Reflectarray", IEEE Trans. Antennas Propagat, vol. 47, pp. 1167–1173, July. 1999.
2. Tsai, F.C.E.; Bialkowski, M.E; "A unit cell waveguide approach to designing multi-layer reflectarrays of variable size patches"; Phased Array Systems and Technology, 2003. IEEE International Symposium on, 14-17 Oct. 2003 Pages: 476 – 481