REFLECTARRAY ANTENNA DESIGN FOR X-BAND APPLICATIONS

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REFLECTARRAY ANTENNA

Reflectarray antenna is a radiating structure consisting of an array of printed radiating elements which are reradiating the energy that is impinged on them from one or more illuminating feed antenna. They are manufactured on a planar substrate using printed circuit technology and offer the possibility of beam steering.

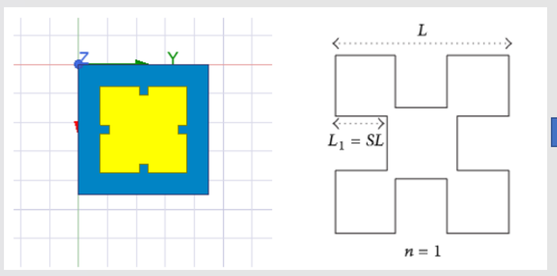
APPLICATION AREAS

The advantages of reflectarrays, such as low profile, lightweight, and conformal geometry, make it desirable for various communication systems, especially for those mobile platforms. Its applications in space exploration, satellite communications, remote sensing, and radar systems are rising up within the last decade, and will continue to increase in the future.

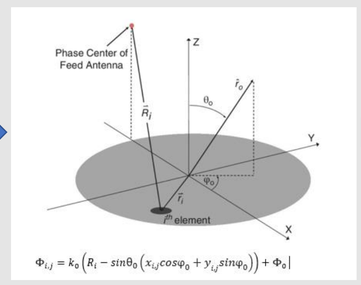
SOLUTION METHODOLOGY AND REFLECTARRAY DEDIGN

The process of reflectarray antenna design can be usually carried out into two separate steps: element design and aperture phase distribution design. In the step of element design, reflectarray elements need to be devised based on the requirements of phase range, element bandwidth, polarization and so on. Then the geometrical features of individual element in the reflectarray aperture need to be adjusted properly to match the desired phase distribution.

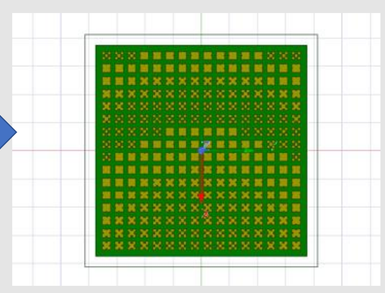
The element is designed using minkowski fractals. The size of the fractals are determined by scaling factor S and the variation of these fractals is providing phase tuning. Then periodic boundary conditions and floquet port excitation are applied to analyze the element. Phase tuning applied by calculating the required phase shift for each element. A model of reflectarray is created on HFSS and simulated using FE-BI boundary condition. In the simulation part antenna is tested for different thicknesses of the substrate. Also, the effect of horn antenna position on efficiency is observed. Finally, reflectarray antenna is fabricated and tested in the laboratory.



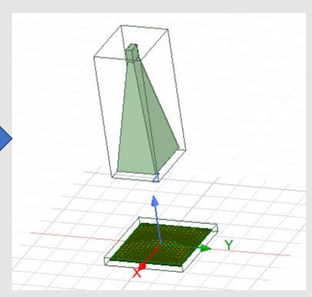
Step 1: Element design



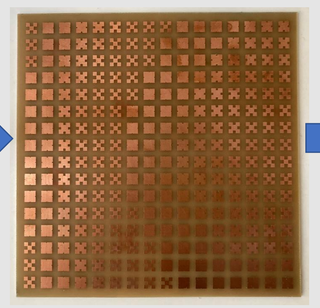
Step 2: Phase Tuning



Step 3: Modelling



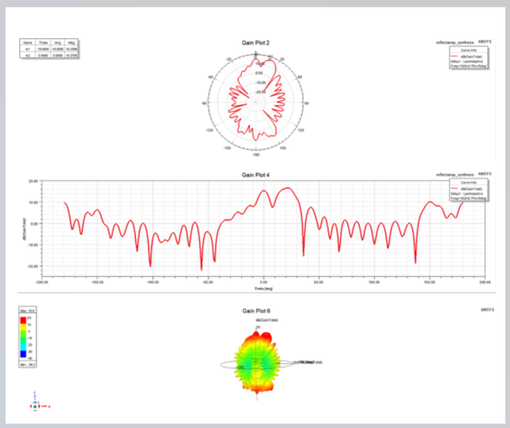
Step 4: Simulation



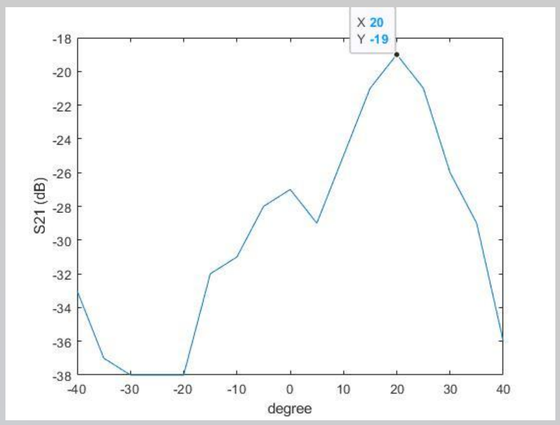
Step 5: Fabrication

Step 6: Testing

RESULTS AND DISCUSSION



Simulation results



Laboratory testing results

In the simulation part, 16.2596 dB maximum gain is reached at 20°. Higher gain values could be achieved by using a thinner substrate or by using a substrate with lower dielectric constant. Also testing results were matching with the simulation results. Overall, reflectarray is designed successfully and the testing results were matching with the simulation results. Also the maximum gain was satisfactory for an FR4 substrate and it is obtained at 20° as intended.

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ACKNOWLEDGEMENTS

This project was completed within the context of ELE401-402 Graduation Project courses in Hacettepe University, Faculty of Engineering, Department of Electrical and Electronics Engineering.
Special thanks to Prof. Dr. Birsen Saka, Nauman Naseer