



Reconfigurable Radiation Using Double Layered High Impedance Surfaces

K. Sanjeeva Rao¹, G. Gunasekaran²

Ph.D Student, Department of ECE, MAHER (Meenakshi University), West KK Nagar, Chennai, India¹

Professor, Department of CSE, Meenakshi College of Engineering, Chennai, India²

ABSTRACT: In the recent communication applications the need for antenna pattern synthesis and the radiation steering is very much desirable to deal with some of the problems in communications. Especially in the domain of multiplexing to give the same channel in multiple directions to get more efficient frequency spectrum appropriate adaptive antennas are desirable. In this paper we design a two-layered model of HIS to shift the radiation energy from $\theta=0^\circ$ to $\theta=45^\circ$ and 135° direction by using the rotation of inner hidden layer. And the radiation pattern is presented in the results.

KEYWORDS: Rotatable Patch, HIS, Radiation Steering, Two-Layer

I. INTRODUCTION

From past two decades High Impedance Ground planes proved very useful in enhancing the antenna parameters without changing the antenna physically. Due to its properties and TE and TM modes exhibiting in the presence of antenna [1]. It may enhance radiation pattern or absorb it. When placed as replacement for conventional ground plane it will suppress the surface wave propagation [9,10]. i.e from each unit cell to next unit cell the propagation of surface wave will degrade in turn it will be mitigated. It is found that the high impedance ground plane surface can act as the reflector medium when placed at one side of the antenna. And the way it enhances and reduces the radiation energy is explained in [1]. And it can also enhance the other radiation patterns as explained in [1,9,10]. And these artificial magnetic conductors are interesting materials in the research domain to obtain the adaptiveness of antennas. The two main scopes are to tune antenna frequency without changing its radiation. And to steer the radiation without altering its frequency. It is evident that when we alter frequencies the better explanation is frequency selective surfaces.

II. RELATED WORK

Up to now various models were introduced in the high impedance ground planes. Different shapes like square, circle, hexagonal etc are used as patches of the HIS. And some used the two-layered models for further enhancement of antenna patterns. Especially the frequency selective models with ring circle model are very useful. Various materials were used to design metallic plates of the HIS plane. Some exhibited better results than the existing ones. And in recent researches some attempted to modify the antenna parameters by changing the working of HIS electronically. In this some electronically variable diodes are used between the metallic plates when these biasing voltages are changed then the antenna radiation will reconfigure respectively.

III. PROPOSED MODEL

In the present paper we propose a new two-layered HIS to obtain radiation reconfigurability. Here the first layer will have pins at the corners and the second hidden layer has pins at the centre and which is rotatable. One unit cell will contain the four patches in the first layer and one in the second layer and the model is shown in the figure [1].

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

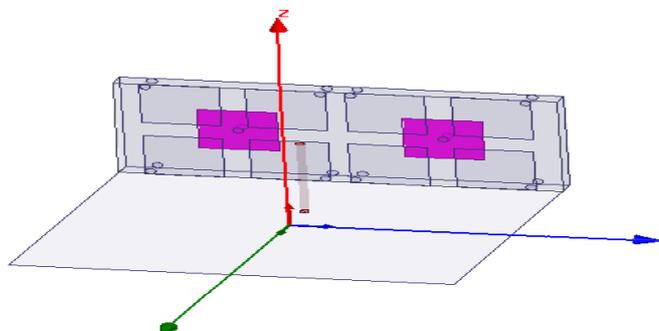


Figure [1] proposed model

In the above figure the highlighted patches are inner layer each unit cells is designed for 2GHz frequency antenna. And the antenna is monopole antenna with arm length 3.6cm and made with pec material operating at 2GHz.

Design considerations: 8.37×3.5 cm Base plane of HIS. 1.5×1.5cm Metallic patches. 0.5cm height and 0.1cm radius pin vias. Are used for designing the High impedance ground plane of two-layers.

IV.SIMULATED RESULTS

The proposed model is designed and simulated using Ansoft HFSS software and the simulated results are illustrated in the following.

Case 1: When two inner plates are kept unchanged and the HIS is placed at one side of the antenna then the radiation occurs as shown in the figure [2].

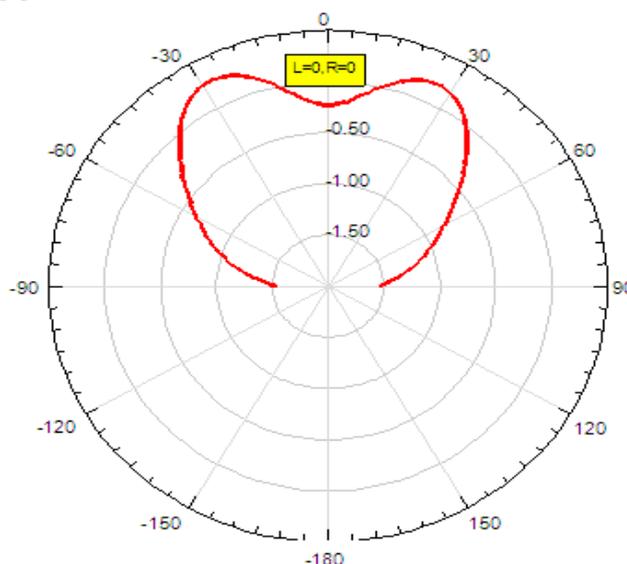


Figure [2] Radiation pattern when left and right side inner plates unchanged

Case 2: when the left side inner plate is rotated to 60° and right side plates is unchanged then the radiation patterns is shown in the figure [4].

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

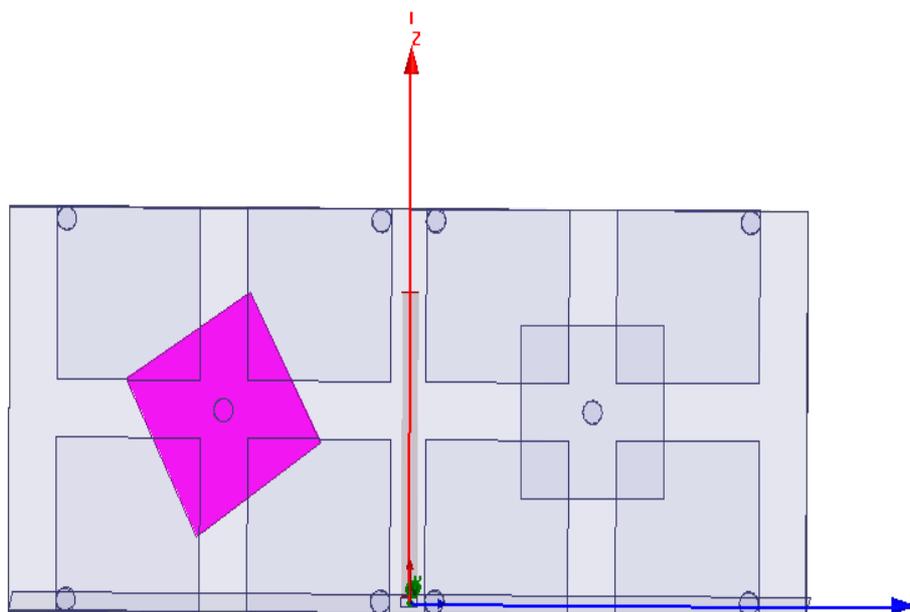


Figure [3] Proposed model Left side plate rotated to 60°

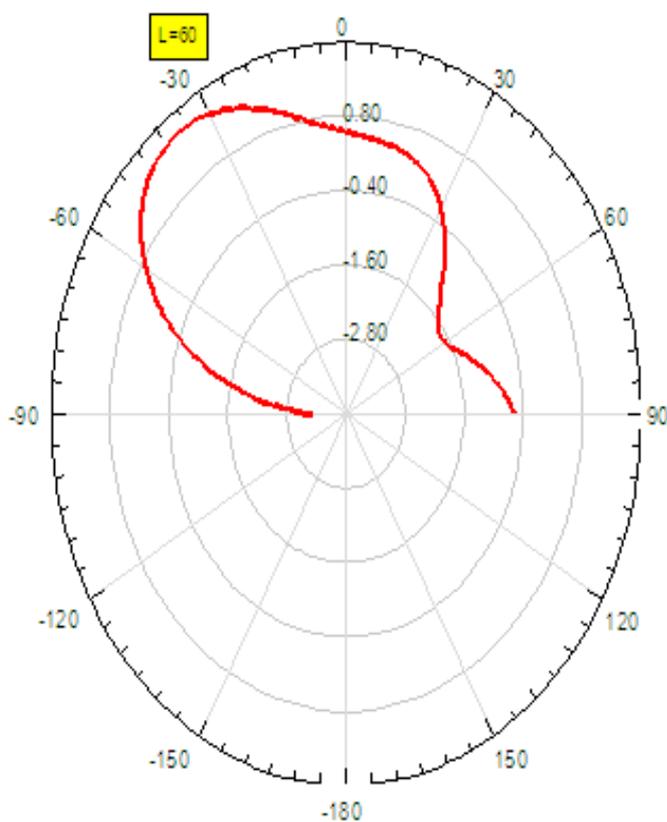


Figure [4] Radiation Pattern when Left plate rotated to 60°

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

From the above figure [4] we can clearly see that the radiation pattern is shifted to left side when the left plate is rotated.

Case 3: when the right side inner plate is rotated to 60° and right side plates is unchanged then the radiation pattern is shown in the figure [6].

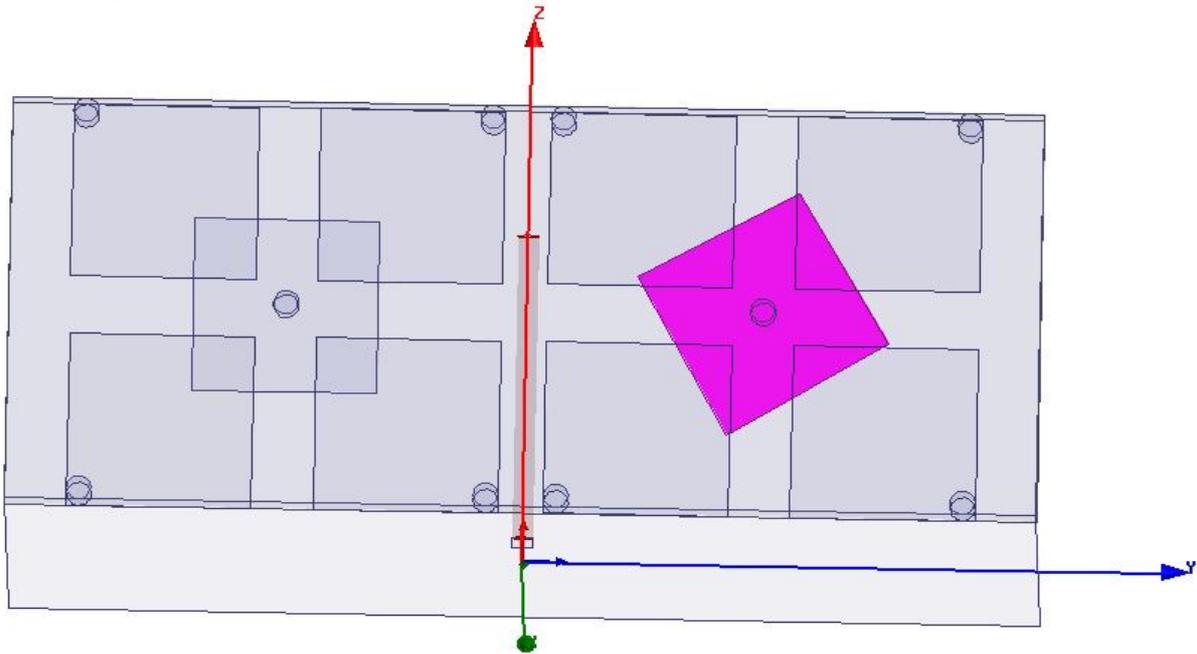


Figure [5] Proposed model Right side plate rotated to 60°

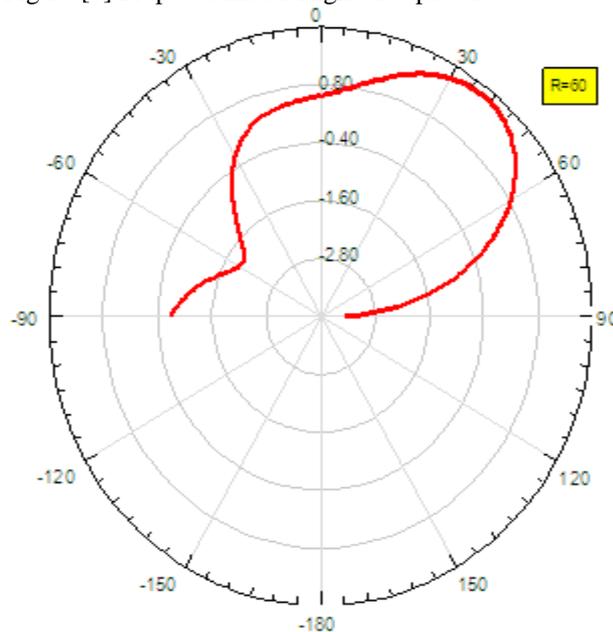


Figure [6] Radiation Pattern when Right plate rotated to 60°

From the above figure [6] we can say that the radiation reconfigured to right side when the right plate is rotated.

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

Case 4: similarly we perform the rotation of left and right plates simultaneously and the overall comparison is shown in the figure [7].

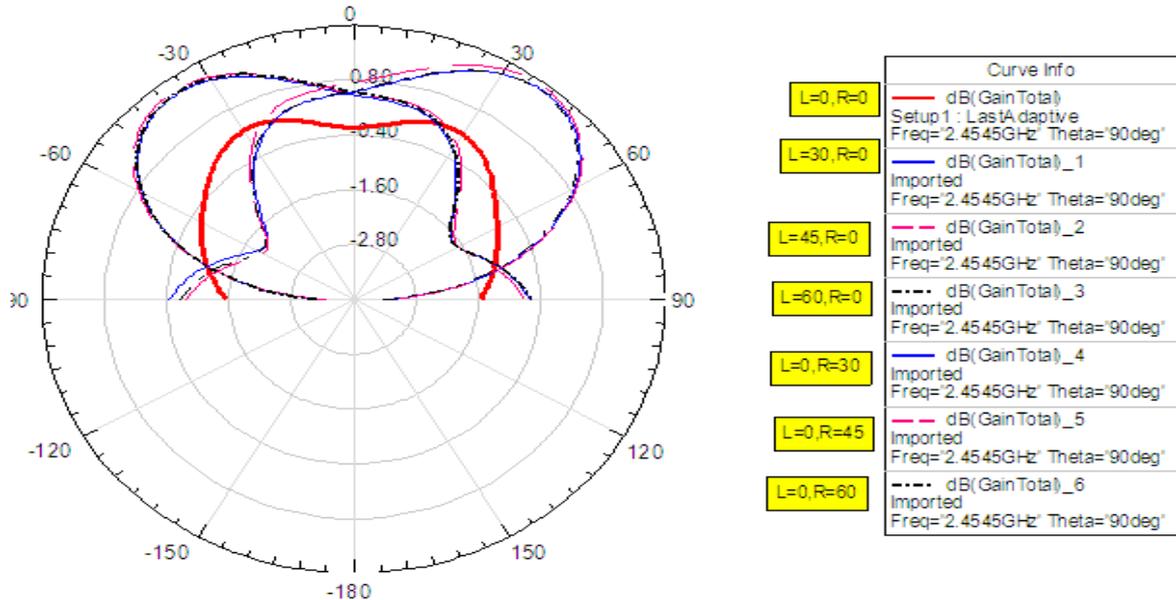


Figure [7] radiation reconfiguration when right and left side inner plates are rotated.

From the above figure we can say that when left side plate is rotated than the radiation will shifted to left side and when the rotation is changing the radiation will enhance in that direction up to some rotation and will again decreases after some rotation and vice versa.

V. CONCLUSION

This paper concludes the idea of radiation reconfiguration using the movable two-layered High impedance ground planes. By the rotation inner plates we can move the radiation to the desired direction. Here rotation of plates will change the phase of the radiation and results it into new direction as illustrated in the results.

REFERENCES

- [1]. J. Doondi kumar , —Analysis of Monopole Antenna by Placing High Impedance Absorber Surface at one Sid /Volume-2Number-1PP-317-321.pdf
- [2]. Filippo costa, An active High impedance surface for low profile Tunable and steerable Antennas, IEEE ANTENNAS AND WIRELESS PROPAGATION LETTER, VOL 7, 2008.
- [3]. Y. Kotsuka, M. Amano, —Broadband EM Absorber Based on Integrated Circuit Concep, Microwave Symposium Digest, 2003 IEEE MTTs International, Volume 2, 8-13 June 2003 Page(s):1263 – 1266 vol.2.
- [4]. C. Balanis, Antenna theory, Analysis, and Design 2nd ed., John Wiley and sons, New York (1997)
- [5]. Kern, D.J.; Werner, D.H.; Monorchio, A.; Lanuzza, L.; Wilhelm, M.J., —The design synthesis of multiband artificial magnetic conductors using high impedance frequency selective surfaces,IEEE Transaction on Antennas and Propagation, Volume 53, Issue 1, Part 1, Jan. 2005 Page(s):8 – 17.
- [6]. Sievenpiper, D. F., \High-impedance electromagnetic surfaces," Doctorate thesis, University of California, 1999.
- [7]. D. Sievenpiper, —High - Impedance EM surface, Ph.D. Dissertation, University of California, Los Angeles, 1999.
- [8]. D. Sievenpiper, E. Yablonovitch, U.S. provisional patent application, serial number 60/079953, filed on March 30,1998.
- [9]. J. Doondi kumar , Enhancing And Directing Radiation With Planar And Ebg Reflectors, IJERD : Volume 7, Issue 5.
- [10]. J. Doondi kumar , —Design and Analysis of C0-axial Feed Rectangular Patch Antenna on High Impedance Surfac /Volume-2Number- 1PP-405-410.pdf