Microstrip patch antenna using holographic structure for WLAN and Ku Band application.

I.Govardhani[1] , M.Venkata Narayana[2], Prof S.Venkateswarlu[3] K.Rajkamal[4]

1.Associate Professor, Department of ECE, K L University.
2. Associate Professor, Head of the Department of SED-1(ECE), K L University.
3. Prof and Head of the Department of CSE, Associate Dean Planning and Development.
4. M.Tech Thesis student. KLUniversity

ABSTRACT:

The microstrip patch antenna is a low-profile robust planar structure. A wide range of radiation patterns can be achieved with this type of antenna and, due to the ease of manufacture, is inexpensive compared with other types of antennas. However, patch-antenna designs have some limitations such as restricted bandwidth of operation, low gain, and a potential decrease in radiation efficiency due to surface-wave losses.

A holographic antenna inspired structure is used to control the surface wave (SW) excited by a microstrip patch antenna. The hologram is designed to support a periodic leaky-wave which radiates at broadside and enhances the radiation of the patch while suppressing the horizontal lobe. This is achieved by introducing dual phase-shifting metallic dipoles with periodic spacing's. In this paper my proposed work to verify the improvements in the gain, broadside gain and overall gain and reflection coefficient(s11) of SW efficiency of the micro strip patch antenna.

KeyTerms: **Microstrip antennas, microwave antennas, surface waves, Leaky wave antennas**.

1.INTRODUCTION:

A holographic antenna inspired structure is used to control the surface wave (SW) excited by a micro strip antenna. Unlike the electromagnetic band gap (EBG), the holographic structure is intended to provide radiative attenuation. In this design, the holographic approach is adapted for microstrip antenna applications. This is achieved by introducing dual phase-shifting metallic dipoles with periodic spacing. Using this technique, the SW is captured and re-radiated in a way that enhances the broadside radiation of the printed antenna while keeping radiation at the horizon low. I will show a systematic procedure to design structures of that type and will show validations of the design based on full-wave simulations and prototype measurements.

2. ANTENNA MODEL:

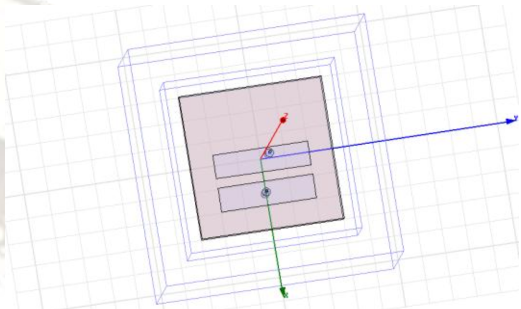

Fig1: Antenna Model.

3. ANTENNA DESIGN CONSIDERATIONS

A rectangular holographic micro strip patch antenna with Rogers RT/duroid5870(tm) substrate has been designed and simulated at dual frequencies those are 5.0503GHz and 14.3970GHz frequencies in this paper. dielectric constant (Єr) of substrate as 2.33 and loss tangent (δ) as 0.0012. 'L' is the resonant length of patch with 2cm, width of the patch 0.5cm and Height of the dielectric substrate should be in between 0.003 λ_0 and 0.05λ_0. We have taken 0.02 times of λ_0. As 50Ω coaxial cables are used normally, feed point is taken where 50Ω resistance occurs.

4.HFS SOFTWARE:

HFSS is a high-performance full-wave electromagnetic(EM) field simulator for arbitrary 3D volumetric passive device modeling that takes advantage of the familiar Microsoft Windows graphical user interface. It integrates simulation, visualization, solid modeling, and automation in an easy-to-learn environment where solutions to your 3D EM problems are quickly and accurately obtained. Ansoft HFSS employs the Finite Element Method(FEM), adaptive meshing, and brilliant graphics to give you unparalleled performance and insight to all of your 3D EM problems. Ansoft HFSS can be used to calculate parameters such as S-Parameters, Resonant Frequency, and Fields.

5.SIMULATION &ANALYSIS

5.1.RETURN LOSS:

It is a measure of the reflected energy from a transmitted signal. It is commonly expressed in positive dB's.The larger the value the less energy that is reflected.
The designed antenna is simulated using HFSS software. The results obtained are mentioned below,

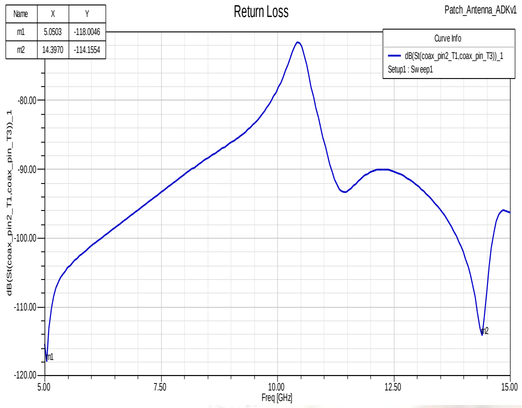

Fig2: Return loss.

A return loss of -118.0046dB is obtained at 5.0503GHz.

Gain: The ratio of the intensity, in a given direction, to the radiation intensity that would be obtained if the power accepted by the antenna were radiated isotropically.

5.2.2-D GAIN:

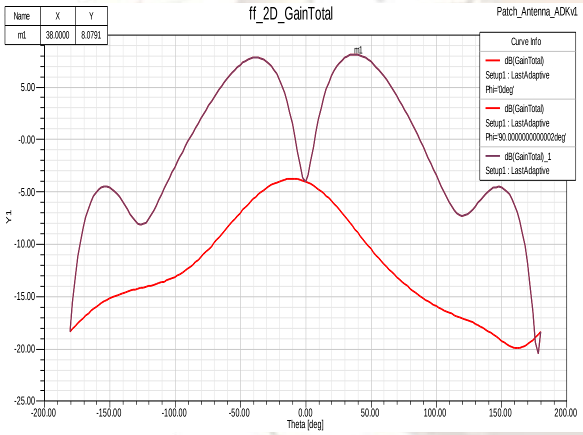

Fig3: 2-D Gain.

5.3.3-D GAIN:

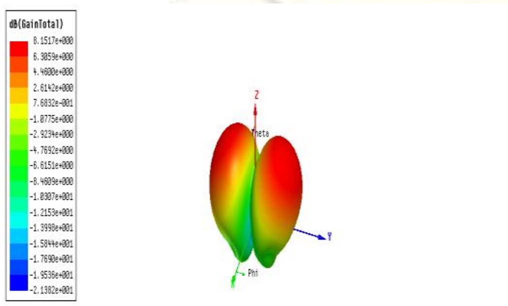

Fig4: 3-D Gain.

For the antenna model a 3D Gain of 8.0791dB and a 3D Gain of 8.1517dB is obtained

5.4.E-FIELD PATTERN:

An electric field can be visualized by drawing field lines, which indicate both magnitude and direction of the field. Field lines start on positive charge and end on negative charge. The direction of the field line at a point is the direction of the field at that point. The relative magnitude of the electric field is proportional to the density of the field lines.

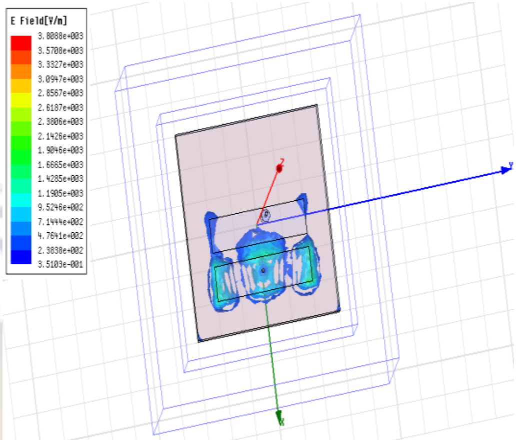

Fig5: E-Field pattern.

5.5.H-FIELD PATTERN **:**

In the case of the same linearly polarized antenna, this is the plane containing the magnetic field vector and the direction of maximum radiation. The magnetic field or "H" plane lies at a right angle to the "E" plane. For a vertically-polarized antenna, the H-plane usually coincides with the horizontal/azimuth plane. For a horizontally-polarized antenna, the H-plane usually coincides with the vertical/elevation plane.

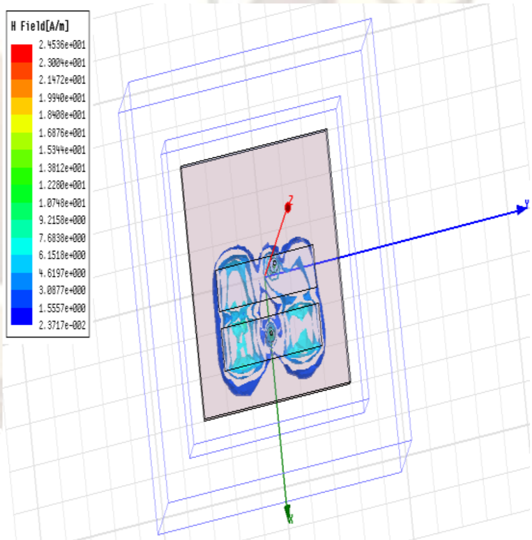

Fig6: H-Field pattern.

5.6.VECTOR E- FIELD:

The field equations of Einstein Cartan Evans (ECE) are used to develop the concept of the static electric field as a vector boson with spin indices −1, 0, +1, which occur in addition to the vector character of the electric field.

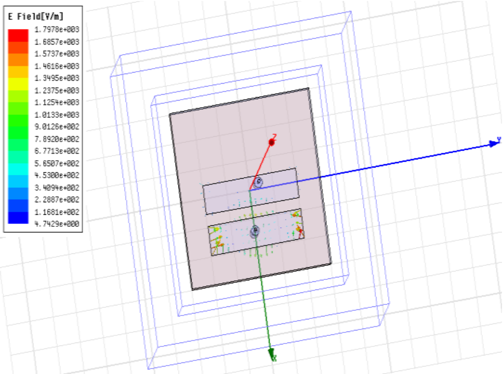

Fig7: Vector E-Field pattern.

The existence of the electric vector boson in physics is inferred directly from Cartan geometry, using the concept of a spinning space-time that defines the electromagnetic field. When the electromagnetic field is independent of the gravitational field the spin connection is dual to the tetrad, producing a set of equations with which to define the electric vector boson. Angular momentum theory is used to develop the basic concept.

5.7.VECTOR H- FIELD

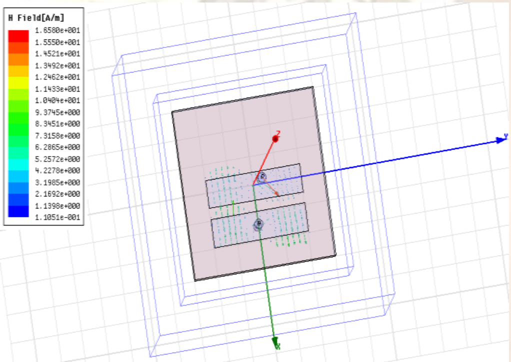

Fig8: Vector H-Field pattern.

5.8.RADIATION PATTERN:

The *radiation pattern* or *antenna pattern* describes the relative strength of the radiated field in various directions from the antenna, at a constant distance.

5.8.1.RADIATION PATTERN OF GAIN TOTAL:

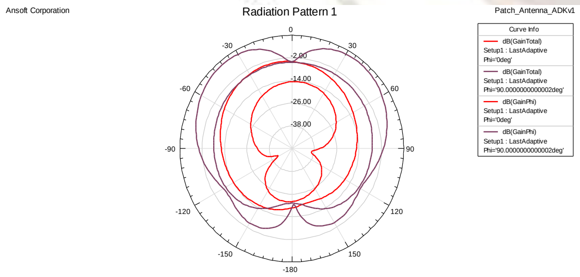

Fig9: Radiation pattern of Gain total.

5.8.2RADIATION PATTERN OF GAIN IN THETA DIRECTION**:**

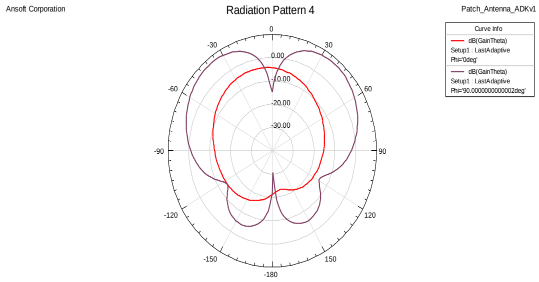

Fig10: Radiation pattern of Gain in Theta direction**.**

5.8.3RADIATION PATTERN OF GAIN IN PHI DIRECTION**:**

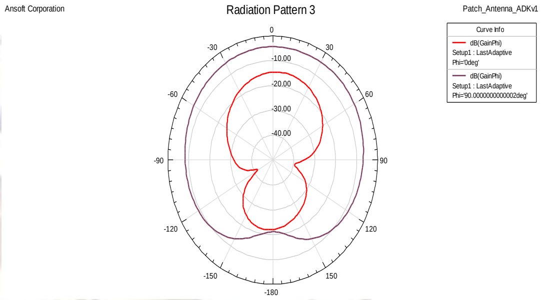

Fig11: Radiation pattern of Gain in Phi direction.

5.9:AXIAL RATIO

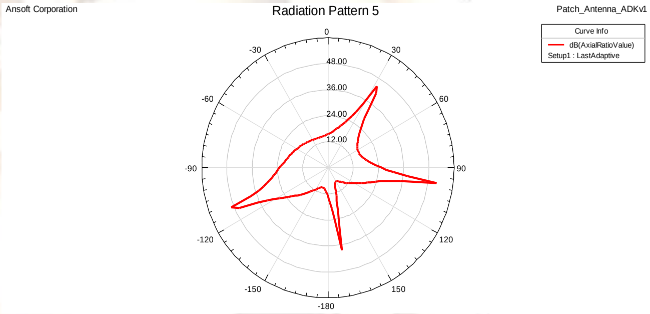

Fig12: Axial Ratio.

Axial Ratio is the ratio of peak value in the major lobe direction to peak value in the minor lobe direction.

6.CONCLUSION:

The holographic concept has been adapted for the micro strip patch application by introducing dual phase-shifting dipole scatters per periodic cell. A holographic antenna based technique to improve the broadside gain and Return loss, SW efficiency, Radiation pattern and axial Ratio of a patch antenna has been presented.

7.ACKNOWLEDGEMENT:

We would like to express our thanks to the department of ECE and management of KL University for their continuous support and encouragement during this work.

8.REFERENCES:

[1] J. R. James, P. S. Hall, and C. Wood, *Microstrip Antenna Theory and Design*. London, U.K.: Peregrinus, 1981.

[2]Comparative Analysis of Exponentially Shaped Microstrip-Fed Planar Monopole Antenna With and Without Notch M. Venkata Narayana1, I.Govadhani2, K.P.Sai Kumar, K. Pushpa Rupavathi.

[3] D. R. Jackson and N. G. Alexopoulos, "Simple approximate formulas for input resistance, bandwidth, and efficiency of a resonant rectangular patch," *IEEE Trans. Antennas Propag.*, vol. 39, no. 3, pp. 407–410, Mar. 1991.

[4] D. Sievenpiper, L. Zhang, R. F. J. Broas, N. G. Alexopolous, and E. Yablonovitch, "High-impedance electromagnetic surfaces with a forbidden frequency band," *IEEE Trans. Microw. Theory Tech.*, vol. 47, no. 11, pp. 2059–2074, Nov. 1999.

[5] R. Coccioli, F. Yang, T. Itoh, and K. Ma, "Aperture-coupled patch antenna on UC-PBG surface," *IEEE Trans. Microw. Theory Tech.*, vol. 47, no. 11, pp. 2123–2130, Nov. 1999.

[6] N. Llombart, A. Neto, G. Gerini, and P. de Maagt, "Planar circularly symmetric EBG structures for reducing surface waves in printed antennas," *IEEE Trans. Antennas Propag.*, vol. 53, no. 10, pp. 3210–3218, Oct. 2005.

[7] A. Neto, N. Llombart, G. Gerini, and P. de Maagt, "On the optimal radiation bandwidth of printed slot antennas surrounded by EBGs," *IEEE Trans. Antennas Propag.*, vol. 54, no. 4, pp. 1074–1082, Apr. 2006.

[8] N. Llombart, A. Neto, G. Gerini, and P. de Maagt, "1-D scanning arrays on dense dielectrics using PCS-EBG technology," *IEEE Trans. Antennas Propag.*, vol. 55, no. 1, pp. 26–35, Jan. 2007.

[9] M. Nannetti, F. Caminita, and S. Maci, "Leaky-wave based interpretation of the radiation from holographic surfaces," in *Proc. IEEE Antennas Propag. Symp. (APS 2007)*, Honolulu, HI, Jun. 2007, pp. 5813–5816.

[10] M. Ettorre, S. Bruni, G. Gerini, A. Neto, N. Llombart, and S. Maci, "Sector PCS-EBG antenna for low-cost high-directivity applications," *IEEE Antennas Wireless Propag. Letters.*, vol. 6, pp. 537–539, 2007.

[11] S. Podilchak, A. P. Freundorfer, and Y. M. M. Antar, "Planar leaky-wave antenna designs offering-conical beam scanning and broadside radiation using surface-wave launchers," *IEEE Antennas Wireless Propag. Letters.*, vol. 7, pp. 155–158, 2008.

[12] R. G. Rojas and K. W. Lee, "Surface wave control using non-periodic parasitic strips in printed antennas," *Proc. Inst. Elect. Eng. Microw. Antennas Propag.*, vol. 148, no. 1, pp. 25–28, Feb. 2001.

[13] A. Sutinjo, "Analysis and design of printed leaky-wave antennas for broadside radiation," Ph.D. dissertation, Univ. Calgary, AB, Canada, May 2009.

[14] W. Menzel, "A new travelling wave antenna in microstrip," in *Proc. Eur. Microwave Conf. (EuMC 1978)*, Paris, France, Oct. 1978, pp. 302–306.

[15] R. Gardelli, M. Albani, and F. Capolino, "Array thinning by using antennasin Fabry-Perot cavity for gain enhancement," *IEEE Trans. Antennas Propag.*, vol. 54, no. 7, pp. 1979–1990, Jul. 2006.

[16] Z. Yu, "A simple and effective method for the reflection coefficient extraction in rectangular waveguide discontinuity analysis by the FDTD," *Microw. Opt. Technol. Lett.*, vol. 15, no. 1, pp. 57–59, May 1997.

[17] R. E. Collin, *Foundations for Microwave Engineering*, 2nd ed. New York: McGraw-Hill, 1992, ch. 8.

[18] P. Burghignoli, G. Lovat, and D. R. Jackson, "Analysis and optimization of leaky-wave radiation at broadside from a class of 1-D periodic structures," *IEEE Trans. Antennas Propag.*, vol. 54, no. 9, pp.2593–2603, Sep. 2006.

[19] A. Sutinjo, M. Okoniewski, and R. H. Johnston, "Beam-splitting condition in a broadside symmetric leaky wave antenna of finite length," *IEEE Antennas Wireless Propag. Lett.*, vol. 7, pp. 608–611, 2008.

[20] D. R. Jackson and A. A. Oliner, *Antenna Engineering Handbook*, 4thed. New York: McGraw-Hill, 2007, ch. 11.

9.AUTHORS BIOGRAPHY:

Govardhani. Immadi working as Associat pr ofesoor in KL University. Completed B.Tech in KLCE affiliated to Acharya Nagarjuna University in 2004. Recived Masters degree from the Acharya nagarjuna University as a University topper in 2009.Major area of working is micro strip antennas, electrically small antennas.

Venkatanarayana.M working as Associat pr ofesoor in KLUniversity,HODSED-1(ECE). Completed B.Tech in 2001 in Bapatla Engineering College affiliated to Acharya Nagarjuna University. Recived Masters degree from the Acharya nagarjuna University in 2009.Major area of working is micro strip antennas, electrically small antennas.

Prof S.Venkateswarlu working as HOD computerscience and Engineering, Associate Dean planning and Development, he completed his B.Tech in 1989 in Bapatla engineering college. affiliated to Acharya Nagarjuna University**.** Recived **Masters degreefrom Jiwaji University in 1997,received Ph.D in 2006 and his area of interest is communication network.**

K.Rajkamal was born in ANDHRAPRADESH, INDIA, 1989. He completed B.Tech in Loyola institute of technology and management affiliated to JNTUKAKINADA, A.P, INDIA in 2010. Now he is pursuing M.Tech Degree in KL University, A.P, INDIA.