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Different Shaped Microstrip Patch Antennas

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Abstract
In the past few decades, microstrip patch antenna has been studied in various forms all over the world, still there is possibility of further developments in it. Number of single elements arranged in the form of array is needed to attain high directivity as high directivity is needed by satellites for communication. This paper presents four different shaped singular microstrip patch antennas. All the four antennas are simulated at a frequency of 2.45 GHz in HFSS 15.0 software, and a comparison is made on the basis of their return loss, VSWR, gain and directivity.

Keywords: *microstrip patch antenna, return loss, gain, directivity, VSWR.*

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I. Introduction

Antenna with high directivity is needed in point to point communication. A grounded thin dielectric substrate is needed in the basic configuration of the microstrip antenna. Then a metallic patch is being printed on the dielectric substrate. A coplanar microstrip line or a coaxial line through the bottom of substrate is being used to fed the element. Light weight, planar configuration, suitable for arrays, low cost, easy to fabricate and their easy integration on the integrate circuits makes them the most commonly used antennas. They are widely used for military and civilian applications such as mobile systems, television, global positioning system, radio broadcasting, surveillance systems, radio frequency identification, radar systems, missile guidance, remote sensing and for many more. Large size, narrow bandwidth, low gain is some of the limitations of the antenna. All the performance parameters such as return loss, gain, directivity, VSWR changes if we change frequency or shape of the antenna. Here are four different shaped antennas are designed on the same frequency and their performances are compared.

II. Proposed Antenna Designs

Simple microstrip patch antennas are designed and simulated on the HFSS 15.0 software to obtain the desired results. All the four antennas are simulated on 2.45 GHz frequency. FR_4epoxy which is light in weight is being used as a substrate material to make the antenna lighter in weight. This material is used where light weight and low cost of the antenna is required.

Rectangular patch antenna

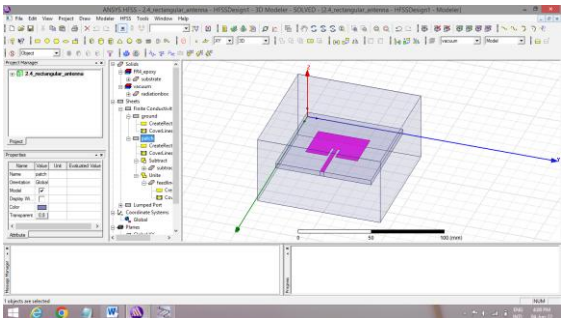

Fig 1: Rectangular patch antenna

Circular patch antenna

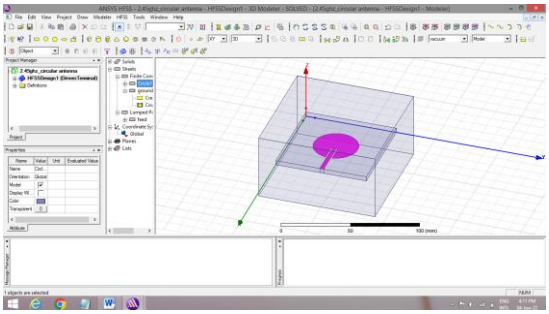

Fig 2: circular patch antenna

Triangular patch antenna

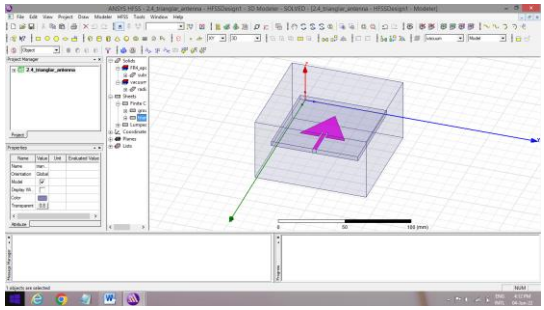

Fig 3: Triangular patch antenna

Hexagonal patch antenna

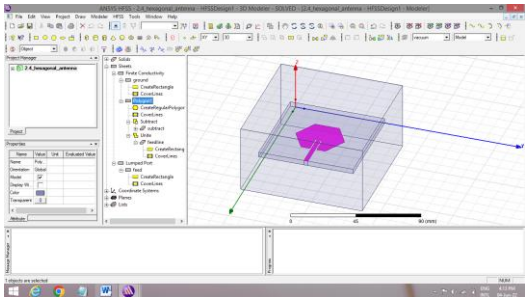

Fig 4 : hexagonal patch antenna

The results which include return loss, VSWR, directivity and gain are simulated and are shown below.

III. Simulation Results

For rectangular patch antenna

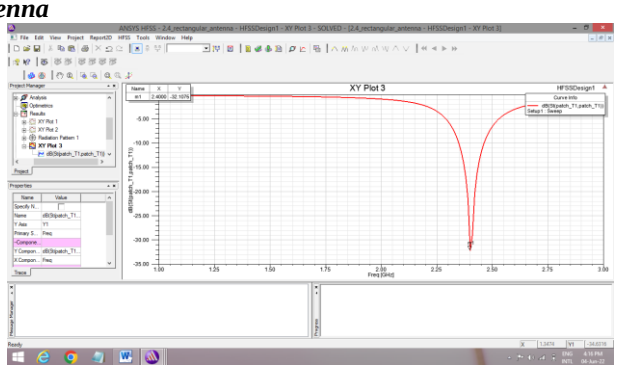

Fig 5: Return loss of rectangular patch antenna

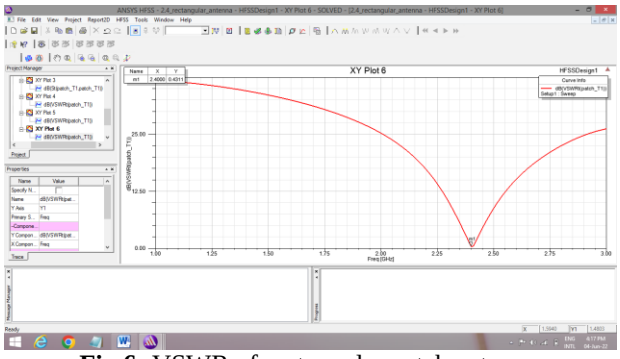

Fig 6: VSWR of rectangular patch antenna

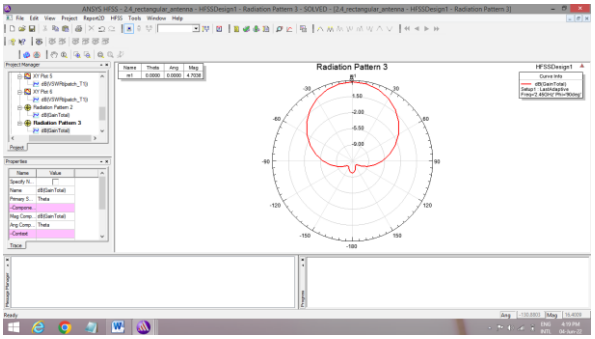

Fig 7: Radiation pattern of rectangular patch antenna

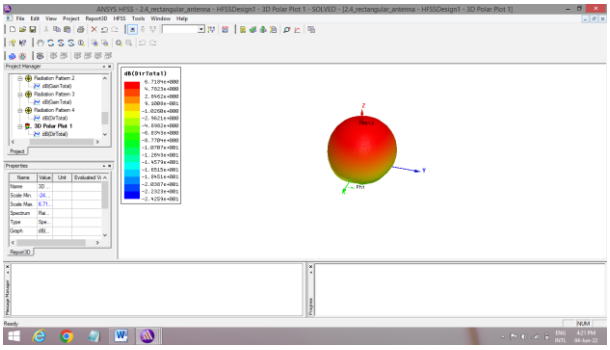

Fig 8: directivity of rectangular patch antenna

Return loss and VSWR of rectangular patch antenna are -32.10 and 0.4 respectively.

Circular patch antenna

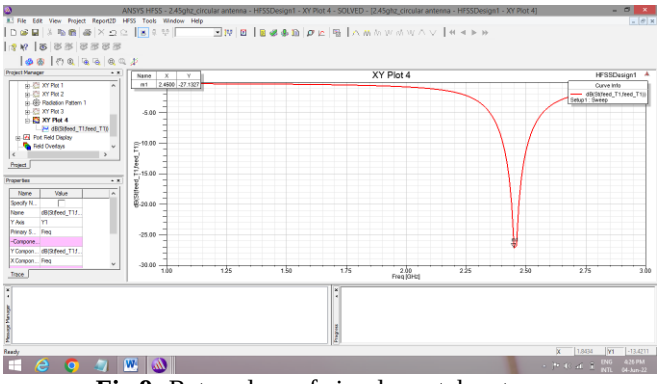

Fig 9: Return loss of circular patch antenna

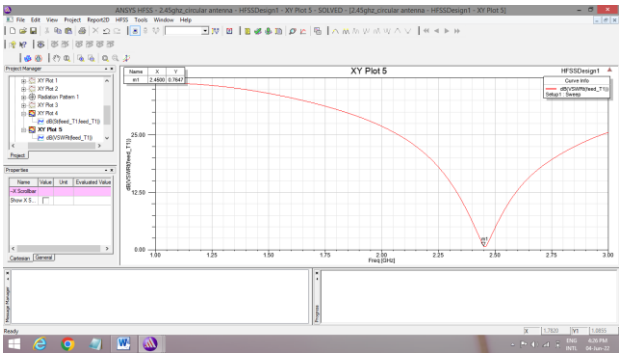

Fig 10: VSWR of circular patch antenna

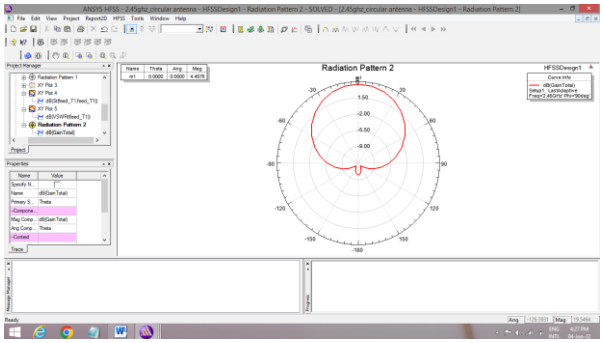

Fig 11: Gain of circular patch antenna

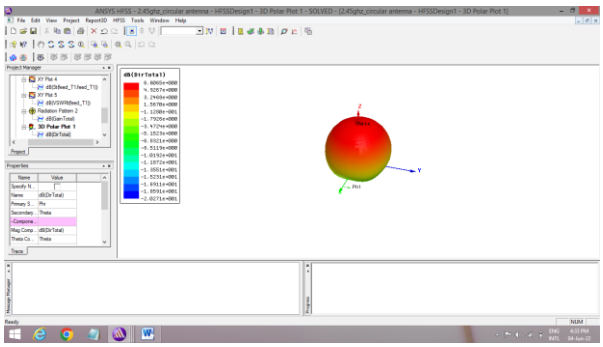

Fig 12: directivity of circular patch antenna

Return loss, VSWR, gain and directivity of circular patch antenna is -27.3, 0.76, 4.45 and -2.42x10^{1} to 6.71 respectively.

Triangular patch antenna

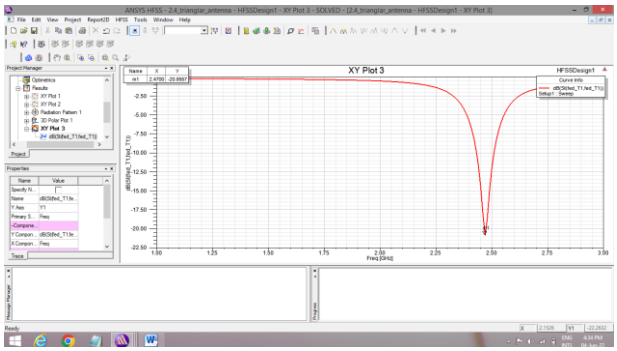

Fig 13: Return loss of triangular patch antenna

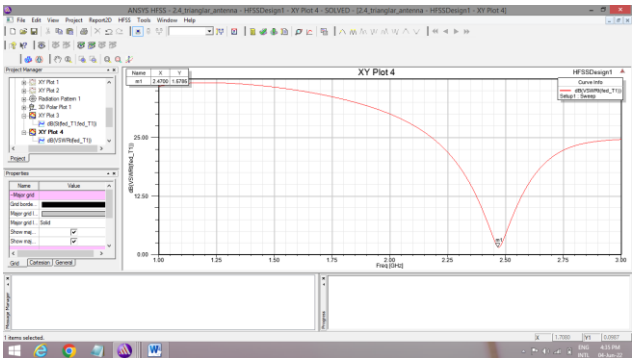

Fig 14: VSWR of triangular patch antenna

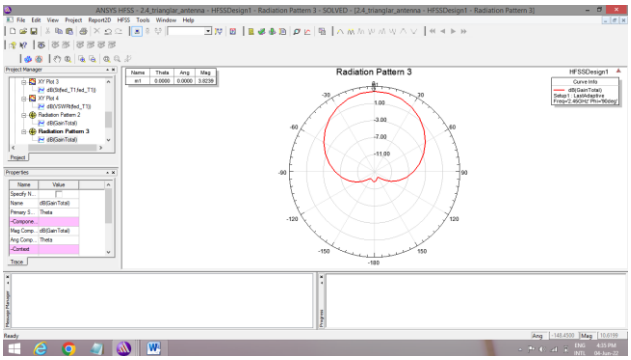

Fig 15: Gain of triangular patch antenna

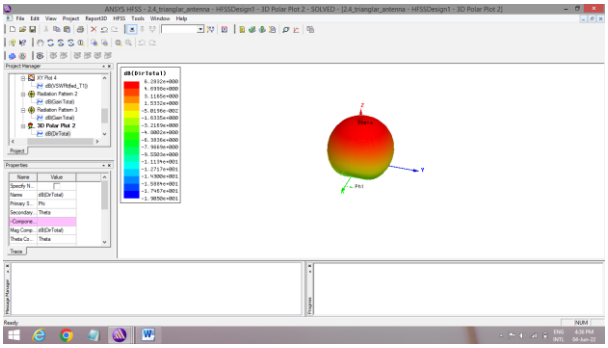

Fig 16: Directivity of triangular patch antenna

The simulation result output of return loss and VSWR of triangular patch antenna are -20.85 and 1.57 respectively.

Hexagonal patch antenna

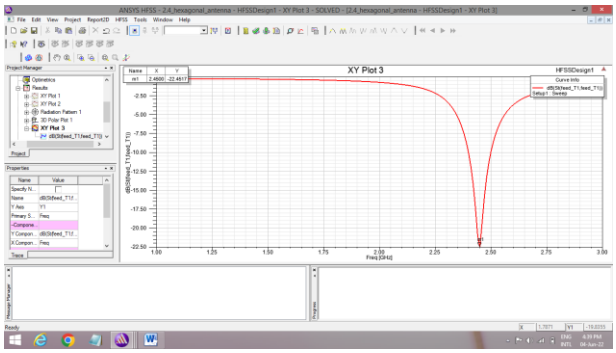

Fig 17: Return loss of hexagonal patch antenna

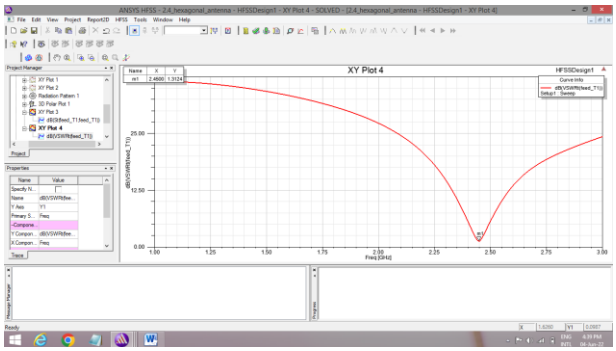

Fig 18: VSWR of hexagonal patch antenna

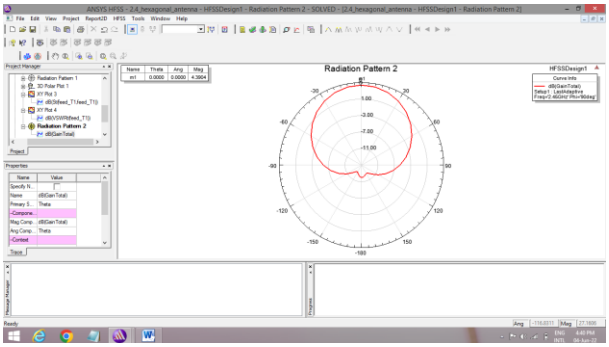

Fig 19: Gain of hexagonal patch antenna

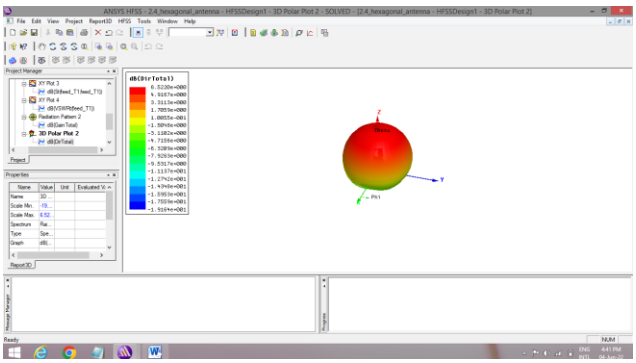

Fig 20: Directivity of hexagonal patch antenna

Return loss, VSWR, directivity and gain of hexagonal patch antenna are -22.45, 1.31, $-1.91x10^{1}$ to 6.52 and 4.39 respectively.

Table 1 : Comparison of characteristics obtained of different antennas

Parameter	*rectangular*	*circular*	*hexagonal*	*triangular*
Return loss	-32.10	-27.13	-22.45	-20.85
VSWR	0.4	0.76	1.31	1.57
Gain	4.70	4.45	4.39	3.82
Directivity	$-2.42x10^{1}$ to 6.71	$-20.02x10^{1}$ to 6.60	$-1.91x10^{1}$ to 6.52	$-1.90x10^{1}$ to 6.28

The comparison of all four different shaped singular patch antennas are shown in table 1.

IV. Conclusion

The performances of different shaped patch antennas are obtained using HFSS 15.0 software. From the results obtained we can say that performances are in the manner **rectangular>circular>hexagonal>triangular**.Best results are given by rectangular shaped microstrip patch antenna which is highly being used.

References

[1]. D. H. Nguyen, J. Ala-Laurinaho, J. Moll, V. Krozer and G. Zimmer, "Improved Sidelobe-Suppression Microstrip Patch Antenna Array by Uniform Feeding Networks," in IEEE Transactions on Antennas and Propagation, vol. 68, no. 11, pp. 7339-7347, Nov. 2020, doi: 10.1109/TAP.2020.2995416.

[2]. R. Hasan, W. A. Ahmed, J. Lu, H. J. Ng and D. Kissinger, " F -Band Differential Microstrip Patch Antenna Array and Waveguide to Differential Microstrip Line Transition for FMCW Radar Sensor," in IEEE Sensors Journal, vol. 19, no. 15, pp. 6486-6496, 1 Aug.1, 2019, doi: 10.1109/JSEN.2019.2909935.

[3]. H. Saeidi-Manesh and G. Zhang, "Low Cross-Polarization, High-Isolation Microstrip Patch Antenna Array for Multi-Mission Applications," in IEEE Access, vol. 7, pp. 5026-5033, 2019, doi: 10.1109/ACCESS.2018.2889599.

[4]. K. S. Vishvaksenan, K. Mithra, R. Kalaiarasan and K. S. Raj, "Mutual Coupling Reduction in Microstrip Patch Antenna Arrays Using Parallel Coupled-Line Resonators," in IEEE Antennas and Wireless Propagation Letters, vol. 16, pp. 2146-2149, 2017, doi: 10.1109/LAWP.2017.2700521.

[5]. U. Rafique, H. Khalil and Saif-Ur-Rehman, "Dual-band microstrip patch antenna array for 5G mobile communications," 2017 Progress in Electromagnetics Research Symposium - Fall (PIERS - FALL), 2017, pp. 55-59, doi: 10.1109/PIERS-FALL.2017.8293110.

[6]. X. Yang, W. Geyi and H. Sun, "Optimum Design of Wireless Power Transmission System Using Microstrip Patch Antenna Arrays," in IEEE Antennas and Wireless Propagation Letters, vol. 16, pp. 1824-1827, 2017, doi: 10.1109/LAWP.2017.2682262.

[7]. Y. Li and K. -M. Luk, "60-GHz Substrate Integrated Waveguide Fed Cavity-Backed Aperture-Coupled Microstrip Patch Antenna Arrays," in IEEE Transactions on Antennas and Propagation, vol. 63, no. 3, pp. 1075-1085, March 2015, doi: 10.1109/TAP.2015.2390228.

[8]. ChiragArora, ShyamSundarPattnaik, and Rudra Narayan Baral, "SRR Inspired Microstrip Patch Antenna Array," Progress In Electromagnetics Research C, Vol. 58,89-96,2015.doi:10.2528/PIERC15052501 http://www.jpier.org/PIERC/pier.php?paper=15052501

[9]. A. Mavaddat, S. H. M. Armaki and A. R. Erfanian, "Millimeter-Wave Energy Harvesting Using 4×4 Microstrip Patch Antenna Array," in IEEE Antennas and Wireless Propagation Letters, vol. 14, pp. 515-518, 2015, doi: 10.1109/LAWP.2014.2370103.

[10]. G. Casu, C. Moraru and A. Kovacs, "Design and implementation of microstrip patch antenna array," 2014 10th International Conference on Communications (COMM), 2014, pp. 1-4, doi: 10.1109/ICComm.2014.6866738.

[11]. H. Sajjad, W. T. Sethi, K. Zeb and A. Mairaj, "Microstrip patch antenna array at 3.8 GHz for WiMax and UAV applications," 2014 International Workshop on Antenna Technology: Small Antennas, Novel EM Structures and Materials, and Applications (iWAT), 2014, pp. 107-110, doi: 10.1109/IWAT.2014.6958609.

[12]. K. Phalak and A. Sebak, "Aperture coupled microstrip patch antenna array for high gain at millimeter waves," 2014 IEEE International Conference on Communication, Networks and Satellite (COMNETSAT), 2014, pp. 13-16, doi: 10.1109/COMNETSAT.2014.7050517.

[13]. T. Mikulasek, A. Georgiadis, A. Collado and J. Lacik, "2$\,\times\,$ 2 Microstrip Patch Antenna Array Fed by Substrate Integrated Waveguide for Radar Applications," in IEEE Antennas and Wireless Propagation Letters, vol. 12, pp. 1287-1290, 2013, doi: 10.1109/LAWP.2013.2283731.

[14]. M. G. N. Alsath, M. Kanagasabai and B. Balasubramanian, "Implementation of Slotted Meander-Line Resonators for Isolation Enhancement in Microstrip Patch Antenna Arrays," in IEEE Antennas and Wireless Propagation Letters, vol. 12, pp. 15-18, 2013, doi: 10.1109/LAWP.2012.2237156.

[15]. B. R. Franciscatto, A. C. Souza, C. Defay, T. T. Trang and T. P. Vuong, "High gain microstrip patch antenna array using multiple superstrate layers for DSRC applications," 2012 IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications (APWC), 2012, pp. 736-739, doi: 10.1109/APWC.2012.6324937.

[16]. R. JothiChitra, B. Ramesh Karthik and V. Nagarajan, "Double L - slot microstrip patch antenna array for WiMAX and WLAN," 2012 International Conference on Communication and Signal Processing, 2012, pp. 137-140, doi: 10.1109/ICCSP.2012.6208410.

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