International Journal of Advance Research, IJOAR .org
Volume 1, Issue 3, March 2013, Online: ISSN 2320-9199

PERFORMANCE INVESTIGATION OF YAGI-UDA ANTENNA USING DIFFERENT SHAPES OF ANTENNA ELEMENT AT 2GHz

Gulshan Sharma,Vijay Sharma and P.K. Singhal
Department of Electronics, Madhav institute of Technology & Science, Gwalior-474005, India gulshan087@gmail.com, chottu.vijay@gmail.com, pks_65@yahoo.com

Abstract:

This paper is aimed to evaluate the performance of the Yagi-Uda Antenna with squared shaped Antenna element and compare its performance from conventional spherical shaped Yagi Antenna. For this job, two Yagi-Uda Antennas has been designed at 2GHz frequency with two different shape of Antenna element. The Antenna's potential characteristics such as return loss, radiation pattern, have been measured for the analysis of proposed Antenna. The related designing parameters were also discussed in this paper.

Keywords-

Antenna, Yagi-Uda, Return Loss, Radiation Pattern

1. Introduction :

A Yagi–Uda Antenna is a widely used Antenna design due to its high forward gain capability, low cost and ease of construction. It is commonly used as a roof top television receiver. Basically an Antenna is a areal system that matches or coupled the energy to the free space. A Yagi-Uda Antenna is a directional Antenna system consisting of an array of a dipole and additional closely coupled parasitic elements as follows:

- A reflector
- One or more directors

A typical Yagi-Uda Antenna consists of a dipole element which is directly connected to the transmission feed-line and responsible of for energizing the whole structure. Another element called reflector is 5% longer than dipole element & other element are called directors. Directors are 5% shorter than the dipole elements. The number of directors depends on the gain and for achieving high gain it should be better to have equally spaced element with larger number of directors.

The function of parasitic element is to improve the radiation pattern in the forward direction. The reflector provides 3dB additional forward gain but having more than one reflector has little benefit [1-6].

2. Antenna design:

There are no simple formulas for designing Yagi-Uda Antenna due to the non-linear relationships between physical parameter such as element length, diameter and position and electrical characteristics such as input impedance and gain, but performance can be estimated by computer simulation [9-11].

For a particular operating frequency typical design parameter has been taken from NBS (see in NBS note 688)[12-13], as shown in Fig. 1.

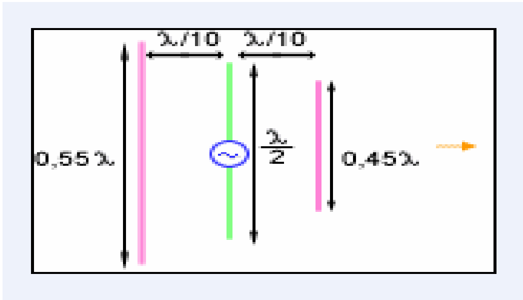

Figure 1 - Geometrical design of Yagi Antenna

In case of Yagi-Uda Antenna the boom isolation play a significant role in performance Antenna. Here, two different booms are used to fabricate the Antennas. All the calculated parameters are shown in Table 1 below.

Table-1

Freq (in MHz)	**2000**
Boom Length	100
Gain (in dB approx.)	1200
Elements	5
Diameter of Parasitic elements (in mm)	6
Shape of Boom	Square & Spherical
Is the Boom isolated from Parasitics	Yes

The typical cross sectional view of the proposed Antennas are shown in Figure 2(a) and Figure 2(b).

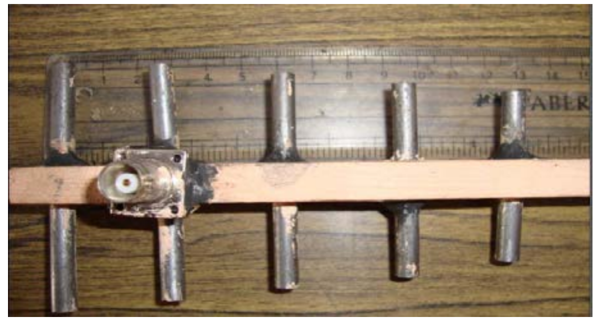

Figure 2(a) - Yagi-Uda Antenna using cylindrical iron rod as Antenna element.

Figure 2(b) - Yagi-Uda Antenna using square iron rod as Antenna element.

3. Measured Results: All the measurement has been done by using FS-315 Spectrum Analyzer connected to the SWR Bridge & proposed Antennas as shown in Fig. 3.

Figure 3 - Setup used for measurement.

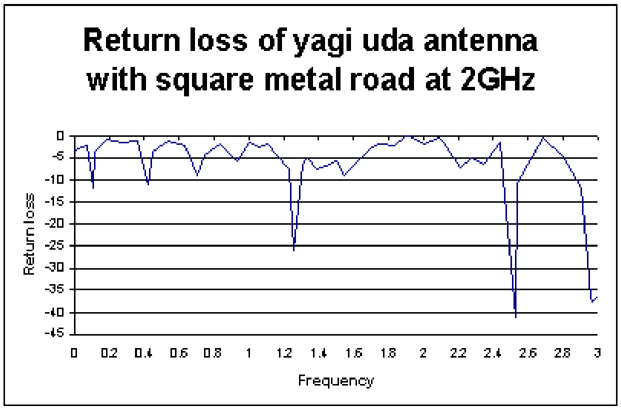

Figure 4(a) – Measured Return Loss of the proposed Antenna with square shaped metal rod.

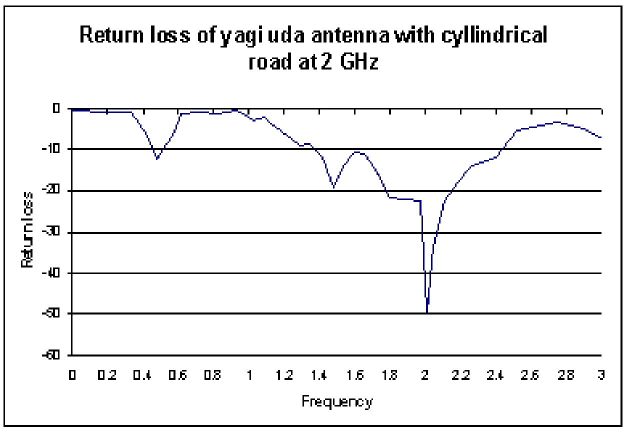

Figure 4(b) – Measured Return Loss of the proposed Antenna with spherical shaped metal rod.

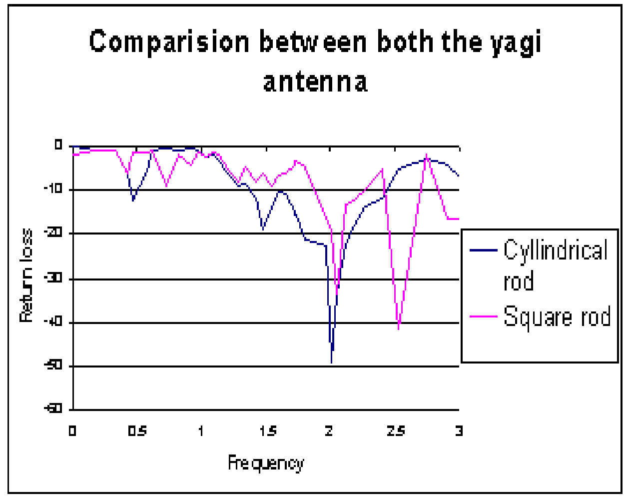

Figure 5: Comparative Analysis between both the Yagi's.

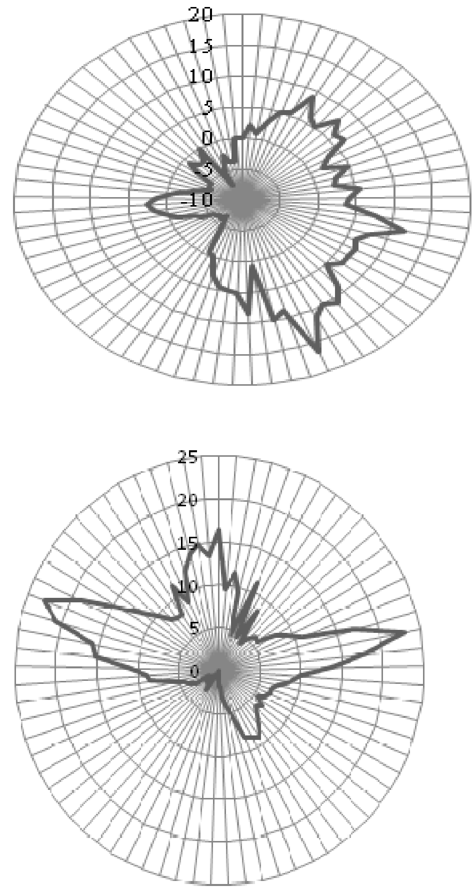

Figure 6: Radiation pattern for the proposed antenna system

ISSN 2320-9119

4. Summary:

A Yagi-Uda Antenna has been fabricated with two different shapes of Antenna elements & from the analysis of the proposed Antennas this paper realized that the spherical shaped is the better choice as compared with square shaped element to achieve better potential Antenna characteristics through Yagi-Uda Antenna. So eventually it can be said that the square shaped Antenna element increases the beam-width & makes the radiation pattern nearest to omni-directional one. In spite of that it also gives multi-frequency return loss characteristics to the Yagi-Uda Antenna. There can be a single reason behind that the reflections occur through their sharp edges which creates the dramatic change in the performance of Yagi-Uda Antenna.

References:

1. Chou, H. T., K. L. Hung, and C. Y. Chen, Utilization of a Yagi antenna director array to synthesize a shaped radiation pattern for optimum coverage in wireless communications," *Journal of Electromagnetic Waves and Applications*, Vol. 23, No. 7, 851.

2. Li, J.-Y. and J. L. Guo, Optimization technique using di®erential evolution for Yagi-Uda antennas," *Journal of Electromagnetic Waves and Applications*, Vol. 23, No. 4, 449.

3. Misra, I. S., R. S. Chakrabarty, and B. B. Mangaraj, \Design, analysis and optimization of V-dipole and its three-element Yagi-Uda array," *Progress In Electromagnetics Research*, PIER 66,156, 2006.

4. Rattan, M., M. S. Patterh, and B. S. Sohi, \Optimization of Yagi-Uda antenna using simulated annealing," *Journal ofElectromagnetic Waves and Applications*, Vol. 22, No. 2, 291,2008.

5. Mahmoud, K. R., M. El-Adawy, S. M. M. Ibrahem, R. Bansal, K. R. Mahmoud Visiting, and S. H. Zainud-Deen, \Performance of circular Yagi-Uda arrays for beamforming applications using particle swarm optimization algorithm," *Journal of Electromagnetic Waves and Applications*, Vol. 22, No. 2{3, 353{ 364, 2008.

6. Yang, X. S., B. Z. Wang, and H. L. Liu, Recon¯gurable Yagi patch array by utilizing odd-even-mode method," *Journal of Electromagnetic Waves and Applications*, Vol. 20, No. 13, 1725,2006.

7. Teisbaek, H. B. and K. B. Jakobsen, Koch-fractal Yagi-Uda antenna," *Journal of Electromagnetic Waves and Applications*, Vol. 23, No. 2, 2009.

8. Kraus J. D., *Antenna*, 243{248, 2nd Edition, McGraw-Hill, New York, 1988.

9. Shiroma, G. S. and W. A. Shiroma, \A two-element L-band quasi-Yagi array with omnidirectional coverage," *IEEE Trans. Antennas Propag.*, Vol. 55, No. 12, 3713{3716, Dec. 2007.

10. Cheng, S., P. Rantakari, R. Malmqvist, C. Samuelsson, T. VÄahÄa- HeikkilÄa, A. Rydberg, and J. Varis, \Switched beam antennabased on RF MEMS SPDT switch on quartz substrate," *IEEE Antennas Wireless Propag. Lett.*, Vol. 8, 383{386, 2008.

11. Lim, S. and H. Ling, \Design of

electrically small, patternrecon¯gurable

Yagi antenna," *Electron. Lett.*, Vol. 43, No. 24,1326{1327, Nov. 2007.

12. Honma, N., T. Seki, K. Nishikawa, K. Tsunekawa, and K. Sawaya,\Compact six-sector antenna employing three intersecting dual-
beam microstrip Yagi-Uda arrays with common director," *IEEE*, 2010.*Trans. Antennas Propag.*, Vol. 54, No. 11, 3055{3062, Nov. 2006.

13. Honma, N., T. Seki, and K. Nishikawa, \Compact planar four- sector antenna comprising microstrip Yagi-Uda arrays in a squarecon¯guration," *IEEE Antennas Wireless Propag. Lett.*, Vol. 7,596, 2008.

14. Lim, S., \Design of a multidirectional, high-gain compact Yagi antenna," *IEEE Antennas Wireless Propag. Lett.*, Vol. 8, 418,2009.