ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 3, Issue 5, May 2015

N×N Antenna Array Simulations Using MATLAB

P. Sai Vinay Kumar[1], Dr M. Padmaja[2]

Abstract: This paper presents simulation of a C-Band (6 GHz) , N×N (N=2, 4, 8, 16, 32) uniformly spaced planar array antenna using MATLAB 2013. The antenna array is simulated using MATLAB code and antenna parameters like Array Factor beam, Array Factor (dB) are calculated using MATLAB coding and hence their graphs are plotted for 2×2, 4×4, 8×8, 16×16, 32×32 array individually.

Index terms: Antenna Array, Array Factor, Planar Array.

I.INTRODUCTION

Phased array antenna is a multiple-antenna system. In order to achieve higher directivity and additional gain, antenna elements can be arranged to form linear or planar arrays. Consist of multiple antennas (elements) 'collaborating' to synthesize radiation characteristics not available with a single antenna. They are able to match the radiation pattern to the desired coverage area and to change the radiation pattern electronically through the control of the phase and amplitude. In addition, they are used to scan the beam of an antenna system, increase the directivity, and perform various other functions which would be difficult with any one single element. The elements can be fed by a single line or by multiple lines in a feed network arrangement. There are three types of array: liner array, planner array and conformal array. Phased array antennas are common in communications and radar and offer the benefit of far-field beam shaping and steering for specific, agile operational conditions. They are especially useful in modern adaptive radar systems where there is a trend toward active phased arrays and more advanced space-time adaptive signal processing.

II. THEORITICAL CONSIDERATIONS

In this paper, an N×N (N=2, 4, 8, 16, 32) planar array [7], with uniform amplitude, spacing and with phased weights is generated using MATLAB code. The planar array is shown in Fig 1. The weights are designed to steer the planar antenna array towards the desired direction $(\theta_d; \phi_d)$.

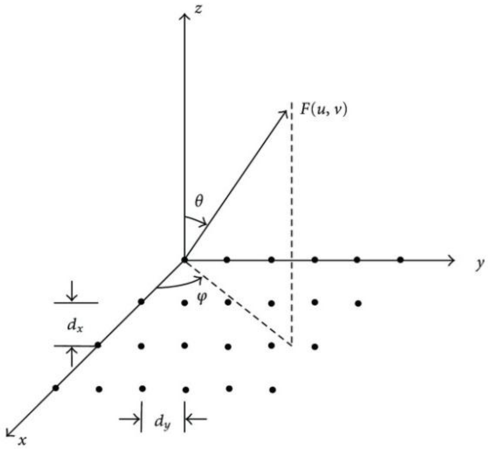

Fig 1 Planar Array

Array Factor:

The array factor is the function of the positions of the antennas in the array and the weights used. Array Factor is given by formula shown below

$$Y = R(\theta,\phi)\sum_{i=1}^{N} w_i e^{-j\mathbf{k}\cdot\mathbf{r}_i}$$

$$= R(\theta,\phi)AF$$

$$\boxed{AF = \sum_{i=1}^{N} w_i e^{-j\mathbf{k}\cdot\mathbf{r}_i}}$$

AF – Array Factor.
Y - Output of phased array
w_i - Phased weights with which antenna array elements are multiplied.
$R(\theta,\phi)$ - Radiation pattern.

III. RESULTS

The **N×N (N=2, 4, 8, 16, 32)** antenna array is simulated and Number of elements, array factor are plotted using MATLAB code. The below are the results for 2×2 , 4×4, 8×8, 16×16, 32×32 planar arrays.

Results for 2×2 Array:

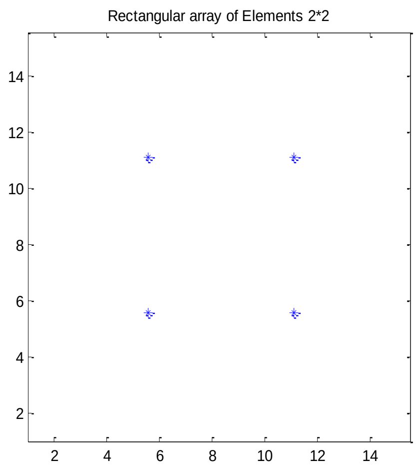

Fig 2(a) 2×2 Rectangular Array

DOI 10.17148/IJIREEICE.2015.3557

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

IJIREEICE

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 3, Issue 5, May 2015

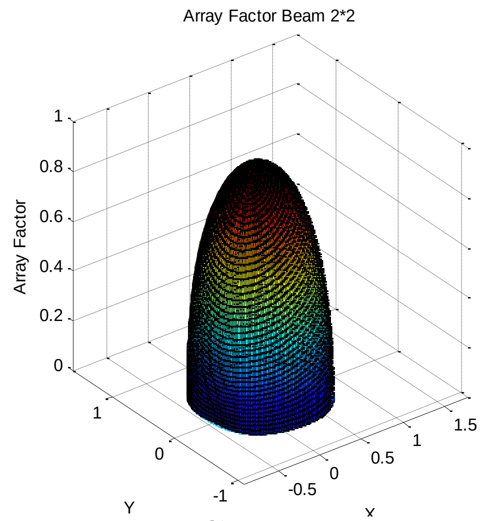

Fig 2(b) Array Factor Beam

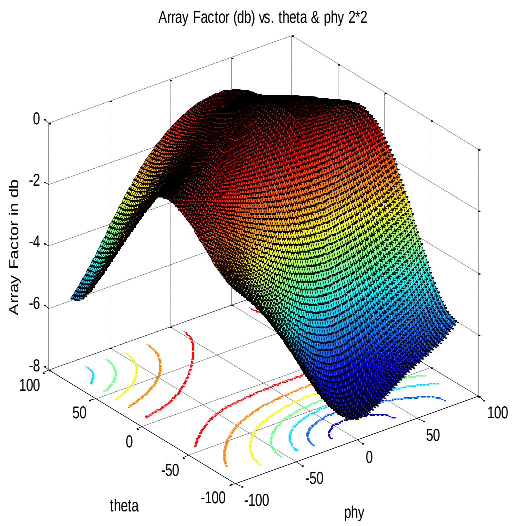

Fig 2(c) Array Factor (dB)

Results for 4×4 Array:

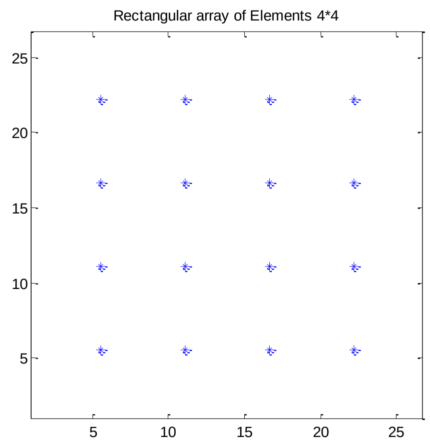

Fig 3(a) 4×4 Rectangular Array

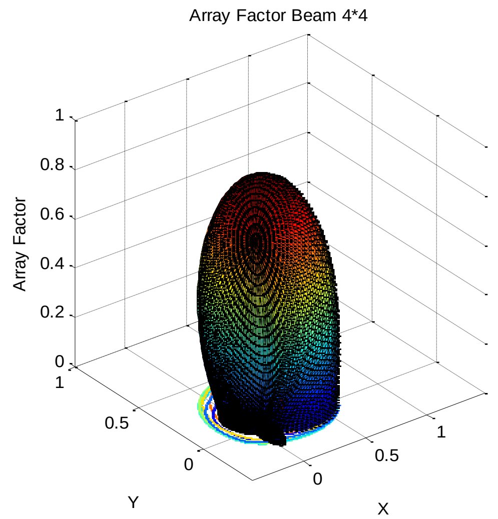

Fig 3(b) Beam Array Factor

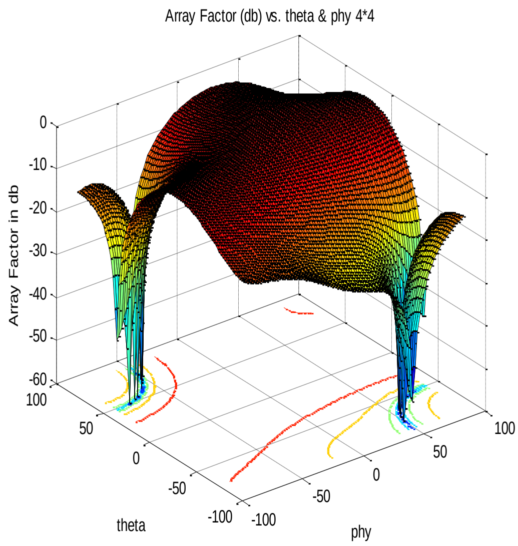

Fig 3(c) Array Factor (dB)

Results for 8×8 Array:

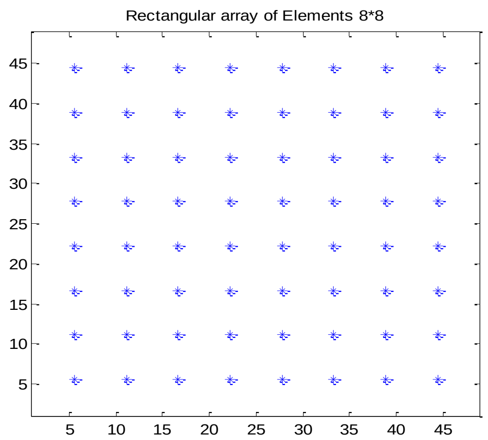

Fig 4(a) 8×8 Rectangular Array

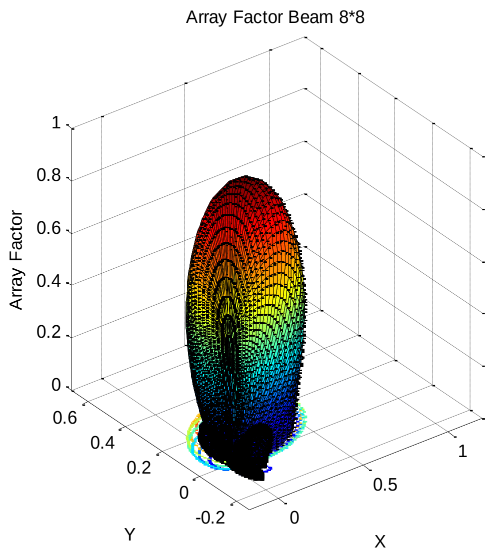

Fig 4(b) Beam Array Factor

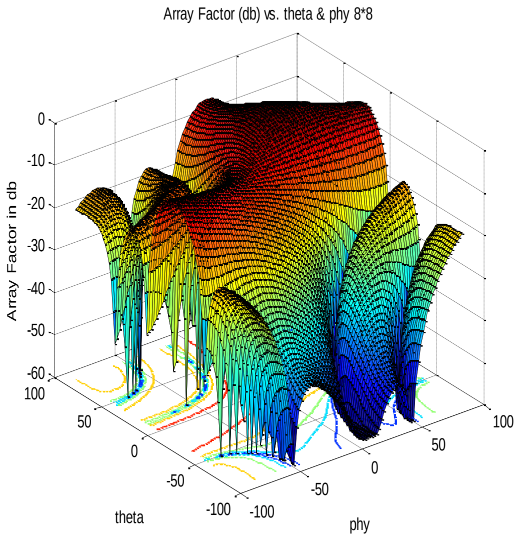

Fig 4(c) Array Factor (dB)

Results for 16×16 Array:

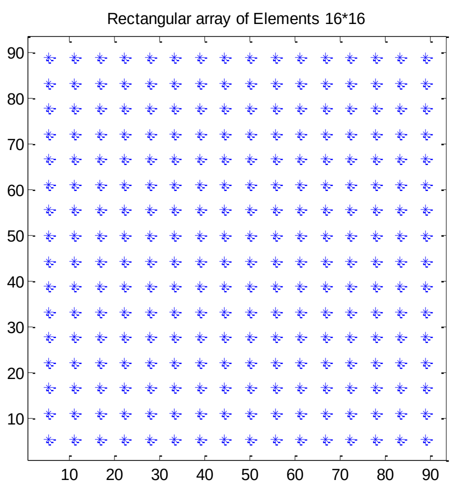

Fig 5(a) 16×16 Rectangular Array

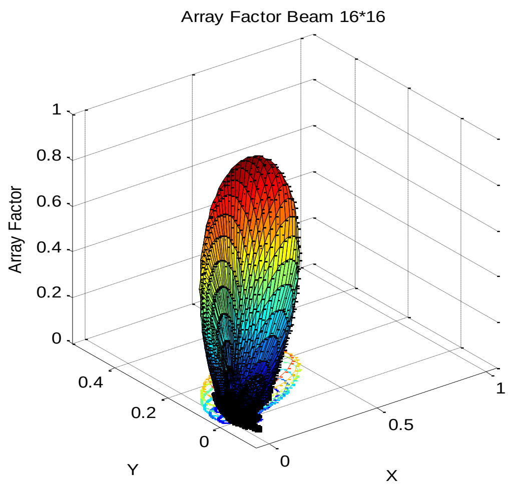

Fig 5(b) Beam Array Factor

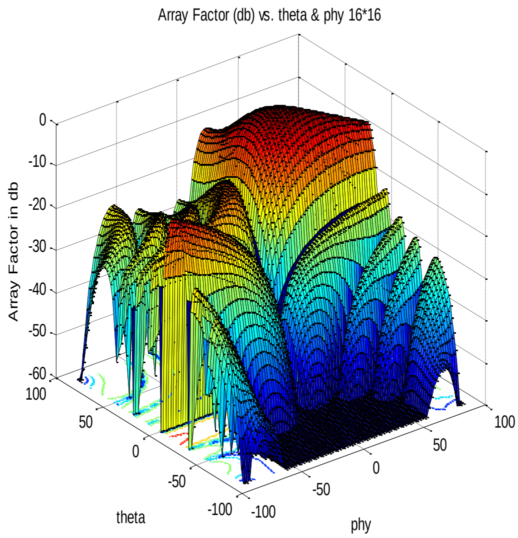

Fig 5(c) Array Factor (dB)

Results for 32×32 Array:

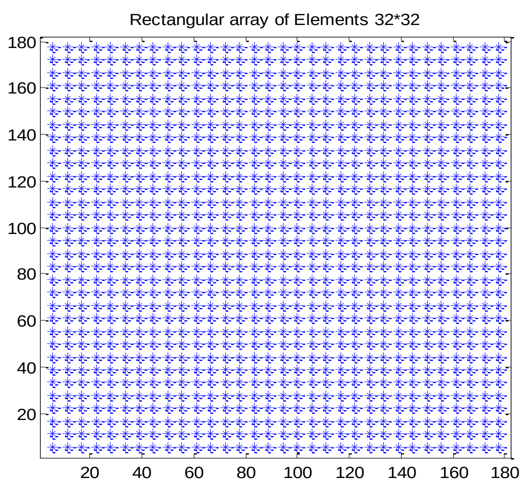

Fig 6(a) 32×32 Rectangular Array

 DOI 10.17148/IJIREEICE.2015.3557

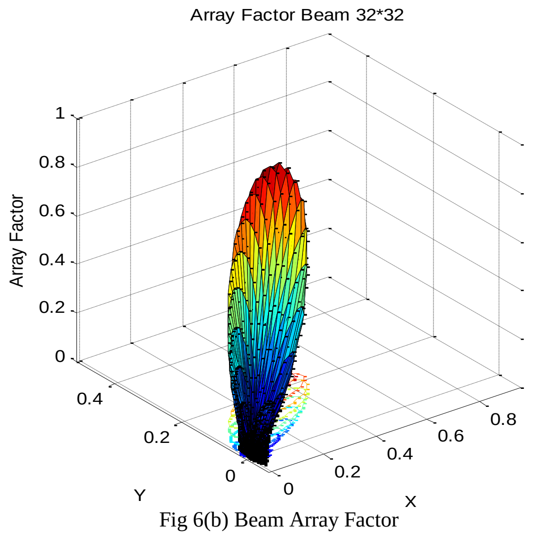

Fig 6(b) Beam Array Factor

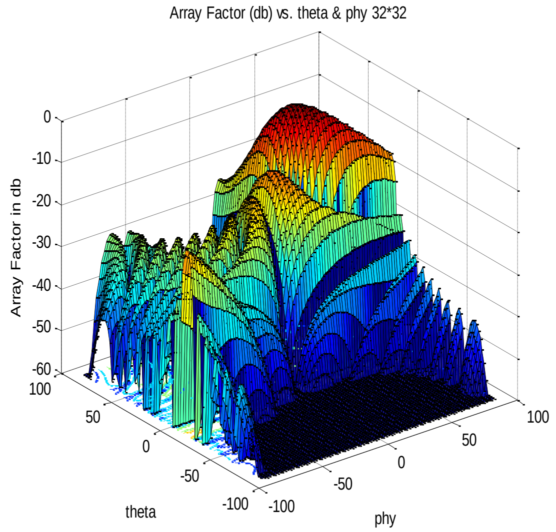

Fig 6(c) Array Factor (dB)

IV CONCLUSION

An N×N (N=2,4,8,16,32) planar antenna array is generated using MATLAB code and the antenna array parameter “Array Factor” is plotted (using an equation represented in theoretical part of this paper) for each array individually. It is observed that the Directivity of the Beam Array Factor of the Antenna Array is increasing with increase in the number of antenna elements and also analysed the effect of the increasing antenna elements on the Array Factor.

ACKNOWLEDGMENT

Extending our grateful thanks to the management of **V R Siddhartha Engineering College** for their support and encouragement to write this paper.

REFERENCES

[1] C. A. Balanis, “Antenna theory analysis and design”,Jhon Wiley & Sons, Inc., Second Edition, 1996.
[2] Matlab formal web site www.mathworks.com.
[3] Pozar, D. M., and D. H. Schaubert (Eds), "the Analysis an d Design of Microstrip Antennas and Arrays, IEEE Press, New York, 1996.
[4] A.A. Oliner, G.H. Knittel, "phased array antennas", Artech House, INC. Dedham, Massachmsetts 02026.
[5] W.L. Stuzman, G.A. Theili, "Antenna theory and Design ". Johr Wiley& sons In c. 1981.
[6] R.C. Hansen , "phased array antennas",Wileyseries in microwave and optical Engineering, 1998. www.antenna-theory.com
[7] J. Microw. “Design of multiple function antenna array using radial basis function neural network” Optoelectron. Electromagn. Appl. vol.12 no.1 São Caetano do Sul June 2013
[8] Z.N. Chen, *Broadband Planar Antennas*, Hoboken, NJ: John Wiley & Sons, 2006.
[9] Elliott,R.S., *Antenna theory and Design*, Revised edition, Hoboken, NJ: John Wiley & Sons, 2003

BIOGRAPHIES

P. Sai Vinay Kumar obtained B.Tech degree in Electronics and Communication Engineering from KL University in 2013. He is pursuing his M.Tech (Communication Engineering and Signal Processing) degree from VR Siddhartha Engineering College, Vijayawada, India. His areas of interest are Antenna designing & Wave Propagation.

Dr.M Padmaja obtained B.Tech degree in Electronics and communications in VR Siddhartha college of engineering. She received her MS degree from BITS Pilani. She did her Ph.D program in the area of communications and signal processing in venkateswara university college of Engineering,Tirupati. She is currently working as Professor, Department of ECE in V R Siddhartha Engineering College, Vijayawada,India. She has taught a wide variety of courses for UG & PG students and guided several projects. She has published several papers in National & International Journals & Conferences. She is the life member of MISTE, FIETE, MIE(I), MBMESI, MSEMCEI.