

# Design and Analysis of H-cut Slot Antenna Using BBO Algorithm

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**Abstract-** In this paper a microstrip rectangular H-cut slot antenna is designed and results are optimised by biogeography based algorithm. FR4-epoxy is used as a substrate having thickness of 1.6mm and dielectric constant is 4.4. In this return losses are calculated and then optimised by biogeography based algorithm. In this effect of different material of substrate has been studied. The resonating frequency of this antenna geometry 4.9 Ghz, 7.3Ghz and 9.3 Ghz. This H-cut slotted antenna works for WLAN, Satellite and Radar applications.

**Keywords-** Biogeography Based Optimization, Microstrip, satellite.

## I. INTRODUCTION

Microstrip Antenna play an important role in modern wireless applications, such as radio, TV, mobile and satellite [1]. They are useful in high power transmission, reduced power consumption and enhanced spectral efficiency. The synthesis of microstrip antenna with desired pattern has been a subject of very much interest in the literature. Several well-known evolutionary optimization techniques; such as Biogeography based optimisation, particle swarm optimization (PSO), Taguchi optimization, genetic algorithm (GA), and differential evolution (DE); have been used in the synthesis of microstrip antenna [2-9]. Biogeography-Based Optimization (BBO) is a biology inspired optimization technique developed by Dan Simon in 2008 and is inspired by mathematical models of biogeography by Robert MacArthur and Edward Wilson. Biogeography based optimization (BBO) technique is a new global evolutionary multi-dimensional optimization method. It is based on the science of biogeography which is the nature's way of species distribution. The mathematical model of BBO is based on the extinction and migration of species between neighbouring habitats which is any island that is geographically isolated from other islands. Islands that are more suitable for habitation than others are said to have a high habitat suitability index (HSI). HSI is considered as a dependent variable. Another interesting variable is called suitability index variable (SIV) which characterizes habitability. It is an independent variable of

the habitat. BBO has already proven itself as a valuable optimization technique compared to other already developed techniques [10-13]. BBO adopts migration operator to share information between solutions like GA and PSO. BBO is applied to the sensor selection problem for aircraft engine health estimation and for general benchmark functions. The Markov analysis, on simple uni-modal, multimodal and deceptive benchmark functions with low mutation rates prove that BBO outperforms on GA. BBO is a new global optimization algorithm and has shown its ability to solve optimization problem.

## II. ANTENNA GEOMETRY

In this antenna design, a microstrip rectangular H-cut antenna is made on FR4-epoxy substrate. Microstrip feed line is used to excite antenna. The dimensions of the patch is  $40 \times 30$  mm. Design of simple patch antenna shown in fig.1.

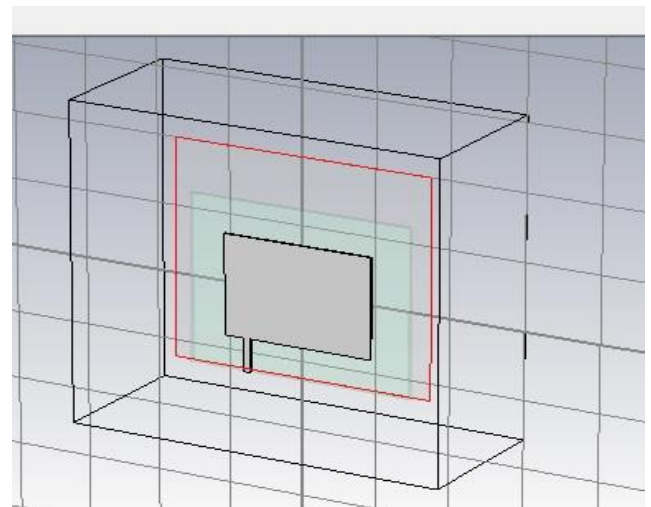


Fig.1: Design of basic patch antenna

In the basic patch antenna design H slot is cut. By cutting H-slot in the patch area of the patch will be reduced and s parameters will also be improved-cut slot antenna is shown in fig.2.

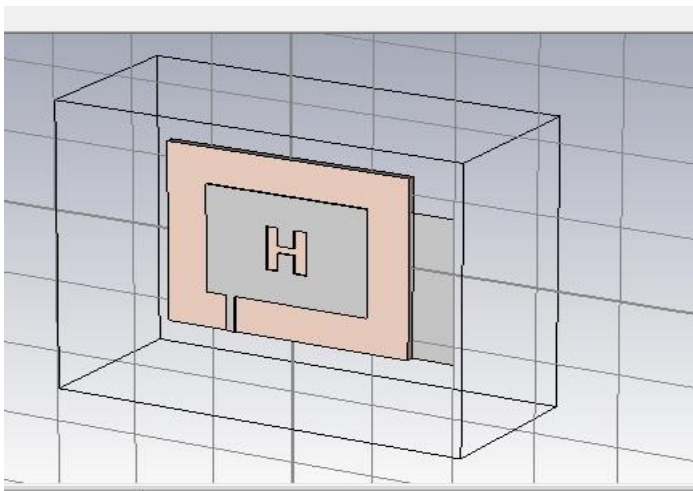


Fig.2 Microstrip Rectangular H-cut Antenna.

III. SIMULATION AND RESULTS

A. Return Loss of h-cut slot antenna and BBO algorithm

Return loss-In this paper return loss of proposed antenna has been studied and analysing results using CST and BBO algorithm. In this the return losses is more in the frequency range 7 to 8 ghz and S-parameter is about -45 db. And two another bands are at 4.9 and 9.3 ghz and their S- parameters are -17 and -37 respectively. In the fig.3 return loss of H-cut antenna has been shown. In this, results are optimized using BBO algorithm and in this compare the results that are obtained from CST and BBO.Fig.4 shows s parameter obtained from BBO. In this studied that at 7.4 Ghz, results of CST and BBO has been matched.

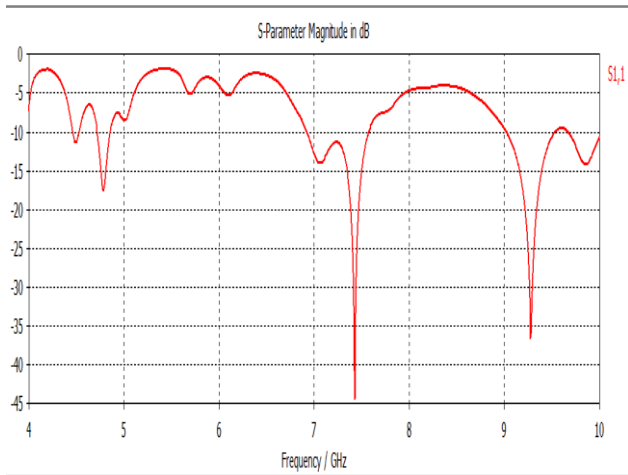


Fig.3 S Parameter of H-cut slot antenna

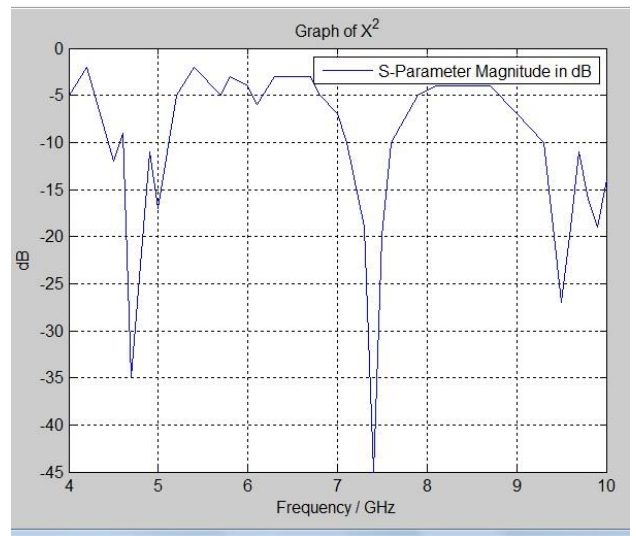


Fig.4 Output of BBO algorithm

B. Effect of different material on the return loss

In fig.5 and fig.6 return loss of different material have been studied. From the results concluded that the FR4-Epoxy shows better results than Rogger and aluminium nitride.

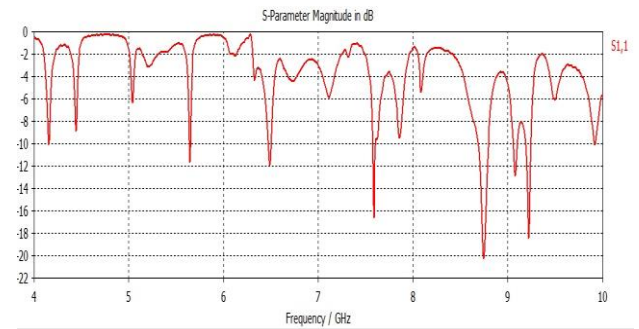


Fig.5 Return loss by using substrate aluminium nitride

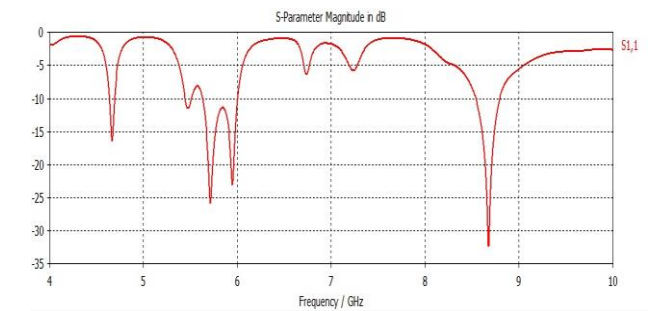


Fig.6 Return losses by using substrate Roger

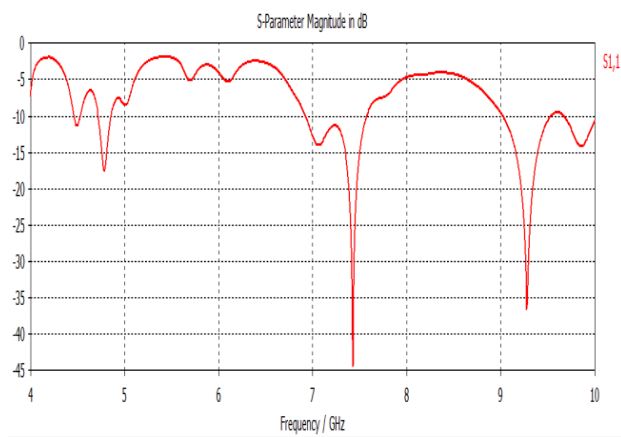


Fig.7 Return losses by using substrate FR4-Epoxy

#### IV. CONCLUSION

In this, a microstrip H-cut antenna has been studied. In this results obtained from CST and BBO has been compared and concluded that at 7.4 GHz frequency results are matched and at 4.9 GHz and 9.3 GHz results show large deviation. In this results of different substrate material have been compared and found that FR4-Epoxy has better results. This antenna works for WLAN, satellite and radar applications.

#### ACKNOWLEDGMENT

The author acknowledge Assistant Professor Sukhdeep Kaur of the department of Electronics and communication, JCDM college of Engineering, for her invaluable support.

#### V. REFERENCES

- [1] C. A. Balanis, *Antenna Theory: Analysis and Design*, John Wiley & Sons, New York, 1997.
- [2] G. Oliveri, and L. Poli, "Synthesis of monopulse sub-arrayed linear and planar array antennas with optimized sidelobes," *Progress In Electromagnetics Research*, PIER 99, pp. 109-129, 2009.
- [3] Perez Lopez, J. R. and J. Basterrechea, "Hybrid particle swarm-based algorithms and their application to linear array synthesis," *Progress In Electromagnetics Research*, PIER 90, pp. 63-74, 2009.
- [4] W. T. Li, X. W. Shi, and Y. Q. Hei, "An improved particle swarm optimization algorithm for pattern synthesis of phased arrays," *Progress In Electromagnetics Research*, PIER 82, pp. 319-332, 2008.
- [5] S. Zainud-Deen, E. Mady, K. Awadalla, and H. Harsher, "Controlled radiation pattern of circular antenna array," *IEEE Antennas and Propagation Symp.*, 2006, pp. 3399-3402.
- [6] L. Pesik, D. Paul, C. Railton, G. Hilton and M. Beach, "FDTD technique for modeling eight element circular antenna array," *Electronics Letters*, Vol. 42, No. 14, pp. 787-788, July 2006.
- [7] W. Mahler, and F. Landstorfer, "Design and optimization of an antenna array for WiMAX base stations," *IEEE/ACIS International Conference on Wireless Communications and*

*Applied Computational Electromagnetics*, 2005, pp. 1006 – 1009.

- [8] M. Al-Aqil, "Synthesis of antenna arrays using the particle swarm optimization method" Master Thesis, Jordan University of Science and Technology, Jan. 2009.
- [9] Nihad Dib, Sotiris Goudos, and Hani Muhsen, "Application of Taguchi's Optimization Method and Self-Adaptive Differential Evolution to the Synthesis of Linear Antenna Arrays," *Progress In Electromagnetics Research*, Vol. 102, pp. 159-180, 2010.
- [10] D. Simon, "Biogeography-based optimization," *IEEE Trans. Evolut.Computat.*, Vol. 12, No. 6, pp. 702–713, December 2008.
- [11] D. Simon, M. Ergezer, D. Du, and R. Rarick, "Markov Models for biogeography-based optimization," *IEEE Transactions on Systems, Man, and Cybernetics - Part B: Cybernetics*, vol. 41, no. 1, pp. 299-306, January 2011.
- [12] D. Simon, R. Rarick, M. Ergezer, and D. Du, "Analytical and numerical comparisons of biogeography-based optimization and genetic algorithms," *Information Sciences*, vol. 181, no. 7, pp. 1224-1248, April 2011
- [13] Ashraf Sharaqa and Nihad Dib, "Design of Linear and Circular Antenna Arrays Using Biogeography Based Optimization" *Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT)*, IEEE 2011