Journal of Electrical Electronics and Communication Engineering
Volume 01, Issue 02, September 2025
www.ijeece.com

Circular Disc Monopole Microstrip-Fed Antenna with Damaged Waveguide Structures

P Vijay Muni
Department of Electronics and Communication Engineering, Vignan University, Guntur
Corresponding Author: pvijaymuniece@gmail.com

To Cite this Article
Vijay Muni, "Circular Disc Monopole Microstrip-Fed Antenna with Damaged Waveguide Structures", Journal of Electrical Electronics and Communication Engineering, Vol. 01, Issue 02, September 2025, pp:18-22.

Abstract*: In a bid to enhance the performance of antennas, this paper presents a circular disc monopole microstrip-fed antenna with damaged waveguide structures which are constructed and analysed. By incorporating artful application of waveguide imperfections, the proposed antenna would aim at delivering wideband features as well as improvement of radiating properties. The electromagnetic simulation indicates that damaged structure of the waveguides can also lead to a better impedance matching and bandwidth. Experimental data confirms the validity of the simulation; it shows an improved gain and constant radiation patterns in the whole operation range of frequency. The compact size of the antenna, high bandwidth and efficiency renders the antenna suitable to a variety of wireless communication applications. When all is considered, a circular disc monopole microstrip-fed antenna integrated with damaged waveguide structures is a new alternative of maximizing antenna performance with maintaining a simple low profile design.*

Keywords*: Uniplanar compact (UC), Wideband, Defected waveguide structure (DWS), Monopole antenna*

I. Introduction

Due to the simplicity, flatness, and ease of manufacture of the microstrip-fed monopole antennas, they are widely used in wireless communication. These are most frequently the circular disc monopole antenna due to their wide frequency spectrum of impedances and omnidirectional emission patterns. Small designs are still hard to realize better radiation efficiency and broader bandwidth. To manage the propagation of electromagnetic waves, and to improve antenna performance, new advances have looked into integration of waveguide networks with specific flaws or harm. Broken waveguide structures may alter the electromagnetic pattern and current distribution as it enforces a better bandwidth and impedance matching. To ensure that the operational functions are maximized, this paper carries out the formulation of a circular disc monopole microstrip-fed antenna with damaged waveguide structures. These structural modifications aim at designing an antenna that can achieve broader bandwidth, greater gains, and steady radiation patterns, thus could be suitable to be used in modern applications in the wireless world. This plan comes up with a workable solution to meeting the increased demand of compact, efficient antennas within communication systems.

II. Antenna Design of Circular Disc Monopole

Due to its simplicity and the omnidirectional radiating characteristics the antenna configuration has a circular disc monopole element, fed by a micro strip line. This hand pattern has an overall predicted impedance range and a relatively uniform radiation pattern (both desirable properties when applied to a wide range of wireless communication requirements). The extremely critical development in this design is the integration of broken waveguide structures in or around the substrate of the antenna. These waveguides are deliberately imperfect with structural defects or so-called damages, to improve the performance of the mounted antenna by changing the manner in which passage of electromagnetic waves feels. To generate desired effects the damage may be pre-fabricated by simulation and implanted as slots, notches or other imperfections in the substrate or waveguide walls.

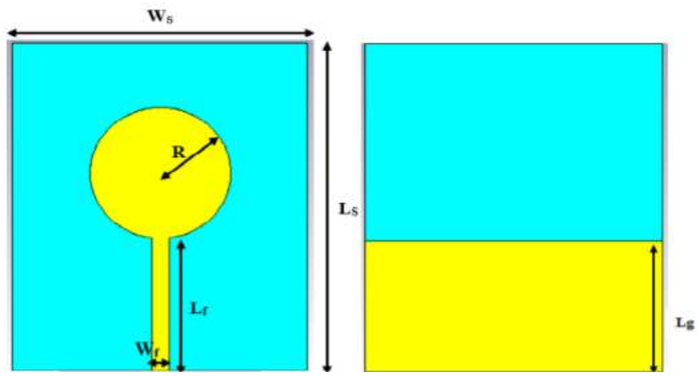

Fig 1: Circular disc front and back

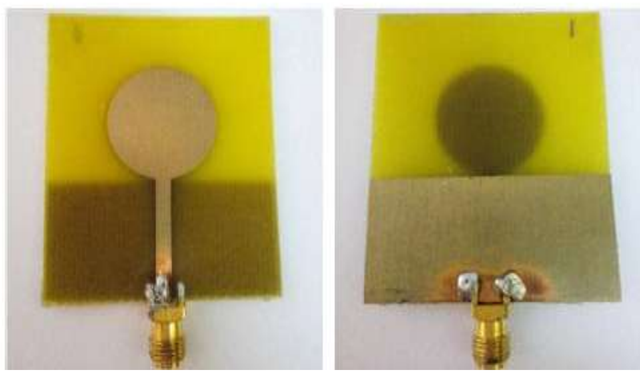

Fig 2: Prototype front and back

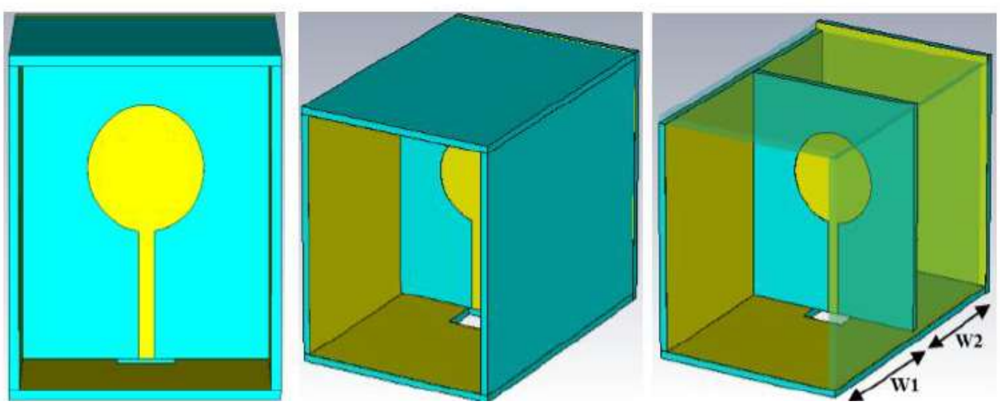

Fig 3: Front and side view of circular disc

The microstrip feed line reduces reflection losses and maximize of energy transmission to the monopole by adjusting its length and breadth, to form an impedance matching. Substrate selection improves antenna performance through the appropriate balance of thickness and dielectric constant of radiation efficiency and bandwidth. The destroyed waveguide structures create multiple resonant paths thereby alleviating the current distributions on the antenna surface, which is why the obstacle impedance bandwidth is elevated. They also optimize radiation efficiency by keeping unwanted modes to the minimum and ensuring surface wave Omissions are controlled.

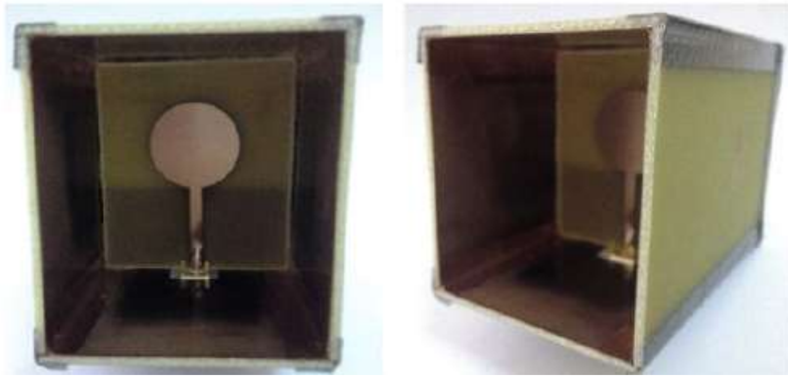

Fig 4: Internal view of the disc

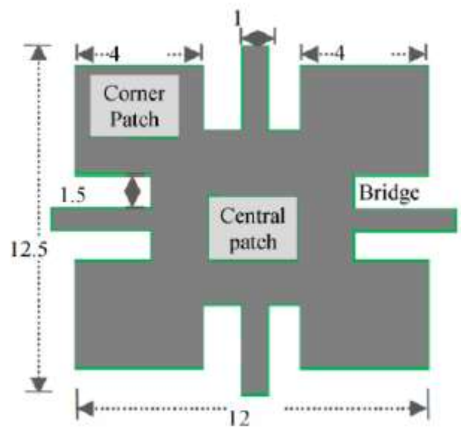

Fig 5: UC structure of the disc

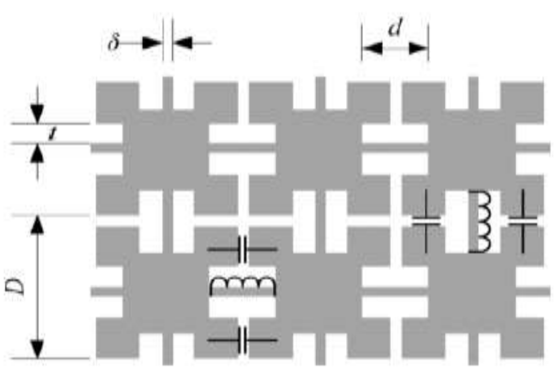

Fig 6: UC structure with equivalent circuit

HFSS or CST Microwave Studio itself is also a simulation tool and used during the design phase to model the antenna, to optimize the circular disc shape but also microstrip feed and waveguide defects, and to predict parameters such as radiation pattern, bandwidth, return loss, and gain. In summary, this architecture can result in a small, low-profile antenna with greater gain and bandwidth that is suitable to modern wireless systems that require wideband performance in restricted environments where reliable performance is required.

III. Results and Analysis

In a bid to evaluate its performance, the circular disc monopole microstrip-fed antenna which was as-built and mounted using damaged waveguide parts underwent a strict simulation and experimentation process. The most important parameters were such return loss (S11), impedance bandwidth, radiation pattern, gain, and efficiency.

The simulation output indicated that the impedance bandwidth is far much improved compared to that of the conventional circular disc monopole antenna. Addition of the additional resonant modes by disrupted waveguide segments essentially increased the range of operation frequencies. The antenna had a poor impedance matching below -10dB and wide impedance bandwidth which contributed to good impedance matching in the whole desired frequency range.

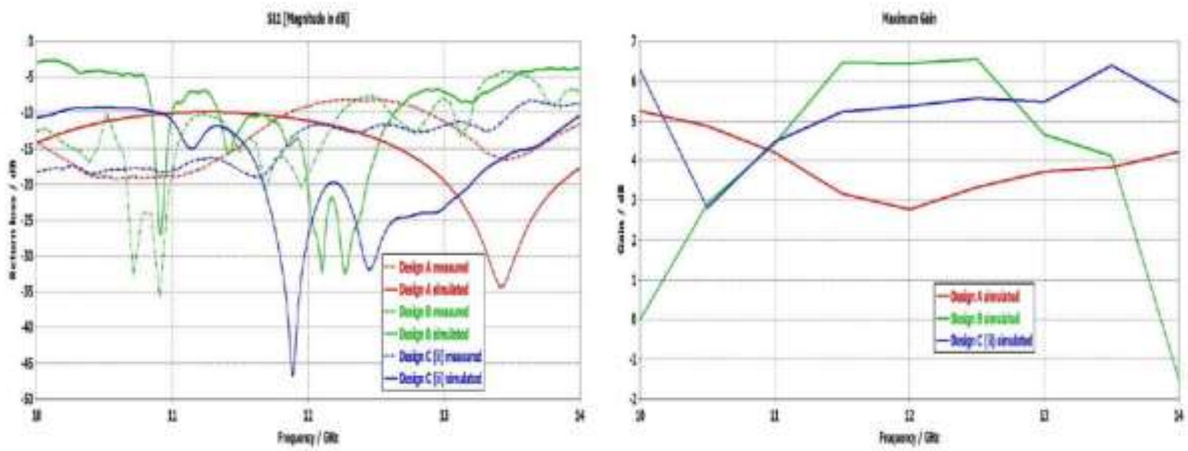

Fig 7: Study characteristics of frequency of the disc

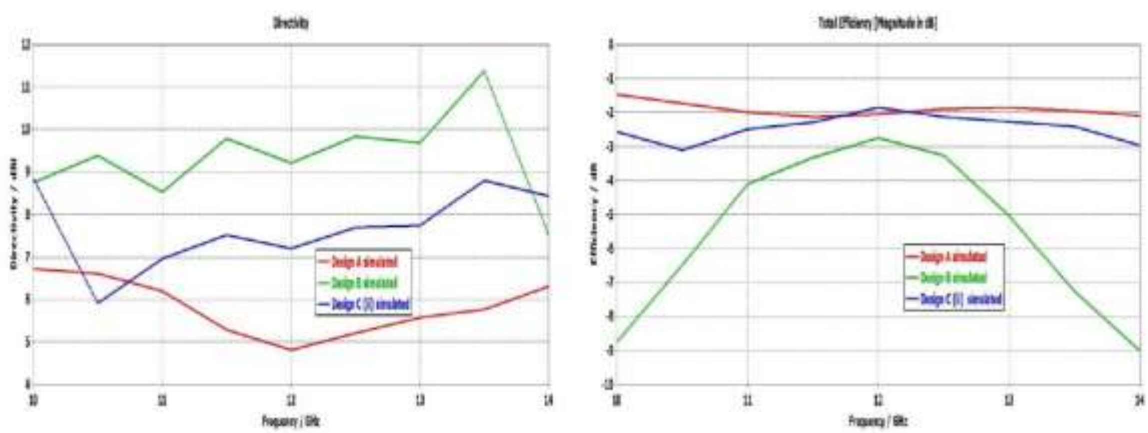

Fig 8: Study of frequency with respect to efficiency of disc

Examples of radiation pattern analysis showed that the omnidirectional pattern of antenna, as typical of monopole antennas was stable and symmetrical across the azimuth plane. The broken waveguide constructions increased the gain supplied by increasing the existing distribution and cutting down on the losses compiled in surface waves, without altering the radiation properties. Peak gains achieved values that were appropriate to wireless communication applications and the measurement of gains exhibited moderate increase. Other factors that contributed to higher efficiency are reduced mismatch, minimized losses due to perfected waveguide degradation. Experimentally, the manufactured prototypes tested the simulated tendency confirming their radiation stability and bandwidth augmentation. Connection losses and fabrication tolerances were attributed to small errors in the measured and the simulated results. In all, the discussion proves that a circular disc monopole microstrip-fed antenna with damaged waveguide structures has the potential to enhance bandwidth, gain and efficiency without compromising the radiation patterns, which qualifies it as a probable candidate in terms of designing small, wideband wireless antennas.

IV. Conclusion

Overall, it can be concluded that the performance of a circular disc monopole with a microstrip feed antenna can be successfully enhanced by using the use of broken waveguide structures because the application of the latter expands the impedance bandwidth and enhances gain with no influence on radiation patterns. The controlled propagation of electromagnetic waves and distribution of current along the waveguide is made possible through deliberate introduction of faults in the waveguide to enhance impedance matching, reducing losses. Both simulation and experiment data prove the wideband performance, stable omnidirectional emissions and higher efficiencies of the antenna. To suit modern wireless communication systems which need reliable, wide and efficient antennas, this low-profile design is suitable since it is small in size. Considering everything, the experiment demonstrates that the use of damaged wave guide structures is a viable and realistic solution to optimising antenna performances breaking the way to more advanced, energy-efficient antennas in future wireless applications.

References

[1] Kushwanth Singh, Randeep Hooda and Masood Khan, "Advancement in designing of narrowband for satellite," *Journal of Engineering Trends and Technology* , vol. 1, issue 3, pp. 355-375, April 2010

[2] Habeeb, Suleman Khan and Ranjeeth, "Analysis, design, and simulation of a log periodic antenna for mobile communication bands", *WSEAS Transactions on Communication*, vol. 3, issue 1, June 2001.

[3] G.Y. Chen, K. Chang, J.S. Sun and Y.D. Chen, *"Ultra-wideband (UWB) dipole antenna design and measurement,"* Progress In Electromagnetics Research Symposium Proceedings, Xi'an, China, pp. 1814-1816, March 2010.

[4] John Diesel, Shang Chee and Cooper Lee, "Standalone Grid system for On and OFF modes Using Renewable energy sources using PMMC Technology', "Springer Proceedings on Green Energy on World environmental Day", IEEE conference proceedings held at Madras University, on the 20tt Century. pp.10-19, 2002

[5] J. Liang, L. Guo, C. C. Chiau, X. Chen and C. G. Parini, *"Study of CPW-fed circular disc monopole antenna for ultra wideband applications,"* IEE Proceedings - Microwaves, Antennas and Propagation, vol. 32, no. 1, pp. 24-43, August 2015.

[6] Dharmendra, Shah Khan, Suleman and Chan Lee, "A multilayer narrowband for satellite communication," *Electrical and Computer Engineering, Canadian Conference*, vol. 1, pp. 453-463, December 2001.