

Design, Simulation, and Fabrication of a Fractal Square Microstrip Antenna Based on Spiral Slots with Dual-band Feature

Akeel Sami Tahir¹, Doha Al-Feadh¹, Wa'il A. Godaymi Al-Tumah^{1*}, Alistair P. Duffy²

¹ Department of Physics, College of Science, University of Basrah, 61004, Basrah, Iraq

² Department of Electrical Engineering, Computing, Engineering and Media, De Montfort University, LE1 9BH UK, Leicestershire, United Kingdom

* Corresponding author: wail.godaymi@uobasrah.edu.iq

ARTICLE HISTORY

Received

3 November 2025

Revised

2 February 2026

Accepted

15 February 2026

Published

22 February 2026

KEYWORDS

Microstrip Antennas
Square Patch
Fractal Antennas
HFSS Software
C-bands
Dual band

ABSTRACT

Microstrip antennas offer versatile operational capabilities, including wideband, dual-band, multiband, and compact configurations, depending on the geometry of the radiating patch. Fractal concepts have emerged as an effective approach for reconfiguring antenna patches to enhance bandwidth and multiband performance. In this study, a novel fractal-patch microstrip antenna is proposed to achieve wideband characteristics suitable for multifunctional wireless communication applications. The antenna employs a square fractal patch incorporating etched spiral slots and semicircular cuts at each corner, with overall dimensions of $79 \times 50 \times 1.59 \text{ mm}^3$. The design was simulated using Ansoft High Frequency Structure Simulator (HFSS) based on the finite element method (FEM). Key performance parameters, including input impedance, return loss, voltage standing wave ratio (VSWR), gain, surface current distribution, and radiation patterns, were analysed. The proposed antenna demonstrates dual-band characteristics, resonating at 4.23 GHz and 7.13 GHz within the C-band region. Simulated results show VSWR values of 1.17 and 1.06 at 4.01 GHz and 7.10 GHz, respectively, indicating good impedance matching and stable radiation performance. Fabricated antenna measurements were conducted and compared with simulation results, showing satisfactory agreement. The proposed fractal-patch microstrip antenna exhibits reliable dual-band operation and favourable radiation characteristics, making it suitable for C-band applications such as satellite communication, internet telecommunication, and mobile feeder systems. Its stable performance under varying weather conditions further supports its potential for practical wireless communication services.