National Institute of Technology Rourkela

Progress Seminar

Seminar Title	: Investigations on Fractal Antennas for Biomedical Applications
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Venue	: Seminar Hall (EC-303)
Date and Time	: 19 May 2025 (11AM)
Abstract	: Fractal antennas have emerged as a cutting-edge technology for wireless data transmission, reception, radio communication, and radar tracking. In **design-1** the proposed antenna integrates a 2nd order Vicsekcross fractal geometry along with a 2nd order Koch Curve fractal, optimizing its structure for multiband operation and miniaturization. The proposed VKFA covers an operational frequency range from 16.92 GHz to 18.74 GHz, demonstrating a peak gain of 5.14 dBic at 17.19 GHz, with good gain throughout the band. The current vector distribution plot reveals that the antenna features two L-shaped slots positioned 180° apart at the center of the radiating patch to achieve circularly polarized (CP) radiation. By etching these L-shaped slots into the patch, two orthogonal field components are generated, enabling CP characteristics. In **design-2** presents a T-Square fractal antenna with multiband characteristics. The radiator shape designed is based on 2nd order T-Square fractal geometry. The multiband antenna exhibits three resonant frequencies 7.84 GHz,8.64GHz and 10.98GHz. The inclusion of defected ground plane (DGS) technique that comprises a circular slit cut in the ground plane helps further to enhance impedance bandwidth. The achieved bandwidth7.74-7.96GHz,8.49-8.83GHz and 10.72-11.14GHz respectively. In **design-3** the design of a rectangular fractal patch antenna, incorporating microstrip line feeding and optimized for operation in the 1.69&ndash2.70 GHz frequency range, catering to S&C-band applications. A machine learning (ML) model is trained on a dataset of 151 samples to optimize the antenna design. The dataset is generated by varying the width and length of the rectangular patch along with width feedline and the length of ground plane. The ML model predicts the optimal dimensions based on the dataset, minimizing errors and refining the antenna design. Various ML techniques are explored, with an XGB regression model providing the best results, achieving an R^2 value of 99.85, RMSE of 0.1144, MAE of 0.068, and MSE 0. 0130.Finally, i**design-4** This article presents the design of a dual-band hybrid fractal antenna. The Machine Learning (ML) techniques are applied to enhance the performances of dual-band hybrid fractal antenna. The research presents a combination of simulation, and experimental verification along with an equivalent circuit model to evaluate the antenna's performances. The hybrid fractal antenna is an amalgamation of Vicsekcross and Sierpinski carpet geometries so it termed as Vicsekcross Sierpinski Antenna (VSA). The proposed antenna has a coaxial feed positioned at 45o with a dielectric substrate RT/Duroid 5880TM (���� = 2.2). A maximum gain response of 7.54 and 5.87 dBi are observed in the frequency ranges of 3.55- 3.65 & 5.69-5.92 GHz. The radiator operational frequency bands are 0.10 GHz (3.55- 3.65 GHz) and 0.23 GHz (5.69-5.92 GHz).