National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Compact Hybrid Fractal Antennas for Defense Applications
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Venue	: Seminar Hall (EC-303)
Date and Time	: 27 Jun 2024 (11AM)

Abstract : Technology surrounding us these days are fundamentally comprise of sources efficiently radiating electromagnetic waves, *The Aerials or Antennas.* The design of ultrathin, high-performance antennas capable of meeting multiple standards presents significant challenges for antenna designers, particularly in the context of today's compact handheld and portable devices. Fractal geometries play a crucial role in antenna applications, demonstrating varying degrees of success in enhancing antenna characteristics.

This thesis explores several wideband fractal monopole antennas. The research begins with the design and implementation of Koch fractal, Minkowski and hybrid fractal antennas. A comprehensive discussion covers their operational principles, electrical behaviours, and performance metrics. The performance of these designs has been evaluated using industry-standard simulation tools and has been experimentally verified.

The fractal antenna foundational concepts employed in the design of wideband fractal monopole antennas. The proposed circularly polarized high gain antenna undergo simulation and experimental validation. Different types of antennas are presented based on fractal geometries. Detailed analyses of surface current, field distribution during antenna resonant modes, and corresponding radiation patterns are conducted. One of a compact Koch curve fractal boundary antenna with circularly polarized characteristics is studied. The structure exhibits stable radiation characteristics with high gain response covering the entire operational band for space applications operating in the S-band.

A compact &pi-shaped circularly polarized fractal antenna is investigated. The prototype is incorporated with the combination of initiator Koch curve and 2^{nd} order Minkowski fractals. The hybrid fractal element yields improved antenna parameters in terms of higher gain response, steady radiation characteristics over the impedance bandwidth essential for radar applications functioning in the X-band.

Furthermore, the work extends to the investigation of a corporate feed sequentially rotated 2×2 circularly polarized hybrid fractal antenna array for space borne tracking applications. The prototype is developed with hybrid fractals geometries to improve the overall performance characteristics of the elements. The array shows stable radiation behaviour over the span of S-band in terms of enhanced gain, stable patterns, and better cross-pol levels over the operational band which are crucial for the intended applications. This research examines the effectiveness of fractal geometries in antenna design, highlighting their true advantages in antenna engineering.