National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Investigations on Reconfigurable Fractal Antennas
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Venue	: Seminar Hall (EC-303)
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Abstract : With the continuous advancement of technology, there is an increasing demand for multifunctional wireless devices capable of providing comprehensive connectivity along with diverse multimedia features. To integrate such functionalities, multiple components are consolidated into a unified wireless platform, thereby increasing hardware density and complexity in accordance with Moore&rsquos law. Beyond multiband wireless support, ensuring reliable signal quality under varying climatic conditions to maintain stable connectivity and high data rates introduces additional design challenges for the Radio Frequency (RF) front-end circuitry. As the necessity for wide spectrum coverage and several standard requirements increased gradually, it became difficult to maintain with the sophisticated compact radiators and conventional complex antennas. Therefore, the Reconfigurable Fractal Antenna (RFA) technique has emerged as a key focus for researchers, being regarded as one of the most effective solutions to address the aforementioned challenges. Reconfigurability, in particular, has become a highly sought-after attribute in advanced RF systems, playing a crucial role in enhancing performance across applications such as wireless and satellite communications, imaging, and sensing. This dissertation aims to develop new design methods for multifunctional antennas to overcome the challenges described earlier. The goal is to enhance the performance of microwave systems by proposing innovative antenna structures and configurations that offer better connectivity, higher data rates, and improved reliability across different environments. The research begins with the design and implementation of wideband fractal antennas, frequency or polarization or pattern and hybrid RFAs. 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 with reconfigurable foundational concepts employed in the design of multifunctional wideband antennas. Various types of radiators are presented based on fractal structures and reconfigurable characteristics. 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 frequency reconfigurable characteristics is studied. The structure exhibits stable radiation characteristics with high gain response covering the entire operational band. A polarization RFAs with high gain is proposed for wideband applications. This simple structure monopole antenna consists of a Koch curve based hexagonal ring radiating patch, two switches (PIN diodes), and partial ground. The proposed antenna has demonstrated good polarization-reconfigurable characteristics between the band coverage of 3.91 GHz and 7.91 GHz. Furthermore, the work extends to the investigation of a circular polarization and pattern reconfigurable Sierpinski fractal patch simultaneously operating at various tunable bands. The prototype is developed with hybrid reconfigurable radiation characteristics to improve the overall performance characteristics of the antenna. This research examines the effectiveness of fractal geometries and reconfigurable radiation characteristics in antenna design, highlighting their true advantages in antenna engineering.