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# Reconfigurable Fractal Antenna for Cognitive radio

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***Abstract*— Reconfigurable antennas have ability to adjust their geometry and behavior to get used to changes in environmental conditions or system requirements. Such as enhanced bandwidth, change in operating frequency, polarization, radiation pattern etc. This paper discusses the use of multiband reconfigurable fractal antennas for cognitive radio once a cognitive device manages to learn the RF environment (cognition part), from past observations and decisions using machine learning techniques.**

***Keywords*— Smart antennas, Slot antennas, Fractal antennas, Ultra wide band antenna, Sierpinski gasket antenna.**

## I. Introduction

This Antennas have become an essential and critical element of all person electronic devices, microwave and satellite communication systems, radar systems and military surveillance and investigation platforms. In many of these systems, there is a constraint to perform a concourse of functions across several frequency bands and operating bandwidths, particularly in the area of Cognitive radio.

Reconfigurable RF-MEMS antenna systems were first introduced in 1998 by E. R. Brown [1]. Reconfigurability in an antenna system is a preferred quality that has been the focal point of much research in recent years. Reconfigurable antennas can thus provide great profitableness in applications such as cognitive radio, MIMO systems, smart antennas, RFIDs etc [2]. There are different types of reconfigurable antenna have been used for UWB and Multiband antennas. Various slot antennas have been used for UWB frequency range and several fractal antenna have been used for multiband frequencies. A fractal antenna can be designed to receive and transmit over a wide range of frequencies through the property of space filling and self-similarity at different physical scales [3]. A famous fractal antenna that is based on the Sierpinski gasket geometry have also been used for multiband purpose [4, 5].

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In this work a Sierpinski gasket reconfigurable antenna was designed and simulated to cover the spectrum for UWB ( Ultra Wide Band frequency) and Multiband frequencies. It is also used for cognitive radio.

## II. Reconfigurable Fractal Antenna Structure

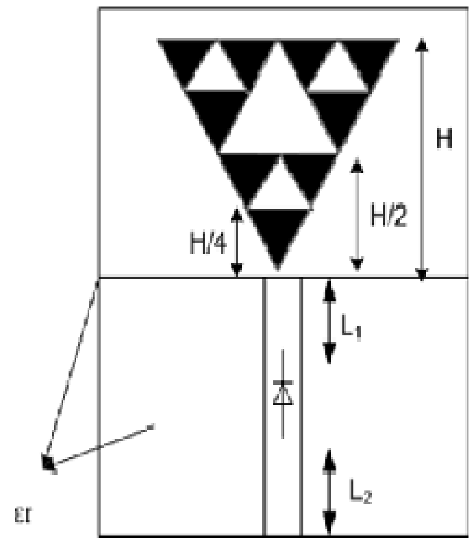


Figure 1. Reconfigurable Sierpinski fractal antenna

The whole Sierpinski fractal monopole antenna structure was printed on a dielectric sheet whose dielectric constant $\varepsilon_r$ =2.5 and thickness is 1.588 mm. The upper part of the antenna was only printed on the dielectric and lower part of the antenna was printed on dielectric below the ground plane. This antenna has three resonating frequencies that is based on the geometrical parameters (H=22 mm.) and (*r*=1/2). These H and *r* parameters represents the height of the overall gasket antenna and scaling of the fractal geometry respectively. This multiband antenna was made as reconfigurable antenna by putting a diode on the λ/4 microstrip line. A inserted diode is switched on/off according the position $L_1$ and $L_2$. These positions are based on which resonating frequency can be reconfigured for cognitive radio. A coaxial feed on microstrip line was used for the turn on and off the frequency.

# III. Reconfigurable Fractal Antenna Results

This reconfigurable antenna was simulated on CST software. It has three resonating frequencies 1.8, 5.5 8.5GHz as shown in Figure. 2. These frequencies were used in Wi-Fi, cordless telephone and satellite communications.

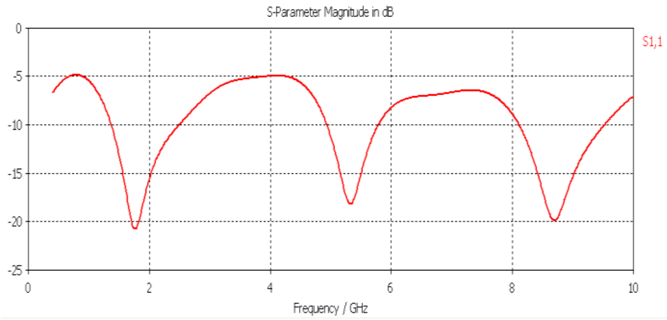


Figure 2. $S_{11}$ plot vs frequency

As inserted diode was switched on, there is only one frequency will be available for the secondary user and other two frequencies were made off. When diode is forward bias then middle frequency is on ($S_{11}$< -10 dB) and more dominating with respect to other two as shown in Figure. 3.

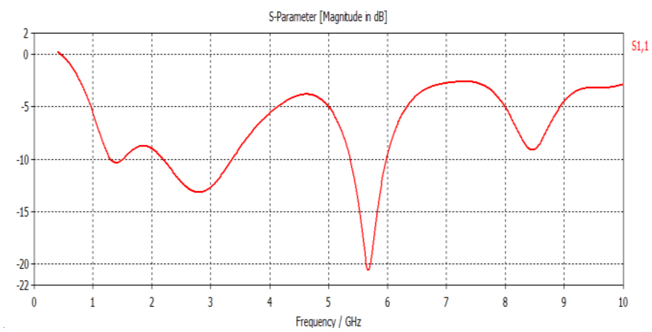


Figure 3. Return loss vs frequency when diode is FB

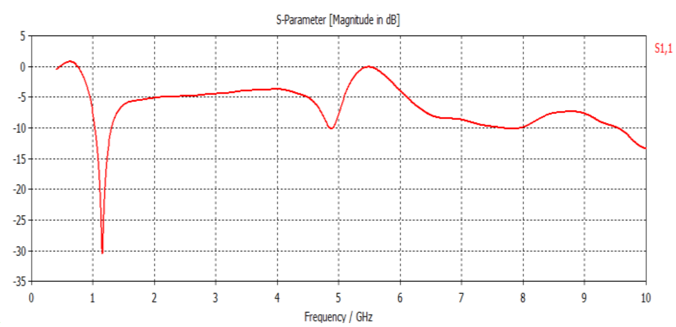


Figure 4. Return loss vs frequency when diode is RB

When diode is reverse bias then first frequency is more dominating than the two, which are less dominating or off ($S_{11}$> - 10 dB) as shown in Figure. 4. In this simulation, equivalent circuit of diode as forward Bias (FB) and reverse bias (RB) have been used. A coaxial feed was used for the turn on and off the frequency.

# IV. Conclusions

A smart multiband reconfigurable fractal antenna based on Sierpinski geometry using diode was presented for cognitive radio receiver. A Smart antenna technology has the prospective of leading to large increases in system performance.

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