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Saw-Tooth Shaped Sequentially Rotated Fractal Boundary Square Microstrip Patch Antenna for Wireless Application

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Abstract—This paper presents a new saw-tooth shaped sequentially rotated fractal boundary (SRFB) square microstrip patch antenna (SMPA) for wireless application. The square shape is rotated by an angle 'θ' and superimposed, realizing fractal like geometry at boundary. The rotation of square shaped patch is divided in equal number of scaling angles θ_n such that for every iteration of angle θ, fractal boundary geometry has been realized. The square shape is modified into a circular shape patch resonating at 2.5 GHz. A 45° tilted rectangular slot is cut inside the radiating element to achieve circular polarization at 2.45 GHz. The antenna is fabricated using an RT Duroid 5880 substrate, having size of 70 mm × 70 mm. The antenna offers measured impedance bandwidth (VSWR < 2) of 50 MHz (2%) with simulated peak gain about 7 dBi. The fabricated antenna is tested, and measured results are in close agreement with simulated ones.

1. INTRODUCTION

The demand of microstrip patch antennas (MPAs) in wireless communication is increasing because of their numerous advantages like low profile, direct connectivity to Radio Frequency (RF) circuitry, planar structure, etc. These MPAs are desirable to offer several characteristics as multiband or broadband response with compact size. Fractals are self-similar structures commonly inspired from nature. Fractal antenna research is primarily focused on developing multiband or compact MPAs [1, 2]. Fractal shaped antenna geometry realizes different performance modifications in MPAs. These self-similar structures can be inside the radiating patch or at an outer edge of patch exhibiting advantages like multiband response or lowering the resonance frequency bands respectively [3–14]. Various fractal shaped antenna geometries such as Sierpinski fractal, Koch fractal, and crown shaped fractals have been designed and developed by different researchers for various wireless applications.

Circularly polarized (CP) MPAs are preferred for wireless communications, as these antennas are unaffected by multi-path propagation delays, Faraday's rotation effects, and direction of transmitter and receiver antennas [15]. These advantages of CP lead to the design of single coaxial feed microstrip patch antennas with circular polarization. The hybrid antenna structure consisting of Koch fractal geometry along with meandered slit and defected ground structure has been reported for wearable wireless body area network application [3]. A wide band circularly polarized tilted fractal slot monopole antenna has been presented in [4]. A compact fractal square shaped MPA for dual-band wireless applications has been reported [5], and a Sierpinski gasket fractal antenna structure and their properties have been discussed in [6].

In last few years, the design and optimization of fractal like geometrical structures and their performance evaluation using many bio-inspired soft computing techniques have been reported. The use of bio-inspired optimization technique along with Artificial Neural Network (ANN) helps to design

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