Design of Simple Multiband Patch Antenna for Mobile Communication Applications Using New E-Shape Fractal

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Abstract: The layout and investigation of a penta band nested round slot fractal antenna with line feeding approach is presented in the current work for multiband programs. The proposed antenna is fabricated on 1.6mm thickness Rogers RT/duriod 5880 substrate fabric with a dielectric constant of 2.2 and length of 88.5mmx60mm. Four iterative steps are tailored in designing and achieving the specified parameters of the antenna. The designed antenna resonates at multi frequency band packages from 4.5GHz (4.56GHz–4.60GHz), 5.3GHz (5.33GHz–5.40GHz), 7.0GHz (6.99GHz–7.04GHz), 8.4GHz (8.30GHz–8.49GHz) and 9.5GHz (9.46GHz–9.61GHz). The radiation patterns found out within the proposed antenna is Omni-directional styles accomplishing a minima l benefit of 1.07dBi and a most gain of 7.89dBi. After a right structure choice and iterative analysis the antenna is designed and simulated to resonate at Microwave frequency band for packages like S-band and C-bands.

I. INTRODUCTION

Antennas are key additives of any wireless system. “Part of a transmitting or receiving system this is designed to radiate or get hold of electromagnetic waves.” In case of wireless verbal exchange systems, antennas play a outstanding role as they convert the digital alerts into electromagnetic waves efficiently.

Micro Strip Antenna: A Micro-strip patch antenna includes a radiating patch on one aspect of a dielectric substrate which has a floor aircraft on the other side.

II. FEEDING TECHNIQUES:

Micro-strip Line Feed : In this type, a conducting strip is hooked up directly to the edge of the micro-strip patch.

Coaxial Feed: The coaxial feed introduces an inductance into the feed that can need to be taken into consideration if the height –h receives large. Further, the probe will even radiate, which could lead to radiation in undesirable guidelines.

Aperture Coupling: Every other method of feeding micro-strip antennas within the aperture feed on this approach, the feed circuitry is protected against the antenna through a conducting plane with a hollow to transmit strength to the antenna.
where k=1,2,……,N; wherein k is the variety of iteration ,Lbk is the width of subtracted rectangle, and Lsk is the width of foremost rectangle. In our proposed antenna, the idea of parameter n is not altered, but its value can fluctuate from one fractal new release to the next. also in every new release, 3k new branches are generated. it is investigated that in the prototype Koch fractal antenna, with the increase within the iteration, the scale of the radiating patch will increase and the resonant frequency diminishes. however, inside the new E-shape fractal antenna, with the boom in iterations, the floor of the radiating patch reduces

B. E-form Fractal Patch Antenna layout:

The configuration of the proposed probe-fed 0.33-order E-shape fractal patch antenna with optimized dimensions is shown in Fig. 1(b). The antenna is built of a single patch on top, two layers of dielectric (air and FR4), and a vertical probe connected from ground to the higher patch. The rectangle patch of antenna \((W_{S1} \times L_{S1})\) with E-shaped fractal such as geometrical parameters \((W_{B1}, L_{B1})\) is supported by using FR4 substrate with relative dielectric steady of 4.4, thickness of \(h = 1\) mm, and \(\tan \delta = 0.02\). In this design, an air-filled layer or foam has been considered necessary to realise multiband traits. An air-crammed layer with dielectric permittivity \(\varepsilon_r = 1\) and thickness of \(h_{air}\) is sandwiched among the substrate and the ground aircraft. usually for design of patch antennas, an infinite floor plane has been meant. but, in realistic, the scale of the ground aircraft is taken to be greater than six instances the substrate thickness in all of the guidelines with respect to patch dimensions to diminish the effect of the finite ground plane [nine]. In this example, the floor aircraft is meant to be 2 cm larger than antenna structure in each facet. The proposed patch is embedded on the substrate symmetrically with respect to the centerline (Y-axis). The patch is fed by way of a right away-related probe along the centerline additionally vertically positioned \(y_{p} = 1\) cm from the lower fringe of the antenna to achieve the first-rate impedance matching.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

A parametric study of the proposed patch antenna was carried out to achieve multiband performance. In order to investigate the effect of the different iterations of E-shape fractal on the antenna performance, four iterations of E-shape fractal as shown in Fig. 2 are chosen as follows: first iteration with consist of three branches (1EFPA); second iteration with \(n_1 = L_{B1}/L_{S1}\) and \(n_2 = 2n_1\) consist of n nine branches (2EFPA); third iteration with \(n_1 = L_{B1}/L_{S1}\) and \(n_2 = 2n_1\) and \(n_3 = n_1\) consists of 27 branches (3EFPA); fourth iteration with \(n_1 = L_{B1}/L_{S1}\) and \(n_2 = 2n_1\) and \(n_3 = n_1\) and \(n_4 = n_1\) consists of 81 branches (4EFPA). According to the simulation results in Fig. 2 and Table I, the 1EFPA is
matched at the GSM850/900 bands, the second design using second iteration E-shape fractal improves the matching to the GSMR850/900/1800/1900/UMTS, and the 3EFPA enhances the former design behavior including the LTE2300/2500 bands, approximately.

The 4EFPA compared to 3EFPA produces a new band in C-band (3700–4200 MHz), but C-band and WWAN/LTE have different applications. Therefore, we choose 3EFPA as an optimized design. Also, from Fig. 2 and Table I, it is observed that as the number of iterations increases, not only do the new frequency bands appear, which demonstrates the multiband trait of the fractal E-shape antenna, but also the operating band in previous iterations remains almost fixed.

Fig. 4 shows the measured and simulated return loss and simulated radiation efficiency. The effect of air gap \( h_a \) on the 3EFPA performance was investigated in Fig. 3. At an increase of \( h_a \) from 2.5 to 10 mm, the resonant frequencies of second and third bands shift toward to the higher frequencies, while the first resonant frequency remains almost fixed.

The implemented dimensions of the geometry parameters of the fabricated 3EFPA antenna are chosen to achieve the optimum performance as predicted from the parametric analysis described in this section and Table I. Fig. 4 shows the measured and simulated return loss and simulated radiation efficiency and measured gain of the fabricated prototype. The return loss was measured using an Agilent 8722ES network analyzer. It is clearly distinct that results of these two investigations closely meet each other and sometimes the measurement results 90%. Antenna gain and radiation efficiency is about 6–6.5 dB and 90%–93% over the third band for LTE2300/2500, which are acceptable for practical applications. For a complete study of the far-field performance of the proposed 3EFPA, we present measured normalized E- and H-planes radiation patterns and simulated current distribution and simulated current distribution for the simple rectangle patch antenna at the three resonance frequencies at 940, 1810, and 2425 MHz in Fig. 5. Beyond the overall similarities, the patterns as broadband radiation patterns with low cross-polarization radiation in the E- and H-planes exhibit some disagreements among bands as well. Mainly, additional lobes tend to display for increasing frequencies [10]. Also, in order to get a deeper physical insight on the behavior of the 3EFP antenna, current density distributions over the fractal surface are presented in Fig. 5. Studying of current distribution reveals that the antenna works in three different hybrid modes at three resonance frequencies. Therefore, in higher frequency, E- and H-plane pattern has slightly altered, as shown in Fig. 5.

V. CONCLUSION

A novel compact multiband fractal published patch antenna has been proposed with simulated and experimental consequences. E-shape fractal patch has been hired to size reduction and enhance the range of operating bands. The proposed E-shape fractal antenna has the frequency resonates at 945, 1945, and 2470 MHz with huge bandwidths of 250 MHz (820–1070 MHz, 26%), 400 MHz (1750–2150 MHz, 20%), and 260 MHz (2340–2600 MHz, 10%) to cover GSM850/900, GSM1800/1900/UMTS, and LTE2300/2500, respectively. Main parameters of operating bands are the return loss, impedance bandwidth, and far-field characteristics had been studied. Therefore, the proposed antenna makes the use of multi band communication with the satisfactory characteristics.

REFERENCES