Comparison of Split Ring Slot Circular Patch Antenna and Triangular Patch Antenna

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Abstract

This Paper present the comparison of split ring slot circular patch antenna and triangular patch antenna designed for multiband purpose in wireless communication. Triangular patch antenna is designed for S and C band applications. Circular patch antenna is designed for K and Ka band applications. Triangular patch Antenna and circular patch antenna are designed with RT/Duroid 5880 substrate and microstrip feeding. Electric field distribution along the slots is manipulated to create many short circuits along the slots. S parameter and other radiation characteristics are studied of both antennas. Advance Design System 2011-10 is used for simulation of these designs. Multiband operation is verified by simulated result.

Keywords: Coaxial probe, Microstrip antenna, Patch Antenna, Resonant Frequency & Scattering Parameter

I. INTRODUCTION

Current advancement in printed antenna technologies have resulted in variety of different techniques for designing low profile, cost effective and high efficient wideband antennas. [4] Most of techniques deals with marginal improvement in no. of Band on which antenna can operate, such as patch with air substrate. [8] However, not much attention has been paid for improving the no. of Band in existing technique. The designs presented in this paper consists of two split ring slots with gap facing opposite to each other in circular patch antenna and split ring slot triangular patch antenna. Studies of similar design with split ring facing in same direction and using Fr4 substrate shows only two frequency band at 2 and 3 GHz [8]. Compared to that design the design presented in this paper produce multiple bands with same directivity and other measured parameters. Further the design provides the flexibility to optimize the parameters by changing the width and relative position of slot.

II. DESIGN PROCEDURE

A way of increasing the no. of band with relative high gain is a Slot Antenna. When a relatively wide slot antenna is fed with a narrow microstrip line, the electric field generated by that part of the Microstrip line over the slot (which does not have a ground plane), cancels the slot electric field, generated by the return current of the microstrip-line in the ground plane, at a certain location near the feed. This creates a fictitious short circuit along the slot near the microstrip feed and hence, generates a fictitious resonance with a frequency, which is slightly higher than that of the main resonance. [3] The next challenging step is to examine whether it is possible to create more than one fictitious short using a similar approach or not. If this is possible, the no. of band for the antenna can be drastically increased by merging these fictitious resonances. In order to test the validity of this idea, we begin with modify a circular Patch antenna to be used for multiband operation by creating a Slot (having Arc shape) inside it as shown in fig 1. The circular patch has a diameter 23.6mm; with two concentric split rings slot of width .5mm and 1mm gap between them. The arc angle of the split gap of outer ring was kept 23^{o} and split gap of inner ring slot is 2mm. The RTDuroid/ 5800 substrate with height h=1.588mm is used in this work. The triangular patch is equatorial has dimension 100mm; with split rings slot of width 2mm and centred at median of triangle. The inner and outer radius of ring slot is 15mm and 17mm respectively with split of 2mm. The RT Duroid substrate with height h=1.59mm is used in this work. The design was simulated with the help of ADS-2011, which uses method of moment to analyse the antenna. Fig 2. Shows the design of split ring Equilateral Triangular patch antenna, with impedance at the midpoint of a side is 187.4048Ω which is matched to two 100 ohm lines in parallel gives 50 ohm impedance which is matched to 50 ohm port impedance through a 50 ohm line.

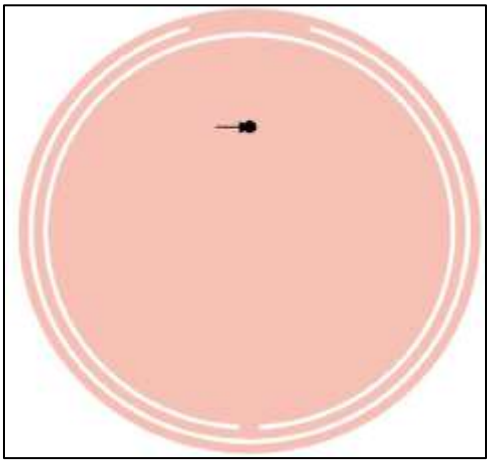

Fig. 1: circular patch antenna

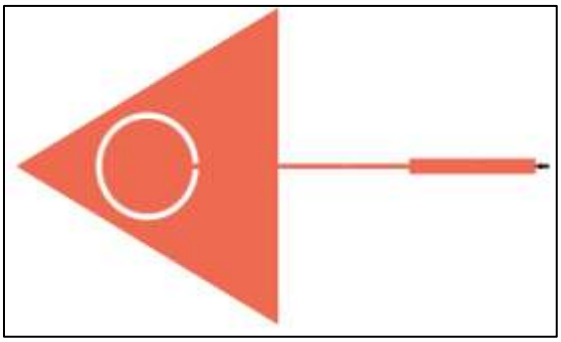

Fig. 2: Triangular patch antenna

III. THEORY

The procedure of analysis of fed and unfed patch antennas using the cavity model is well known. For the equilateral triangular patch, however, the resultant expressions are rather lengthy. For reference purposes the formulas for resonant frequency is given in this section. Their derivations are omitted.

Circular patch is most popular configuration, the modes supported by circular microstrip antenna are TMz, where z is perpendicular the patch. There is only on degree of freedom to control i.e. radius of patch. [4] There is no effect on operating mode by changing the radius; however it does change the absolute value of resonant frequency of each [6]. Circular patch antenna can be analyzed conveniently using cavity model [7]. The formula for resonant frequency and input impedance at the feed point is given by (1) and (2) respectively [4]

IV. RESULT ANALYSIS

The simulation result verifies the multiband behavior of both antenna. The scattering parameter of circular patch antenna design is shown in fig 3.There are total six bands at 8.025 GHz, 9.177 GHz, 10.17 GHz, 11.20 GHz, 12.03 GHz, and 13.13 GHz.

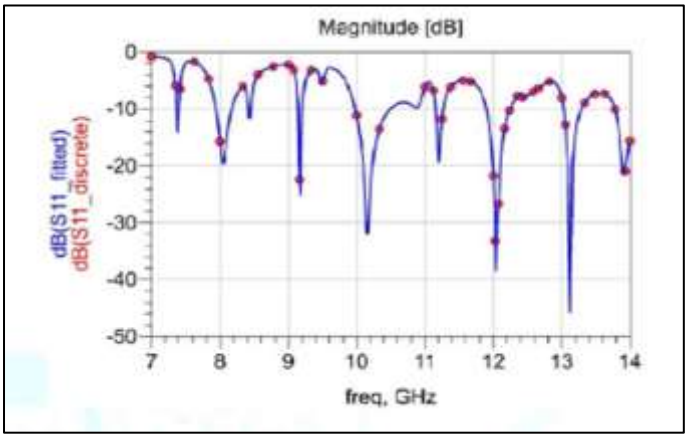

Fig. 3: S parameter of circular patch antenna

The simulation of triangular patch antenna shows its dual band operation. The scattering parameter of design is shown in fig 4.There are total two bands at 2.366 GHz and 4.518 GHz.

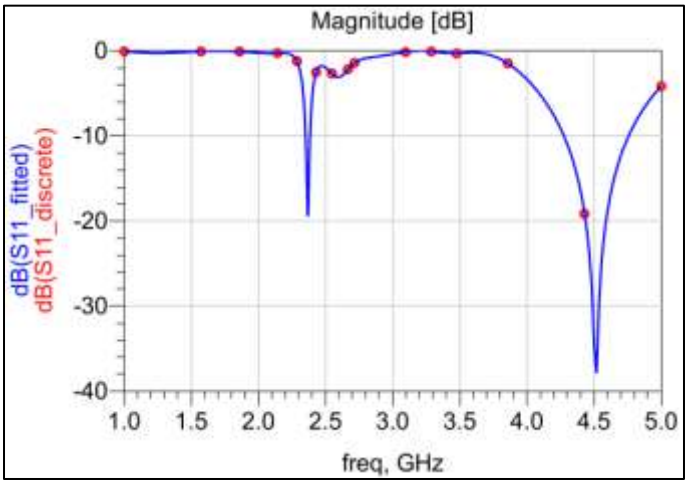

Fig. 4: S parameter of triangular patch antenna

The gain of antenna is not constant, which shows variation in gain from 8.133dB to 4.386 dB for circular patch antenna. The variation in gain from 8.96dB to 5.35 dB of triangular patch antenna. The reason is the mismatch between feed at patch because the input impedance of patch varies with frequency.

V. CONCLUSION

The new and simple techniques for designing wideband or multiband slot antenna are presented in this paper. These techniques are based on creating number of fictitious resonance along the slot and using them to obtain a wideband overall response with similar radiation pattern and polarization over the entire bandwidth of antenna. This is accomplished by creating circular slot inside triangular patch antenna and two slot rings along the circular patch antenna. Simplicity of the design process, consistent radiation and other parameter and excellent polarization purity make these techniques very attractive for designing wideband antennas.

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