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Design of Multimode Slot Microstrip Antenna for Wideband Application

Manpreet Kaur[1], Manpreet Kaushal[2]
[1, 2]Department of ECE, ASRA College of Engineering and Technology, Sangrur

Abstract: This paper presents a multimode slot microstrip antenna for wideband application. This antenna has the capability of wideband and also multiband application. The FR4 glass epoxy substrate is used to design the antenna with relative permittivity 4.4 and thickness 1.6mm. The proposed antenna has a compact size of 60 * 50 * 1.6 mm^3 and is fed by coaxial probes. The -10dB impedance bandwidth of proposed antenna is simulated for the 3 GHz to 12 GHz. The antenna has the three resonant frequencies i.e. 8.4506GHz, 9.3333GHz and 6.012GHz. The antenna is designed and simulated by using HFSS (High Frequency Structure Simulator) version 13 software. Proposed antenna can be used for various wireless communication applications such as WLAN, satellite communication, long distance radar telecommunication etc.
Keywords: Microstrip Antenna, Defected Ground Structure, Directional antenna, Meta material.

I. INTRODUCTION

With the rapid improvement in modern wireless based communication technologies directive antennas are highly desirable. While slot microstrip antennas can be optimally utilized in wireless networking to achieve high data rates, good RSSI, better frequency reuse. Slot antennas have the ability to adjust their radiation pattern in a way that their main beam always points in direction of receiving node or base station. While advancement in wireless techniques one major characteristic of devices are small size and low cost. In paper [1], authors proposed the microstrip patch antenna which covered the two frequencies of 1.8 and 2.4GHz as resonant using CST electromagnetic simulator. This antenna did not cover the wideband. Paper [3] discussed about the multi-slot antenna for operation in the 4G/LTE band. This paper covers only the 2.4GHz frequency band. Now we required the antenna for satellite application so that slot antenna is required with combination of different type of slot. In this paper, the proposed antenna consists of multiple slot with triangular slot and L shaped slot with single feed. The design was simulated at high frequency structure simulator. The antenna, which has compact dimensions of 60 * 50 mm^2, is printed in the front of Substrate FR4_epoxy of thickness 1.6 mm, relative permittivity 4.4 and tangent loss is 0.02. The dimension of the ground plane is same as the substrate dimension. The excitation of 50 ohms through co-axial probe feed is given to the patch. The design dimensions of the proposed antenna are obtained using HFSS (High Frequency Structural Simulator). The HFSS is based on the Finite Element Method (FEM) to simulate the proposed antenna..

II. PROPOSED WORK

The geometry shows the configuration of the proposed slot antenna as shown in figure 1. In the geometry, there are two slots on each side of the patch. The patch is of rectangular shape. On each side of the patch there are two slots of L-shape and Triangular shape. The shape of antenna is such that the antenna is directional rather than Omni-directional. This proposed design operates at frequency ranges from 6GHz to 10GHz for the radar application. The geometry of the design is based on the directional approach. The antenna is designed to measure the Return loss. In geometry shown in figure 1 there is one single feed used to excite the antenna. The slot antenna shown in figure 1 is steered by the directional approach. As shown in figure 4.3, the different slot radiates the power in the different directions. So that it covers all the directions and it works as Omni-directional.

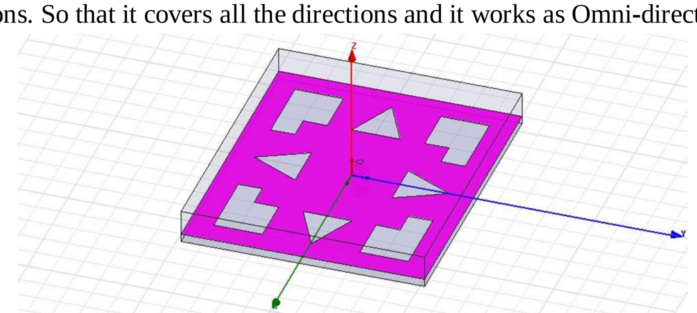

Figure 1. Proposed Design

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III. RESULTS

A 6-12 GHz frequency range below -10dB VSWR has been obtained. Multiband operation of the designed antenna is explained by using the Return loss versus frequency graph shown in figure 2. The return loss of -10.1986, -10.3706, -31.4864, -10.1487 and -27.7800dB is obtained at 8.1261, 8.8919, 8.4505, 9.5586 and 9.3333 GHz respectively. The bandwidth of the proposed antenna is greater than that of reference antenna. It can be found by locating two points on the return loss curve which shows the more bandwidth rather than reference model.

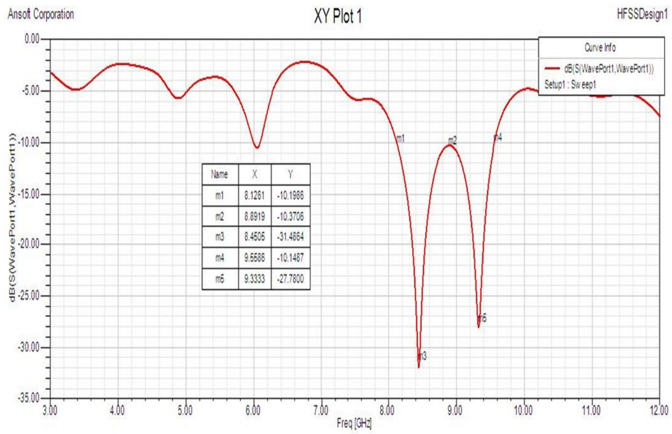

Figure 2 Return Loss

Radiation pattern for proposed antenna is also depicted in the figure 3. there are two main lobes due to which the proposed antenna works as a bidirectional antenna which is quite acceptable for the applications like radar systems, ultra wide band systems etc.

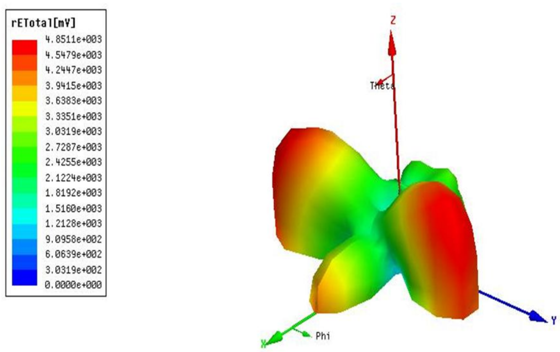

Figure 3 3D Radiation Pattern Plot

Gain is always related to the main lobe and it is expressed in dBi or dB. As shown in figure 4.the radiation pattern of the antenna gain phi in polar coordinates as well as in 3D.

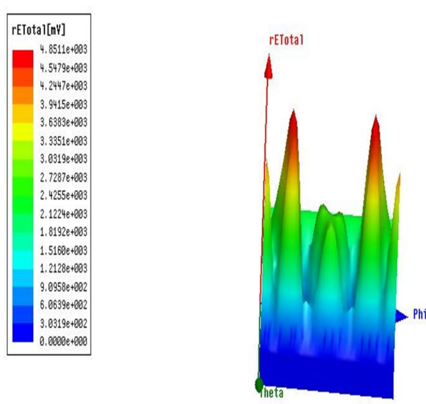

Figure 4 Polar Plot

IV. CONCLUSION

The multimode slot microstrip antenna is proposed with its return loss, radiation pattern, VSWR is shown in the result. As it is analyze from the result that it is showing good characteristics to work for many wireless communication applications. It is offering return loss to be less than -10 dB for many frequencies so supporting multiband applications. Radiation pattern being Omni-directional and VSWR is also less than 2. As it is microstrip antenna its size is small. So requirements for multiband support and small size are met with the proposed antenna. The objective was achieved by designing an Ultra wide band sinuous antenna for radar communication applications. The proposed antenna was simulated and it is giving good results for entire wide band with gain of 4dB and bandwidth of 68%. Peak directivity of 4.18, peak gain of 4.26, radiation efficiency of 1.01 and peak realized gain of 2.34 is attained from the current model. This model can be used in the radar communication devices of warning receivers and in other suitable UWB applications.

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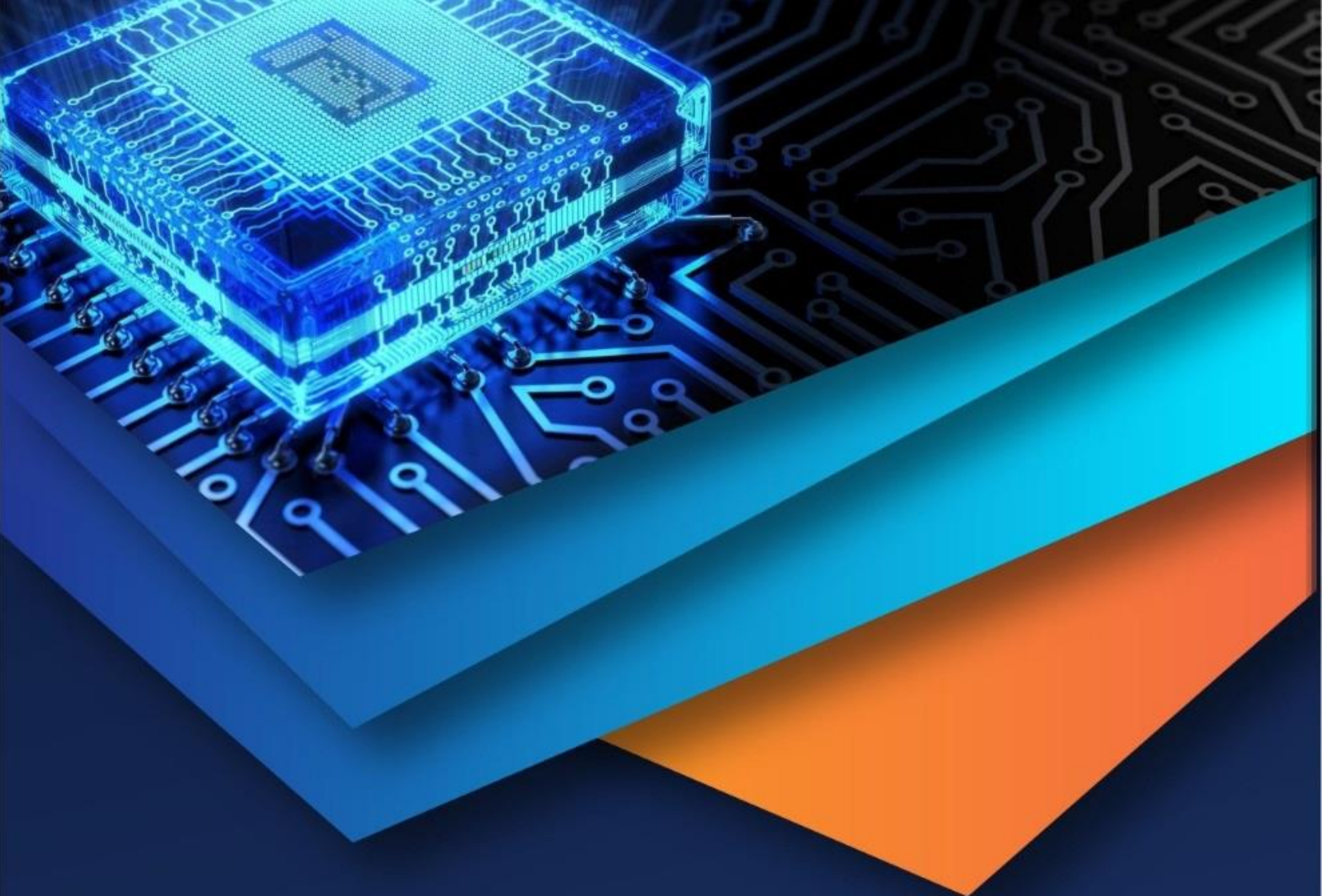

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