Gain Enhancement of Microstrip Triangular Patch Antenna Array using Defected Ground Structure

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ABSTRACT
This paper presents a gain enhancement of microstrip triangular patch antenna array using defected ground structure (DGS). The proposed antenna is designed using 2×1 triangular array. An antenna without DGS is first designed acting as reference. In designing the antenna integrated with DGS, two rectangle shaped DGS were etched off from the ground plane. Using DGS the gain of the antenna is enhanced from the reference paper. Gain is improved from 9.5dB to 11.2 dB at 2.4GHz. The minimum peak of return loss (S11) is -21.29dB. For designing of the structure the thickness h=1.61mm with Dielectric constant=1.6 is used and the antenna occupies 170mm × 160mm die of area. This antenna is operating at the resonance frequency of 2.4GHz which are suitable for ISM band and WLAN. CST microwave studio software is used for the simulation of the designed structure.

Keywords
Microstrip antenna array, WLAN, DGS

1. INTRODUCTION
Patch antennas play a very important role in today's world of wireless communication systems. There is always very large demand for high performance, small size, low cost Wireless communication system .In order to meet these requirement planer microstrip antenna is preferred because of their various advantages such as lightweight, low cost, low volume, ease of manufacturing [1]. To Increase gain microstrip patch array antenna are a good choice.

The conducting patch can take any shape but triangular shape attracted much attention. This is due to their small size and high gain performance capability. Recently, increasing interest is directed towards DGS for performance improvement of microstrip antenna other variety of microstrip circuits.

The bandwidth and the size of the an antenna are generally conflicting properties i.e. improvement of one of the characteristics normally results in degradation of the other. To overcome these researchers such as slotting, DGS, use of dielectric substrate of high permittivity etc. The other method to miniaturize the microstrip antenna is to modify its geometry using irises [4] or folded structures[5][6] based on the perturbation effect [7]. Defected ground structure (DGS), where the ground plane metal of the microstrip antenna design is modified intentionally in order to enhance the performance [8][9]. The name for this technique simply means that a "Defect" has been etched off in the ground plane, which disturbs the shield current distribution in the ground plane and influences the input impedance as well as current flow of the antenna. A defect in the ground plane causes to increase in effective capacitance and inductance.

In this paper we introduce DGS at the ground to increase the gain of the antenna array. The performance of this new design is compared to conventional one.

2. DESIGN AND CONFIUGRATION
The geometry of the proposed antenna array is shown in fig. 1, which consists of 2x1 triangular microstrip antenna. Fig. 2 shows the ground plane with DGS. One of major steps in designing a patch antenna is to choose a suitable dielectric substrate of appropriate thickness h and loss tangent. A thicker substrate, besides being mechanically strong, will increase the radiation power, reduce conductor loss, and improve impedance bandwidth. However, it will also increase the weight, dielectric loss, surface wave loss, and extraneous radiations from the feeder. The substrate dielectric constant plays an important role similar to that of substrate thickness. A low value for the substrate will increase the fringing field at the patch periphery, and thus, radiated power. The patch antenna having a permittivity = 2.2, substrate thickness h = 1.6, the dimension of the patch antenna are shown in Fig. 1 and Fig. 2 at the center frequency of 2.4 GHz.

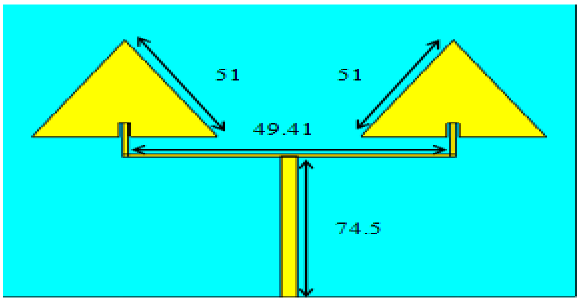

Fig 1: Front view of proposed antenna (All dimensions are in mm).

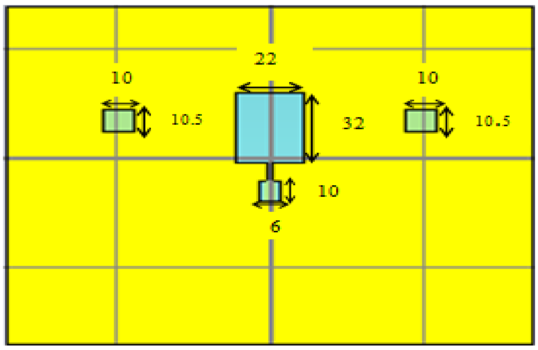

Fig 2: Ground plane with DGS of proposed antenna (All dimensions are in mm).

3. RESULTS AND DISCUSSION

S11 is represents how much power is reflected from the antenna, and hence is known as the reflection coefficient. Return loss with DGS is presented in fig 3. We can say that when we apply DGS at the structure than, we get the good return loss plot. At 2.4 frequencies return loss is approximately -21.29 dB.

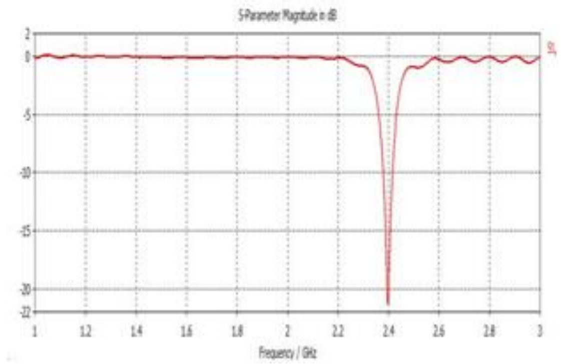

Fig 3: Simulated return loss of proposed antenna.

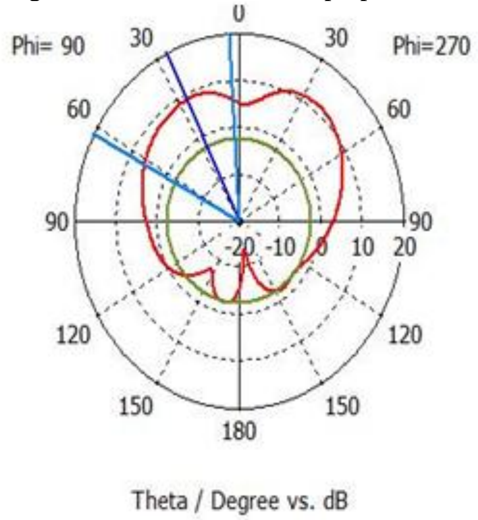

Fig 4: 2-D farfield pattern of 2x1 planner array with DGS

Fig. 4 depicts the farfield pattern of antenna array with DGS. Gain of proposed antenna with DGS structure is 11.231 dB and without DGS its gain is 9.515 dB. So we can say that we can increase the gain by using DGS technology and also we can improve the antenna array efficiency.

4. CONCLUSION

A 2x1 planar array antenna with DGS has been designed, simulated. It has been shown that the proposed 2x1 planar array antenna without DGS its gain is 9.515 dB. Further 2x1 planner array with DGS its gain is 11.231 dB and return loss is -21.29 dB. Hence, this type of antenna can be used for WLAN and ISM application.

5. REFERENCES

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