Dual Frequency Rectangular Microstrip Patch Antenna with Novel Defected Ground Structure

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Frequency operated microstrip antenna have already attracted much attention due to the practical application in communication systems. There are normally two ways to generate two operating frequency: using multi-resonator and using reactive load on the antenna structure. The reactive element can be lump element or just special structure, e. g., short pins or slot etched on the patch. By proper design, the slot will not modify the desired mode but perturb the undesired mode. Some researchers have realized more sophisticated slot design, i. e., meander shape slot on the both edge of the patch to further reduce the patch size [1]. More recently, the photonic bandgap structure has draw great attention on the electromagnetic engineering. The photonic bandgap concept (PBG) applied in electromagnetic engineering could be referred to as electromagnetic bandgap (EBG). Since the basic concept is the same and only different frequency range is involved, we could still use the term PBG to refer to the EBG related structure. It is interesting that some researchers has used the PBG structure on the ground plane to suppress the high order harmonics for the microstrip patch antenna [2], others use the PBG structure on the ground plan of the PCB board to enhance the signal integrity, i.e., to reduce the cross talk or to increase the signal to noise ratio. In this paper, we study the rectangular patch antenna with defected ground structure (DGS). This DGS structure in the ground plane is only under the feeding miscrostrip line and does not present under the microstrip patch, so that the radiation through the ground plane can be controlled to a low level. The DGS consists of three tapered photonic bandgap structure in parallel, which is similar to the design of low pass filters in [3], however, only half of the tapered photonic bandgap structure is used for our purpose. The microstrip patch antenna with DGS under the feeding stripline is shown in Fig. fig:1, where $r_1 = 1.5\,\mathrm{mm}$, $r_2 = 1.2\,\mathrm{mm}$, $r_3 = 1.0\,\mathrm{mm}$, $r_4 = 0.8\,\mathrm{mm}$, $p_1 = 3.5\,\mathrm{mm}$, $p_2 = 4.5\,\mathrm{mm}$, $W = 12.45\,\mathrm{mm}$, $L = 16\,\mathrm{mm}$. A commercially available package, CST Microwave Studio, is used to simulate the return loss using the 3-D FDTD method. Adaptive meshing scheme is adopted to obtain convergence results. The return loss for the conventional stripline feed microstrip patch antenna and our proposed structure is shown in Fig. 2. It is very interesting to note that the novel structure has two effects on the behaviour of the return loss. First, the high frequency harmonics were greatly suppressed; second, a dual frequency operation mode (the frequency ration is around 1.3) is presented. By tuning the PBG structure parameters, the second operating frequency can be shifted lower or higher in certain range.

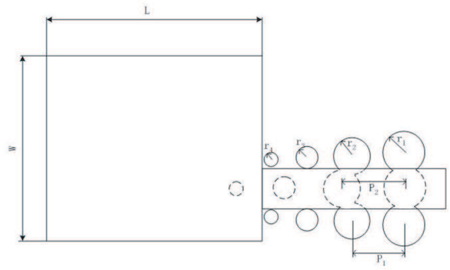

Figure 1: A microstrip patch antenna on a PBG defected ground plane.

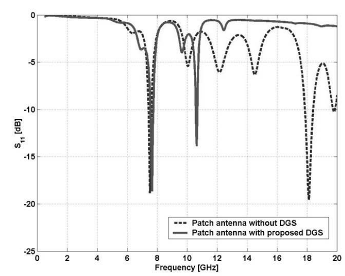

Figure 2: Return loss for the conventional microstrip antenna and proposed antenna.

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