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Design of Electromagnetic Band Gap Based Artificial Ground Plane

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Abstract: Communication systems are the most powerful things that are leading the universe with the development of technology and electronics. These increased the source of communication between nations, people, etc. It is done through wireless communication. The heart of communication is the antenna. As the growth of the population of our planet increases, it results in the increase of users of mobile, electronic devices that helps to communicate with each other. This increase in users causes terrible traffic in communication with a limited number of antennas. So basically to reduce this traffic, we will introduce the antennas of multiple frequencies. With the increase in the number of antennas radiation and electromagnetic interference will increase. Due to this the parameters like gain, efficiency, directivity, etc. Will be nightmares in the field of communication. Thus, in order to overcome these drawbacks in wireless communication a technique called Electromagnetic Band Gap (EBG) structures is introduced. The EBG structure is a 3-D object that provides the promising improvement in parameters such as gain, directivity, efficiency and antenna bandwidth of any antenna. EBG is a structure in which the conductors are placed with the electromagnetic band gaps of the substrate. These structures are used as patches for an antenna to reduce noise and maximum radiation interference caused by the number of conducting elements and the surface currents present in any of the micro-strip antennas. In a single word EBG structure is introduced to improve the performance of any of the low profile antennas. This EBG structure is designed using software called HFSS. HFSS is a tool that automates the creation of geometry, configuration of the solution and post-processing reports of more than 25 antenna elements. This helps in the design of many simple antennas.

Keywords: EBG, HFSS.

1. INTRODUCTION

Electromagnetic commotions and obstructions (EMI) in semi-leading gadgets and built-in circuits remain difficult as the operational recurrence and reconciliation level of electronic gadgets increases steadily. Up to this point, some techniques have been proposed to quell the commotion and EMI. In general, the EBG shows two infrequent properties that include restriction of surface wave propagation when used as a stop band or EBG and in stage impression of episode waves continuing as an attractive counterfeiting director (AMC). Due to these attractive properties, EBG are updated in a wide range. The stopband bandmark can quell clamors and EMI in desired groups.

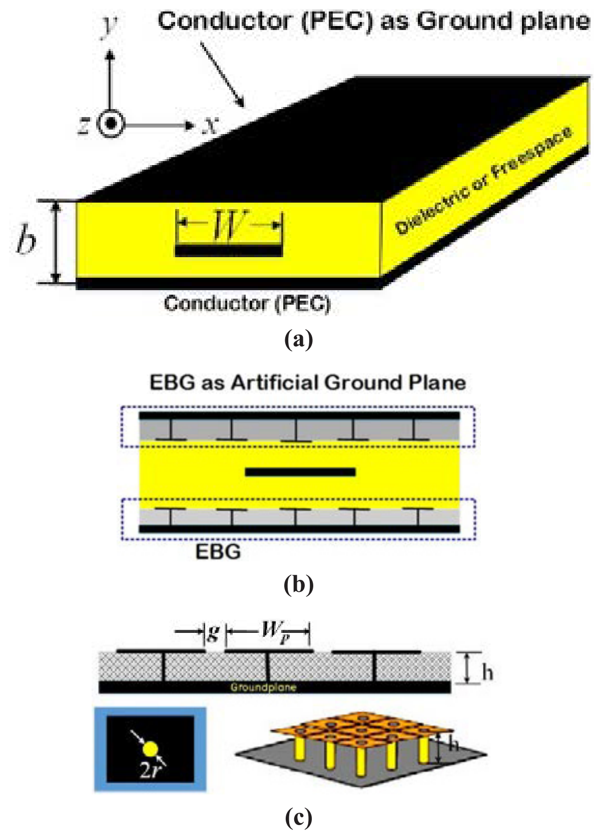

Figure 1: Configuration of the mushroom type structure

2. ORIGIN OF EBG

The idea of electromagnetic band-crack structures (EBG) begins from the science of strong state material and optical area, where photonic gemstones with illegal drill-hole for light discharges were proposed. EBG can be recognized in one, two and three dimensional structures. The three-dimensional EBG is more appropriate to obtain an entire band hole, since it can restrict the waves for each point of incidence. It should be noted that the band gap in EBG is not only due to periodicity of the structure additionally due to the individual reverberation of a component.

3. CONSTRUCTION AND CHARACTERISTICS

The routine band line comprises a band line between two reference conductor ground planes as shown in Figure (A). Taking into account the final objective of having a 50 Ω mark impedance, the band line is composed of width (W) of 10 mm and air thickness (b) of 7 mm. While, the design of the EBG coordinated with stripline is shown in Figure (Second). Contrasted with the usual band line, ground planes are supplanted with EBG surface using fungus classification structure. Figure (C) Demonstrates the transverse and 3D perspective of the fungal classification structure. The EBG substrate material is RT5880 with $\in r$ of 2.2 and thickness (h) of 1.575 mm. Each cell unit comprises a square fixation of 0.2 μg*x* 0.2 μg (6 × 6 mm^2) and by a measurement of 0.1 μg (r = 0.3 Mm). The patches are isolated from each other by a separation of 0.025 \ G = 0.75 mm).

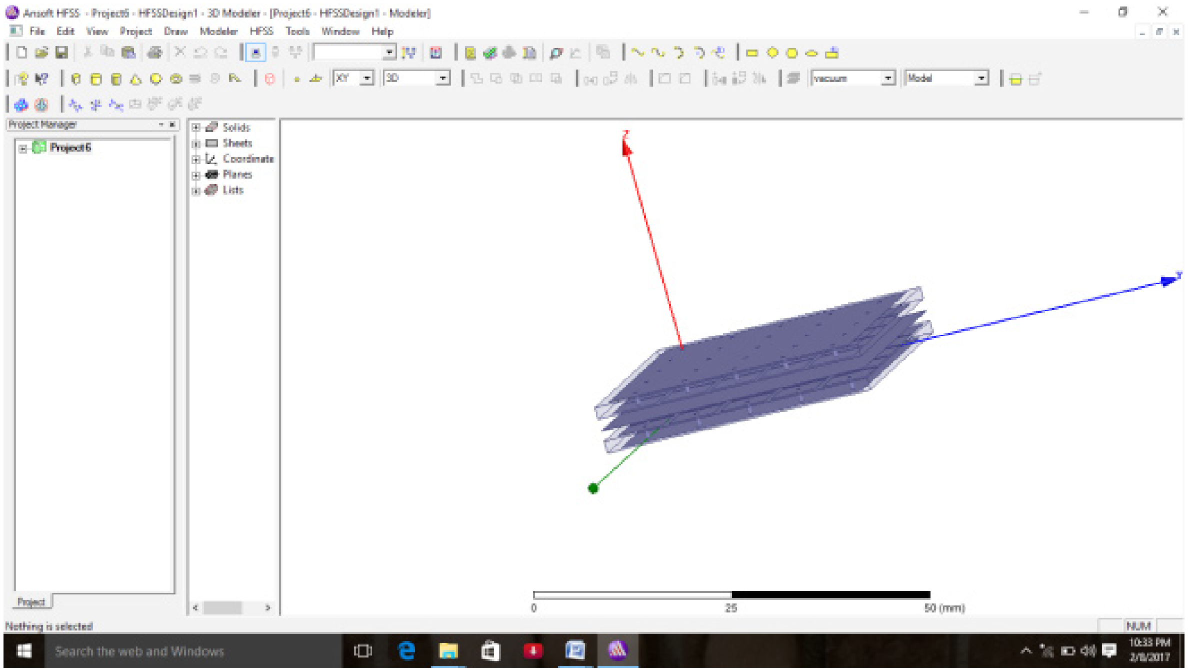

Figure 2: Designed EBG Structure in 3-D view

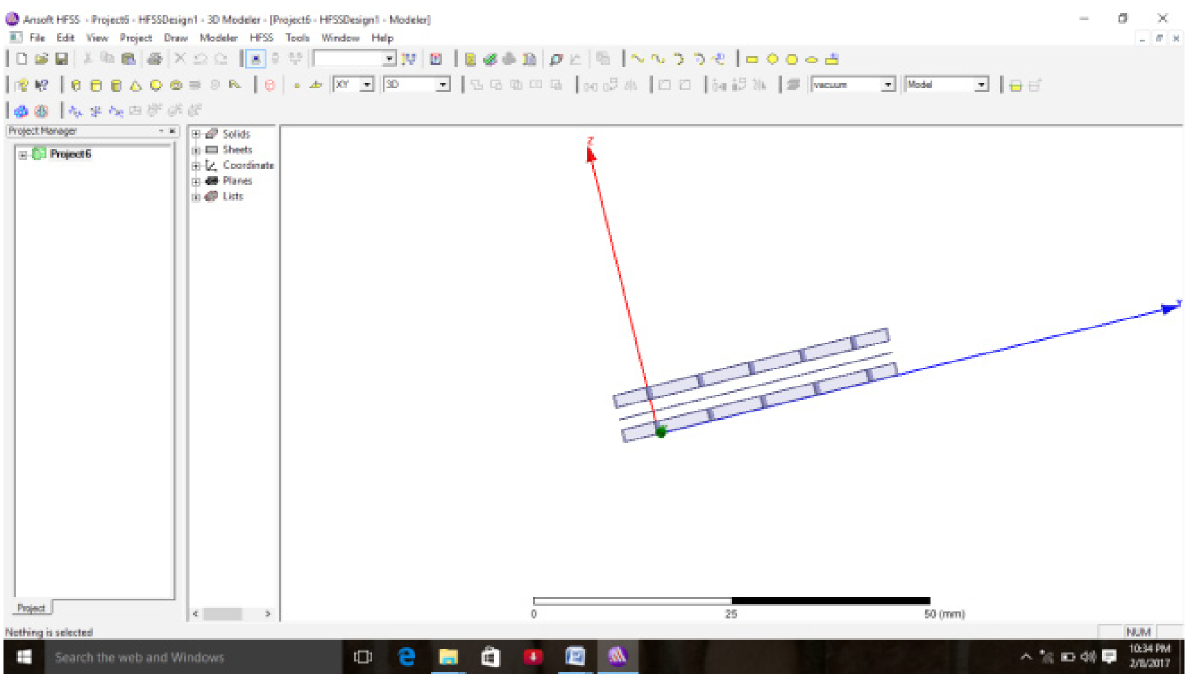

Figure 3: Designed EBG Structure side view

4. SIMULATION

For the purpose of the simulation we use a single cell instead of considering the whole unit. We have built a box of radiation around the cell. Its transparency is fixed at 0.86. Consider a face and assign it to the master boundary 1. The opposite side of the face is assigned with the slave-1 boundary. The face to the right of the slave-1 is assigned with the boundary of the master-2 and its opposite face with the slave-2. The upper and lower surfaces are assigned with the excitation of the float port. The direction of alignment of the boundaries is made with the help of two vectors u and v.

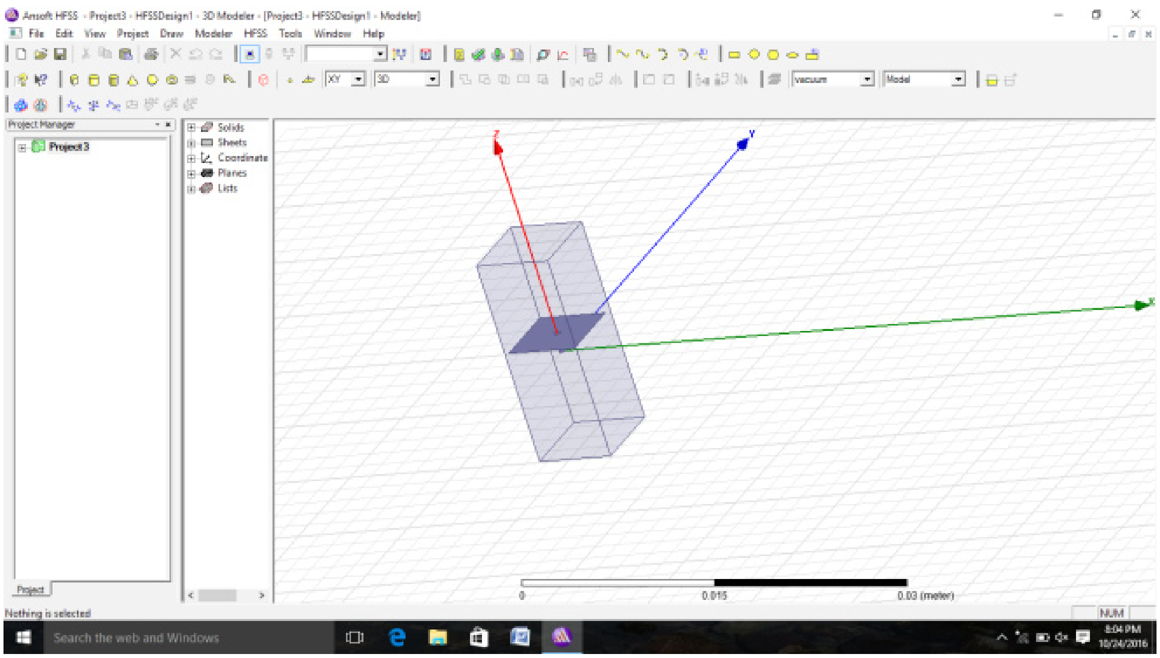

Figure 4: Single unit cell considered for simulation

By assigning the master and slave limits to the faces of the radiation box, it assumes similar cells surrounding it and analyzes the entire unit. The results of the simulation are given on the basis of the whole structure even if a single cell is excited. We want to simulate this structure at a frequency of 20 GHz, considering the frequency range from 15 GHz to 25 GHz.

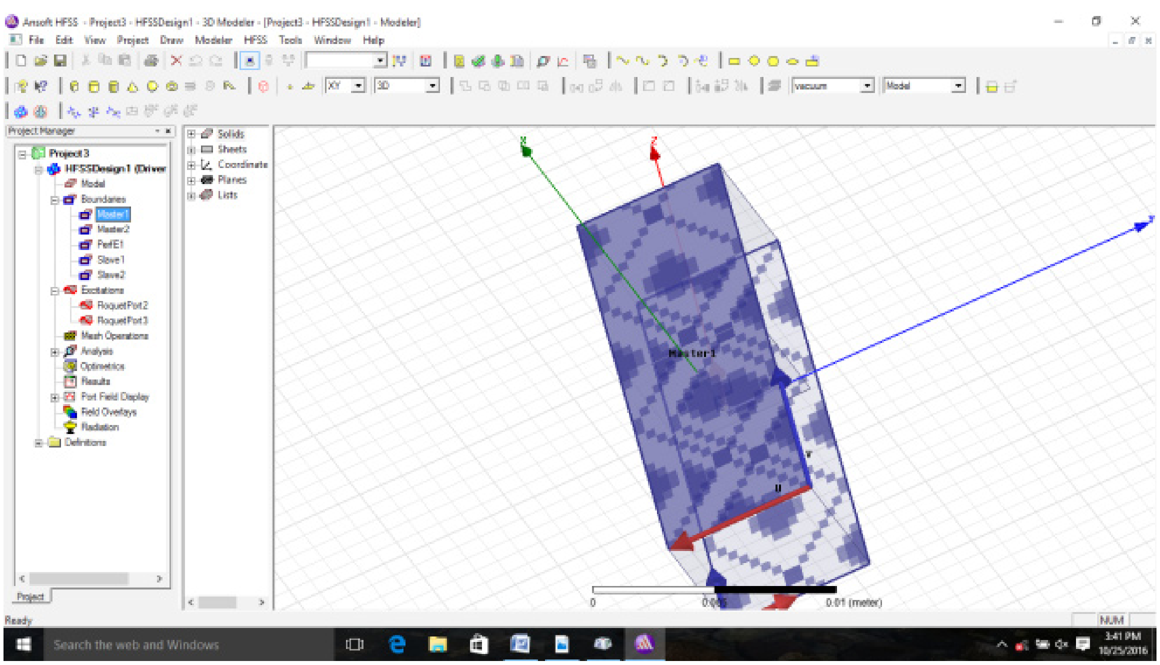

Figure 5: Boundary assignment to the cell

5. RESULTS AND FUTURE PROSPECTS

The optimization of the structure of the electromagnetic band gap is partially performed and the performance of the proposed structure is under simulation. The future scope of work revolves around the increase of the gain and the bandwidth of the proposed structures. The realization of the results would be concluded with the manufacture of the EBG structure. The research has been mainly limited to the theoretical study.

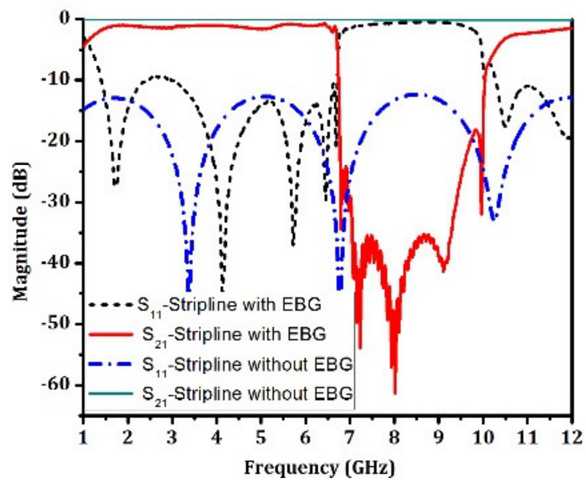

Figure 6: S-parameters of stripline with and without EBG

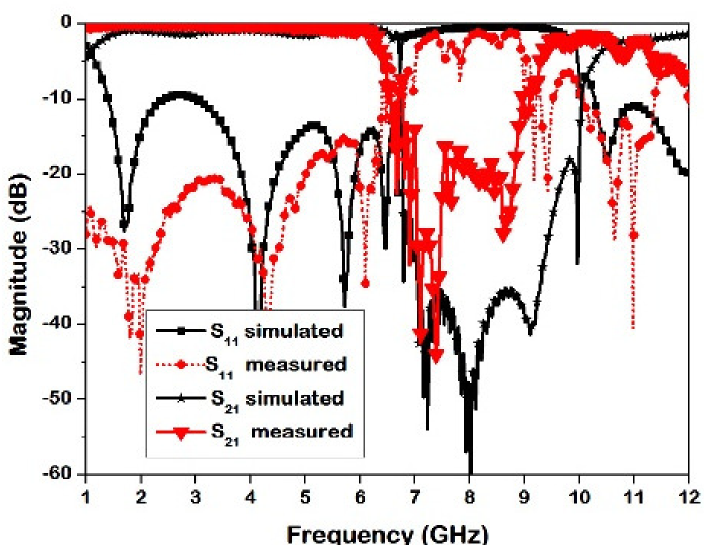

Figure 7: Measured and simulated Sparameters of stripline with EBG

6. CONCLUSION

An EBG-type mushroom structure replaced the conventional ground plane of stripline has been successfully studied and demonstrated. The interactions between the EBG structure and the effective change of the bandwidth in the capacitance and the inductance of the entire structure of the bandwidth. The proposed EBG structure presents a 10 GHz phase reflection for a normal panel wave incidence. In addition, a surface waveband band range of 6,76 to 10,08 GHz is obtained. Within the stopband, the EBG blocks wave propagation in the transmission line. Consequently, no noise or interference can be propagated from the component ports to other ports.

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