SOME OBSERVATIONS ON SIERPINSKI FRACTAL PATCH ANTENNA

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ABSTRACT:

The input parameters and radiation patterns exhibit a log-periodic behavior for Sierpinski gasket antenna. In long wavelength bands the current does not reach up to the top of the antenna, resulting in poor matching. To compensate it, this work proposes creating low resistance paths for the sub-gaskets using metallic connections at the junction points. Simulation of the structure was accomplished using commercial IE3D^{TM}. It is observed that connections of suitable width between the sub-gaskets result in better match for all the fractal bands of a Sierpinski gasket. Other possibility is a Sierpinski gasket without dielectric substrate, mostly affecting the radiation patterns at different fractal bands.

INTRODUCTION:

Fractal antenna technology is currently been applied to the design of multiband antennas and hence providing a solution to the needs of the now-a-days telecommunication market trend [1] and for some of the defense problems. The Sierpinski gasket antenna was the first example of multiband fractal shaped antenna [2, 3]. In this, both the input parameters and the radiation patterns present a log-periodic behavior. Often it is observed that the match for the higher orders is better than the lower ones and its effect is observed on the Sierpinski behavior [2]. It is because, in the long wavelength range also, the current does not reach upto the top of the antenna. To compensate the same, low resistance paths are created at the junction points of the Sierpinski fractal dipole antenna and the corresponding Sierpinski behavior is studied.

SIERPINSKI GASKET ANTENNA:

Fractal geometry implies the same geometry at different scales. The current distribution on the antenna's surface depends on the antenna's geometry. So on a self-similar antenna, it is expected the same current distribution in different scales. Due to the point contact nature of Sierpinski gasket at the junctions of different subgaskets, current is not able to reach upto the top of the antenna even in the long wavelength range. To facilitate the flow of the current, the subgaskets are connected by metallic connections.

The original antenna is a Sierpinski gasket in dipole form with four iterations with a log-period of 2. Other antenna dimensions are shown in the figure. The gasket was printed on a Duroid 5880 substrate ($\varepsilon_r = 2.2$), without ground plane. Two different types of connections were made. The first one is the Sierpinski gasket with thin metallic connections (fig. 1.a). The other antenna is with the same basic structural specifications, but now with thick metallic connections at the junctions (fig. 2.a). The point of observation is to find a better match for the lower frequency bands without affecting the fractal behavior. Simulation of the whole system was accomplished with the use of commercial method of moment (MoM) code such as IE3D^{TM} [4].

OBSERVATIONS:

The input reflection coefficient plot for the structure with thin metallic connections is shown in fig. 1.b. In this case all the four bands are almost in good match. The S_{11} plot for the second structure (fig. 2.a) is shown in fig. 2.b. Here the two lower bands are in good match as opposed to the two higher bands. That means, in this case the good match for the lower bands is obtained at the expense of the higher order bands. In order to verify the fractal behavior, we have observed the radiation patterns at the four fractal bands for the second structure. As observed, with the increase in frequency, the pattern is gradually deviating from the ideal dipole behavior with side lobes.

CONCLUSION:

The comparison of the reflection coefficient plots corresponding to the Sierpinski gaskets with two different types of connections reveals that, without affecting the fractal behavior, connections of suitable width can be made between the subgaskets to get a better match for all the fractal bands of a

Sierpinski gasket. Another important point to observe from the structure with thick metallic connections is the possibility of a Sierpinski gasket without a dielectric substrate, which mostly affects the radiation patterns at different fractal bands.

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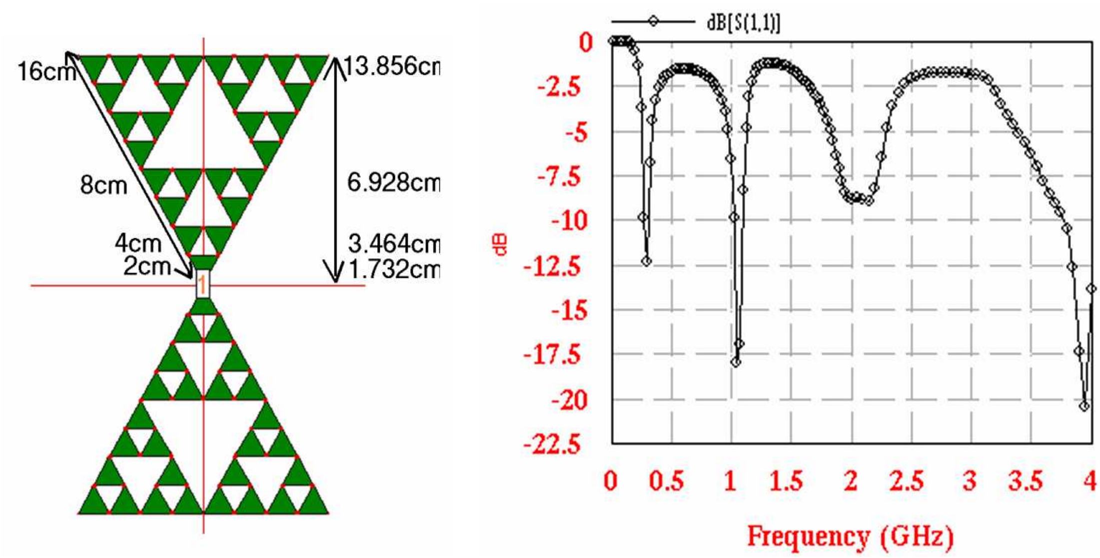
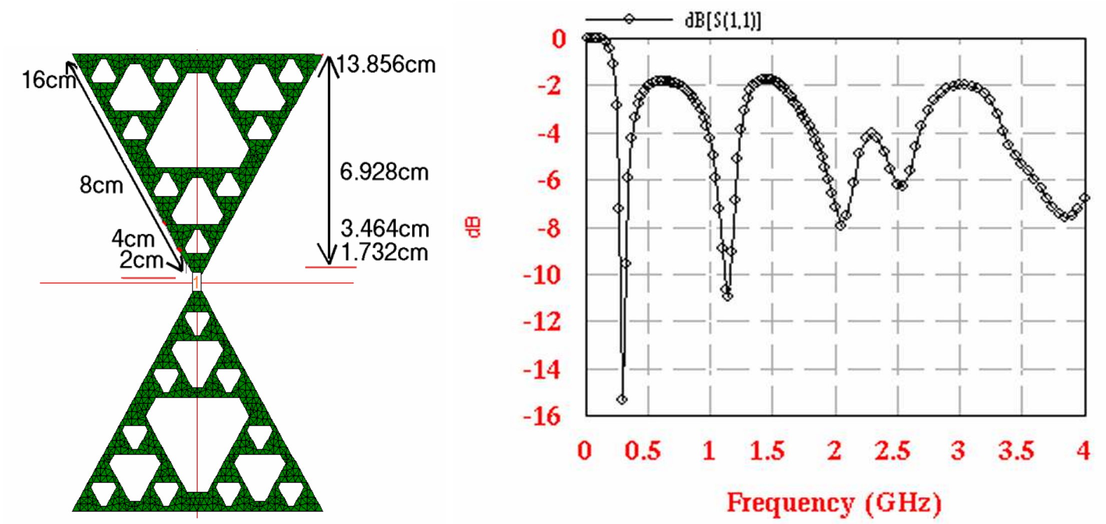
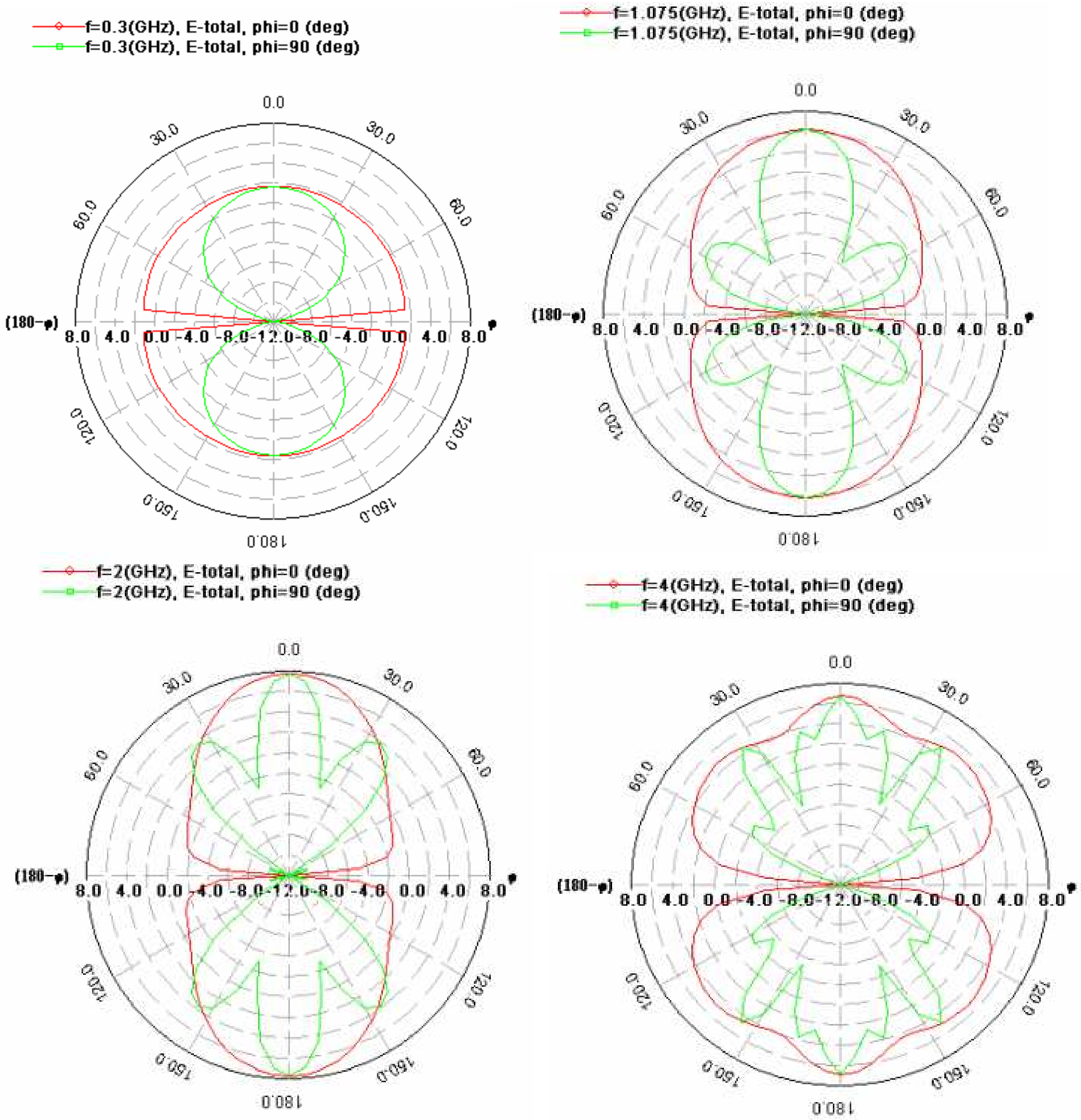


[Fig. 1.: (a) Sierpinski gasket dipole with thin metallic connections between subgaskets, (b) Input reflection coefficient plot.]



[Fig. 2.: (a) Sierpinski gasket dipole with thick metallic connections between subgaskets, (b) Input reflection coefficient plot.]



[Fig. 3: Radiation patterns at the four fractal bands of the Sierpinski gasket with thick metallic connections as shown in fig. 2.a.]