A Novel Design of Fractal Antenna with EBG-GP

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Abstract:
A new microstrip antenna is developed with a fractal patch and an electromagnetic bandgap ground plane (EBG-GP). This antenna was designed using Ansoft HFSS. A prototype was built and measured. The measured resonant frequency for this antenna is lower than that for a typical rectangular patch antenna with inset-fed, resulting in a size reduction of about 33.9 % at 2.45 GHz.

Keywords: Fractal Antenna, Electromagnetic bandgap, microstrip antenna, rectangular, patch, wireless, EBG-GP

1. Introduction

Fractal curves are used in the design of a patch antenna with an electromagnetic bandgap ground plane (EBG-GP), in order to get size reduced antennas [1]. The use of an EBG ground plane in the development of a fractal antenna level 1 allows to increasing the antenna bandwidth without change the overall antenna performance when compared to the typical microstrip antenna geometry. The proposed fractal antenna with EBG-GP has shown good radiation properties with good return loss results (<-20 dB) and impedance matching condition using the inset-feed technique.

2. Antenna Design

In the development of the fractal antenna level 1 a scaling factor of ¼ L and ¼ W was applied in a rectangular microstrip conducting patch with L and W dimensions, resulting in the fractal geometry shown in Figure 1(a). Observe that an inset-feed technique was used to match the antenna. The EBG-GP geometry is shown in Figure 1(b). The periodic array in the ground plane was obtained after a series of simulations in order to improve the antenna bandwidth. The antenna was built on a FR-4 substrate with ε_r equal to 4.4 and height equal to 1.5 mm.

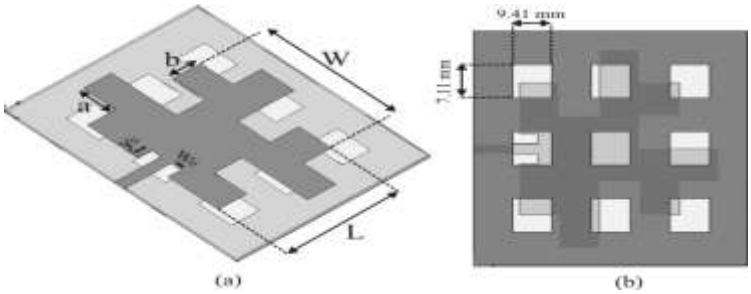

Fig. 1: Fractal microstrip Antenna with EBG-GP: (a) perspective view and (b) bottom view.

The proposed antenna was designed using Ansoft HFSS that implements the finite element method. A prototype was built and measured using a vector network analyzer.

3. Simulated Results & Discussion

Two resonant frequencies were measured and simulated: 1.62 GHz and 2.0 GHz. Figure 2(a) shows the measured and simulated results in HFSS for the return loss.

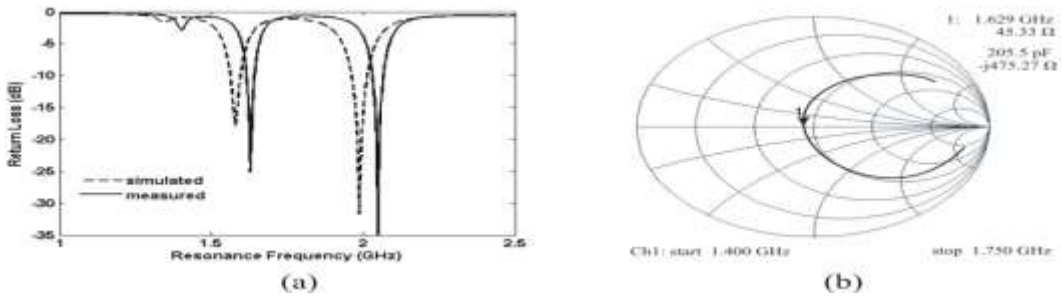

Figure 2: (a) Return loss and (b) input impedance results.

The input impedance measured at 1.62 GHz is 45.33 Ω. The antenna dimensions and parameters are given in Table below.

Table: Proposed antenna dimensions and parameters.

Measured resonant frequency	1.62 GHz / 2 GHz
Measured return loss	25.1 dB / -41.2 dB
Bandwidth	31 MHz / 40 MHz
Bandwidth (%)	1.91% / 2%
VSWR	1.13
Relative permittivity (εr)	4.4
Loss tangent (tan δ_e)	0.02
Patch length (L)	29.094 mm
Patch width (W)	37.2343 mm
y_0	3.4 mm
W_0	2.87 mm
a	7.27 mm
b	7.27 mm

4. Conclusion

This work described the development of an EBG-GP fractal antenna level 1 in order to reduce its resonant frequency, when compared to that of a rectangular microstrip patch antenna, and to improve its bandwidth for wireless communication system applications. Good agreement between measured and simulated results was obtained.

References

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