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Design Of Dipole Microstrip Antenna With Cohen-Minkowski Fractal For 433 433 Mhz Frequency

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ABSTRACT

This final project discusses the design of a dipole microstrip antenna with Cohen-Minkowski fractals for a frequency of 433 MHz which can be applied to Industrial, Scientific, and Medical (ISM) Band channels. The microstrip antenna uses a substrate made from FR-4 with a thickness of 1.6 mm and a channel impedance of 75 . Antenna design and simulation using AWR Microwave Office 2004 Software.The results of the design using the Cohen-Minkowski fractal can minimize the antenna size by 29% iteration-1, and 40% iteration-2 so as to give a VSWR value of 1.02 for the dipole without iteration, 1.74 for the iteration-1 fractal dipole, and 1, 26 iterations of fractal dipoles. The return loss resulting from the antenna design is -37.7 for the dipole without iteration, -11.29 for the iteration-1 fractal dipole, and -18.69 for the iteration-2 fractal. Then the gain obtained from the antenna design is 4.78 dB for the dipole without iteration, 4.91 dB for the iteration-1 fractal dipole, and 4.78 dB for the iteration-2 fractal dipole. The radiation pattern generated from the antenna is unidirectional.

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1. INTRODUCTION

Fractal geometry has been known for almost a century, the study of fractal antennas is a relatively new research. The term fractal was coined in 1975 by the French mathematician, Benoît B. Mandelbrot. Since Mandelbrot's work various application areas for fractals have been discovered and studied, a particular area of research is fractal electrodynamics. This study shows that fractals have good electromagnetic radiation patterns and advantages over traditional antennas. Such Advantages face the problems of modern wireless communication. Compared to conventional antennas, fractals have a larger bandwidth and are of the same size. With fractal antennas, it is possible to achieve a resonant frequency that is multiband and this frequency is not harmonic.

The dipole microstrip antenna is a planar element consisting of a pair of thin conductor blades located on the dielectric surface. The dipole microstrip has a shape that resembles a patch microstrip, only there is a slight difference in the ratio of length to width. Compared to patch microstrips, dipole microstrips have several advantages, namely smaller size and wider bandwidth .

In this study, we will discuss the design of a dipole microstrip antenna with Cohen-Minkowski fractals for a frequency of 433 MHz. The 433 MHz frequency is included in the Industrial, scientific and medical (ISM) channel specifications intended for local applications in industry, scientific testing, and medical applications.

2. RESEARCH METHOD

The methodology used in writing is as follows:

a. Study of literature
   By reading theories related to the topic of the Final Project which consists of reference books either owned by the author or from libraries as well as from articles, journals, internet services, etc.
b. Design and Simulation
   It is the process of designing a dual-band dipole microstrip antenna starting from the selection of materials, designing the antenna geometry and simulating it using structural simulator software, high frequency..
c. Analysis Study
   That is a series of processes carried out to find out whether the designed antenna has worked as expected.

3. RESULTS AND DISCUSSIONS

3.1 Initial Simulation of Microstrip Dipole Antenna Without Iteration Frequency 433 MHz

After obtaining the dimensional characteristics of the antenna, the next process is to perform a simulation. The results of the initial design simulation of the antenna can be seen in Figure 1.

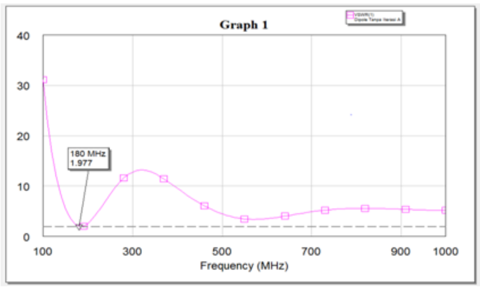

Figure 1. Initial Antenna Simulation

a. Optimization

From the simulation results of a microstrip dipole antenna without an iteration frequency of 433 MHz, it is known that the antenna has not worked well at the desired frequency, so the process of optimizing the dimensions of the antenna needs to be done. Optimization is done by changing the length of the arm or patch of the dipole antenna so that the desired results are obtained. The results of the optimization can be seen in the Appendix.

b. Antenna Simulation Results After Optimization

After designing and optimizing the characteristics of the microstrip dipole antenna without iteration for a frequency of 433 MHz, the VSWR value of 1.06 is obtained as shown in Figure 2.

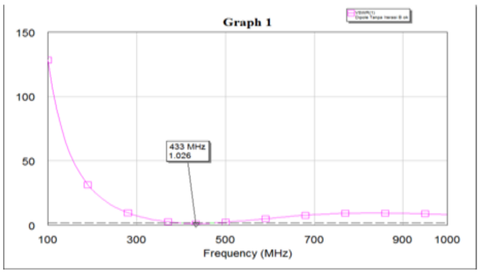

Figure 2. Antenna VSWR Graph Without Iteration Frequency 433 MHz

From the simulation results it is also known that the radiation pattern from the antenna is unidirectional where the radiation pattern is more effective in certain directions only, and the Gain obtained from the microstrip dipole antenna without iteration Frequency 433 MHz is 4.78 dB as shown in Figure 3.

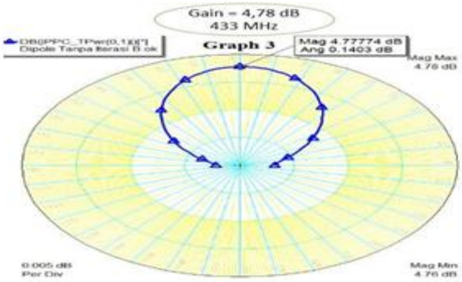

Figure 3. Radiation Pattern and Antenna Gain Without Iteration

Return loss obtained from a microstrip dipole antenna without an iteration frequency of 433 MHz is -37.7 dB as shown in Figure 4.

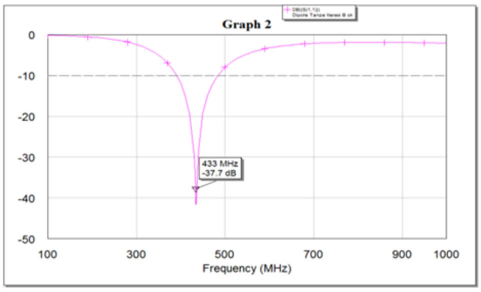

Figure 4. Graph of Antenna Return Loss Without Iteration Frequency 433 MHz

3.2 Preliminary Simulation of Cohen-Minkowski Fractal Dipole Microstrip Antenna 433 MHz Frequency Iteration-1

After obtaining the size of the Cohen-Minkowski fractal dipole microstrip antenna iteration-1, the next process is to perform simulations. The simulation results from the design of the iteration-1 Cohen-Minkowski fractal dipole microstrip antenna are shown in Figure 5.

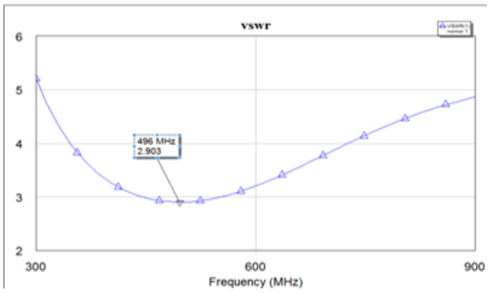

Figure 5. Antenna Simulation Results before Optimization Based on Figure 4.5, VSWR results from a dipole microstrip antenna

Cohen-Minkowski fractal iteration-1 does not work well at the desired frequency. To get a better VSWR value and at the desired frequency, an optimization process is carried out.

a. Optimization

Optimization in the design of the iteration-1 Cohen-Minkowski fractal dipole microstrip antenna is done by changing the length of each segment on the patch antenna from 1 mm to 5 mm. After the optimization process is carried out, the VSWR is 1.8 at a frequency of 419 MHz. Because the results have not fallen at the desired frequency, it is done optimization on the patch length of the iteration-1 fractal dipole microstrip antenna starting from 1 mm. After getting the desired results on optimization, then the best VSWR value is 1.7 at a frequency of 433 MHz. Complete data regarding the optimization process can be seen in the Appendix.

Based on the optimization results, the dimensions of the iteration-1 Cohen-Minkowski fractal dipole microstrip antenna obtained are as shown in Figure 6 with the dimensional characteristics in Table 1.

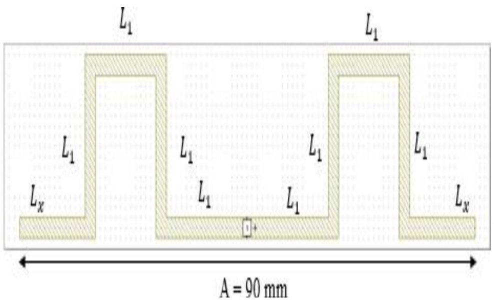

Figure 6. Antenna Dimensions After Optimization

Table 1. Antenna Dimensions Iteration-1 After Optimization

Size	Symbol	Score
Patch length antenna	A	90 mm
Length of one segment fractal antenna		16 mm
Edge sleeve length antenna after optimization		13 mm
Antenna patch width	-	2 mm
Substrate length antenna	-	96 mm
Antenna substrate width	-	20 m

b. Simulation Results of Iteration-1 . Antenna

After designing and optimizing the characteristics of the iteration-1 Cohen-Minkowski fractal dipole microstrip antenna for a frequency of 433 MHz, the VSWR value of 1.7 is obtained as shown in Figure 7.

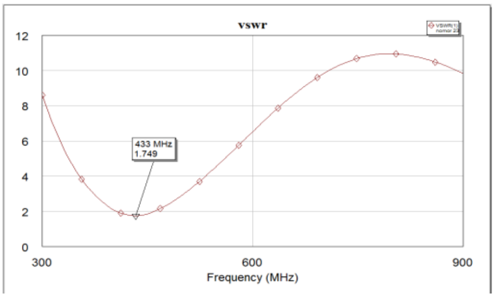

Figure 7. VSWR Graph of Iteration-1 Antenna Frequency 433 MHz

From the simulation results, it is also known that the radiation pattern from the antenna is unidirectional where the radiation pattern is more effective in certain directions, and the gain obtained from the antenna is 4.91 dB as shown in Figure 8.

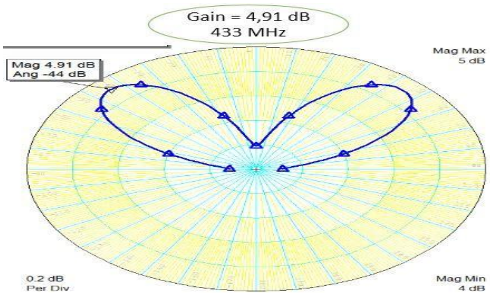

Figure 8. Radiation Pattern and Antenna Gain Iteration-1 Frequency 433 MHz

Return loss obtained from the Cohen-Minkowski fractal dipole microstrip antenna iteration-1 frequency of 433 MHz is -11.29 dB as shown in Figure 9.

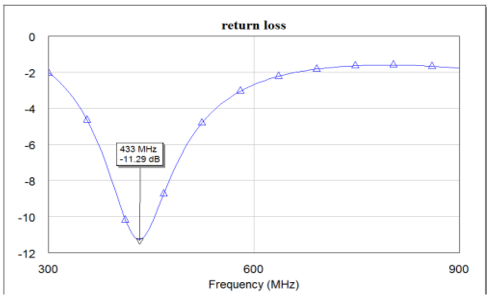

Figure 9. Graph of Return loss Antenna Iteration-1 Frequency 433 MHz

3.3 Initial Simulation of Cohen-Minkowski Fractal Dipole Antenna Iteration-2 Frequency 433 MHz

After obtaining the size of the Cohen-Minkowski fractal dipole microstrip antenna iteration-2, the next process is to perform simulations. The simulation results from the design of the Cohen-Minkowski fractal dipole microstrip antenna iteration-2 are shown in Figure10.

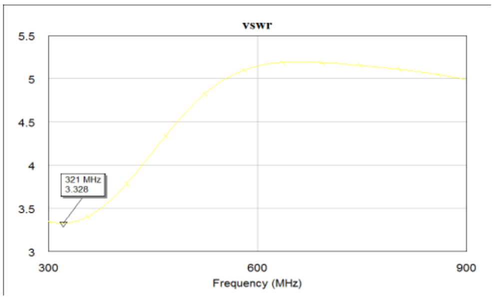

Figure10. Results of Iteration-2 Antenna Simulation before Optimization

Based on Figure 10, VSWR results from fractal dipole microstrip antennas Cohen-Minkowski iteration-2 has not worked well at the desired frequency. To get a better VSWR value and at the desired frequency, an optimization process is carried out.

a. Optimization

Optimization in the design of the Cohen-Minkowski fractal dipole microstrip antenna iteration-2 is done by changing the length of each segment on the patch antenna from 1 mm to 5 mm. Before the optimization process is carried out, a VSWR of 1.3 is obtained at a frequency of 335 MHz. Due to results it has not fallen at the desired frequency, then optimization is carried out on the iteration-2 fractal dipole microstrip patch antenna starting from 1 mm. After getting the desired results on optimization, the VSWR value is 1.2 at a frequency of 433 MHz. Complete data regarding the optimization process can be seen in the Appendix.

Based on the optimization results, the dimensions of the iteration-2 Cohen-Minkowski fractal dipole microstrip antenna obtained are as shown in Figure 11 with the antenna dimensions in Table 2.

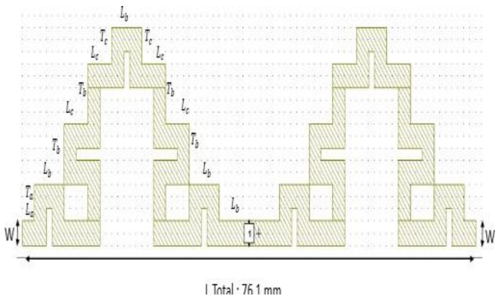

Figure 11. Dimensions of Iteration-2 Antenna After Optimization Process

Table 2. Dimensions of Iteration-2 Antenna After Optimization

Size	Symbol	Score
Patch length antenna	L Total	76 mm
Length of one segment antenna		2 mm
Length of one segment antenna		5 mm
Length of one segment antenna		4 mm
One segment height		3 mm

antenna		
One segment height antenna		5 mm
One segment height antenna		3 mm
Antenna patch width	W	2 mm
Substrate length antenna	-	80 mm
Antenna substrate width	-	21 m

b. Antenna Simulation Results

After designing and optimizing the size of the iteration-2 Cohen-Minkowski fractal dipole microstrip antenna for a frequency of 433 MHz, the VSWR value of 1.2 is obtained, as shown in Figure12.

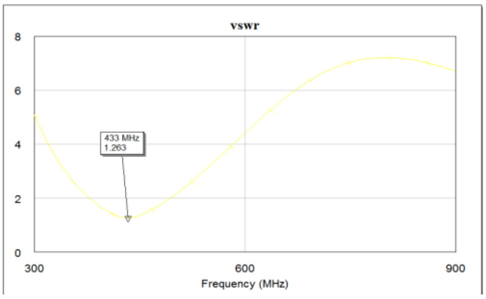

Figure 12. Graph of VSWR Antenna Iteration-2 Frequency 433 MHz

From the simulation results, it is also known that the radiation pattern of the antenna is unidirectional where the radiation pattern is more effective in certain directions only. The gain obtained from the Cohen-Minkowski fractal dipole microstrip antenna with a frequency of 433 MHz is 4.78 dB as shown in Fig 13.

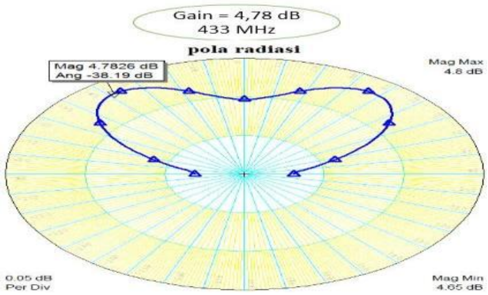

Figure 13. Radiation Pattern and Antenna Gain Iteration-2 Frequency 433 MHz

Return loss obtained from the Cohen-Minkowski iteration-2 fractal dipole microstrip antenna with a frequency of 433 MHz is -18.69 dB as shown in Figure 14.

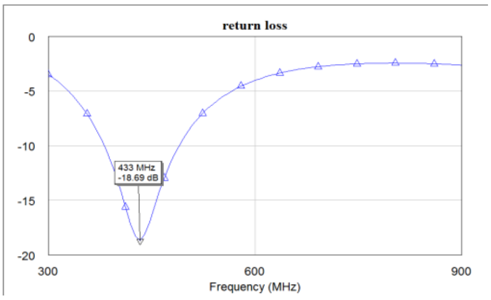

Figure 14. Graph of Return loss Antenna Iteration-2 Frequency 433 MHz

4. CONCLUSION

The Cohen-Minkowski fractal dipole microstrip antenna has been successfully designed and can work at a frequency of 433 MHz.

The VSWR value obtained from the antenna design is 1.02 for the dipole without iteration, 1.74 for iteration-1, and 1.26 for iteration-2, has reached the expected antenna specifications contained in Table 1.

The smaller the fractal size, the better the VSWR value obtained.

Return loss obtained from the design of the antenna, -37.7 for the dipole without iteration, -11.29 for the fractal iteration-1, and -18.69 for the fractal iteration-2, and have reached the antenna specifications expected in Table 1.

Gain The results obtained in the antenna design are 4.78 dB for no iteration, 4.91 dB for fractal iteration-1, and 4.78 dB for fractal iteration-2, and have not reached the expected antenna specifications in Table 1.

Things that must be considered when simulating a Cohen-Minkowski fractal microstrip antenna with a frequency of 433 MHz are the dimensions of the patch antenna, the size of the fractal, and the distance between the two patch dipoles.

The radiation pattern obtained in the antenna design is unidirectional, and has reached the expected antenna specifications in Table 1.

Judging from the analysis and discussion of the shape and size of the antenna, the microstrip dipole antenna with iteration-2 Cohen-Minkowski fractal at a frequency of 433 MHz which is applied to the Industrial, Scientific, and Medical (ISM) Band channel can minimize the dimensions of the antenna without fractals by 40%.

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