Abstract: In this paper we compare fractal antenna with simple microstrip antenna having same dimension. We can note that using fractal antenna we can obtain multi frequency. Using fractal antenna the weight of the antenna is decreasing because of fractal but it is somewhat difficult to design. The result shows that return loss and VSWR are increased with increase in fractal iteration, but the gain decreases.

Keywords—Fractal, Antenna, Microstrip.

I. INTRODUCTION

Micro strip is the second generation antennas. It is a metallic patch, printed on thin grounded dielectric substrate using a process similar to lithography in which patterns are printed on the substrate while fabricating printed circuit boards or integrated circuit. The main advantages are its low weight and low cost. Narrow bandwidth and low efficiency are its main disadvantages.

A. Introduction of a fractal

Fractal antennas are still in their early stages of development. In 1988, the first fractal antenna later on patent and published was built by Dr Nathan Cohen. As we know antenna size and operating wavelength are related such that, when the size of an antenna is made much smaller than the operating wavelength or less than one fourth of the operating wavelength (λ/4), it becomes highly inefficient. A curve or geometrical figure, each part of which has the same statistical character as a whole. They are used in which similar pattern recur at a progressively smaller scale, and in describing partly random chaotic phenomena such as a crystal growth and galaxy formation.

B. Geometry of antenna

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resonant frequency f_r</td>
<td>2.4 GHz</td>
</tr>
<tr>
<td>Height of dielectric substrate h</td>
<td>1.59mm</td>
</tr>
<tr>
<td>Dielectric constant ε_r</td>
<td>4.4(FR4)</td>
</tr>
<tr>
<td>Length of substrate L_s</td>
<td>47 mm</td>
</tr>
<tr>
<td>Width of substrate W_s</td>
<td>56.45mm</td>
</tr>
<tr>
<td>Length of patch L_p</td>
<td>28mm</td>
</tr>
<tr>
<td>Width of patch W_p</td>
<td>38mm</td>
</tr>
<tr>
<td>Thickness of ground T_s</td>
<td>0.05mm</td>
</tr>
</tbody>
</table>

C. Simulation

HFSS is a commercial finite element method solver for electromagnetic structures from Ansys. The acronym originally stood for High Frequency Structural Simulator. It is one of several commercial tools used for antenna design, and the design of complex RF electronic circuit elements including filters, transmission lines, and packaging. It was originally developed by Professor Zoltan Cendes and his students at Carnegie Mellon University. Prof. Cendes and his brother Nicholas Cendes founded Ansoft and sold HFSS.
stand-alone under a 1989 marketing relationship with Hewlett-Packard, and bundled into Ansoft products. After various business relationships over the period 1996-2006, H-P (which became Agilent EESof EDA division) and Ansoft went their separate ways: Agilent with the critically acclaimed FEM Element and Ansoft with their HFSS products, respectively. Ansoft was later acquired by Ansys.

D. Microstrip line feed

As illustrated in Figure, a microstrip patch can be connected directly to a microstrip transmission line. At the edge of a patch, impedance is generally much higher than 50 ohms (e.g., 200 ohms). To avoid impedance mismatch, sections of quarter-wavelength long impedance transformers can be used to transform a large input impedance to a 50-ohm line. With this feed approach, an array of patch elements and their microstrip power division lines can all be designed and chemically etched on the same substrate with relatively lower fabrication cost per element. However, the leakage radiation of the transmission lines, in some cases, may be large enough to raise the sidelobe or cross-polarization levels of the array radiation.

E. Equations

- The practical width of the microstrip patch conductor that will produce an effective resonator is given by

\[
W = \frac{1}{2F \sqrt{\mu_0 \varepsilon_0}} \sqrt{\frac{2}{(\varepsilon_r + 1)}}
\]

- However, for widths smaller than those selected according to equation, the radiator efficiency is lower while for larger widths, the efficiency is greater.

- However, excessive width is not desirable because the influence of higher order modes becomes significant which may cause field distortion. The ideal width for practical use can be determined from equation, although the value may not correspond to the optimal one.

- Once \( W \) is known, the effective dielectric constant, \( \varepsilon_{reff} \) is calculated using equation

\[
\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{(\varepsilon_r - 1)\left[1 + \frac{12h}{W}\right]}{2}
\]

- Substitute this value of \( \varepsilon_{reff} \) into equation for the equivalent length of the transmission line extension.

\[
\Delta L = \frac{0.412h(\varepsilon_{reff} + 0.3)(W/L + 0.264)}{(\varepsilon_{reff} - 0.258)(W/L + 0.8)}
\]

- The length, \( L \) of the microstrip resonator slot is then given by

\[
L = L_{eff} - 2\Delta L
\]

- And \( L_{eff} \) is given as:

\[
L_{eff} = \frac{1}{2\pi \sqrt{\varepsilon_{reff} \mu_0}}
\]

- So, length \( L \) is given as:

\[
L = \frac{1}{2\pi \sqrt{\varepsilon_{reff} \mu_0 \varepsilon_0}} - 2\Delta L
\]

- Length is a critical parameter because of the inherent narrow bandwidth of the resonant element, and hence equation should be used to obtain an accurate value of the line length \( L \).

- Here, \( 2\Delta L \) is the apparent increase in the slot length due to the current flowing around the end of each slot.

F. Result of microstrip antenna

- The plot shows the effect of varying the frequency and phase on the radiation pattern of the microstrip antenna. The radiation patterns are shown for different phase angles, and the effect on the VSWR (VSWR) is also illustrated.

- The gain (dB) is plotted against frequency for different phase angles, showing the effect of phase on the gain of the antenna.

- The radiation pattern is shown for different phase angles, demonstrating the polarization and directivity of the microstrip antenna.

- The VSWR plot shows the variation of VSWR with frequency for different phase angles, indicating the impedance mismatch at various frequencies.

- The gain plot shows the variation of gain with frequency for different phase angles, indicating the efficiency of the antenna.

- The radiation pattern shows the variation of radiation pattern with frequency for different phase angles, indicating the directivity of the antenna.

- The VSWR plot shows the variation of VSWR with frequency for different phase angles, indicating the impedance mismatch at various frequencies.

- The gain plot shows the variation of gain with frequency for different phase angles, indicating the efficiency of the antenna.

- The radiation pattern shows the variation of radiation pattern with frequency for different phase angles, indicating the directivity of the antenna.
G. Result of Fractal antenna

H. Comparison of fractal antenna with microstrip antenna

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parameters</th>
<th>Simple MSA</th>
<th>Fractal Antenna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Resonant Frequency</td>
<td>2.38</td>
<td>2.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9.3</td>
</tr>
<tr>
<td>2</td>
<td>Return loss(dB)</td>
<td>-21.58</td>
<td>-20.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-40.95</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-28.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-16.95</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-15.038</td>
</tr>
<tr>
<td>3</td>
<td>VSWR</td>
<td>1.1</td>
<td>1.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.4</td>
</tr>
</tbody>
</table>

ACKNOWLEDGMENT

First I would like to thank Mr. A.I. Darvadiya sir, Mr. B.H. Nagpara sir, Mr. H. H. Mathukiya sir, Mr. Darshit Trivedi, and the entire department of Electronic and Communication Engineering at Shri C. U. Shah College of Engineering and technology, Wadhwani which prepared me for this project.

I wish to personally thank Dr. K. H. Wandra sir, Prof. D. N. Khandhar for giving me the opportunity to work on this very demanding and very rewarding project and for his devotion to this project. I wish to also personally Mr. A. I. Darvadiya sir support and great advice and for being there during crunch time.

Our sincerest appreciation must be extended. We also want to thank faculties of the College. They have been very kind and helpful to us. We want to thank all teaching and non-teaching staff to support us. I also thankful my friends who directly or indirectly support me for choosing this project for final year degree engineering. We would like to express our sincere gratitude to our Guides for their help during the course of the project right from selection of the project, their constant encouragement, expert academic and practical guidance.

CONCLUSION

Microstrip antenna using Fractal geometry is Multiband antenna by using fractal antenna more than one Frequency can be obtained. So, we can use Fractal antenna for many Applications instead of using different antenna for various applications. Also the weight of fractal antenna is light and size is compact. Using Fractal antenna we can improve VSWR and impedance. Also the return loss is improved due to use of fractal geometry.

REFERENCES