Modelling and computation of fractal antennas: circle monopole, the life-flower antenna

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Abstract: This paper explorers the modelling and computation of fractal antennas. In the beginning the fractal geometry of antennas explained Also two new kinds of fractal antennas described: circle monopole and Life-Flower geometry antenna. Both antennas are series of circles nested to each other in a special order. Computational modeling was performed over the range of 0.1Ghz. - 20 Ghz. Obtained results of electrodynamic characteristics of antennas present in the next section. The specific multi- and wide-band properties of the selected antennas are analized in the conclusion.

Keywords: Fractal antennas, Multiband, Wideband, Computational modeling.

1. Introduction

The word "Fractal" means that the selected geometry has a fractional dimension. In the radiophysics it means, that a given radio-element has a specific geometry which has a fractional dimension [1], like fractional geometry of antenna **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**. Author's explored two kinds of fractal geometry in application to antennas. The first ones is a series of circles nested to each other in specific order, the second antenna geometry presents a Life-Flower circles. As well-known fractal antenna has a number of frequency band often equal to the number of iterrations of fractal. This feature of fractal antenna makes it high effective in cellure phones **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.** and micriwave devices, due to density packing of antena geometry in a small square.

2. The fractal geometry: circle monopole

2.1. *Modeling*

The circle monopole presents an a series of circles nested to each other. Radius of the outer circle R=11mm, and the radius of inner circles 3 times smaller then the outer $R_1=R / 3$. All seven inner circles allocated inside of outer circle so that each inner circle gets in touch with neighbour inner circles and outer circle too. Each iterration of this fractal structure presents new seven circles of three times smaller radius allocated inside the circle of previous iterration. So the radius of each iteration $R_{i+1}=R_i /3$. In the Figure 1. presents the circle monopole of first iterration and in the Figure 2. presentes the second iteration of the same fractal geometry. Both antennas has a monopole feeder. The constructed antennas was computational modeled in the AntSoft HFSS™ v10 and impedance, SWR frequency depending, radiation pattern were resulted.

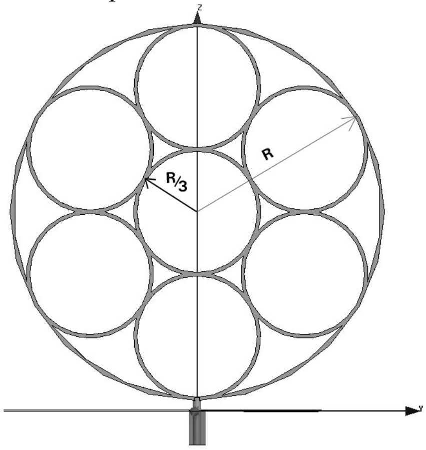

Figure 1. Fractal circle monopole of first order

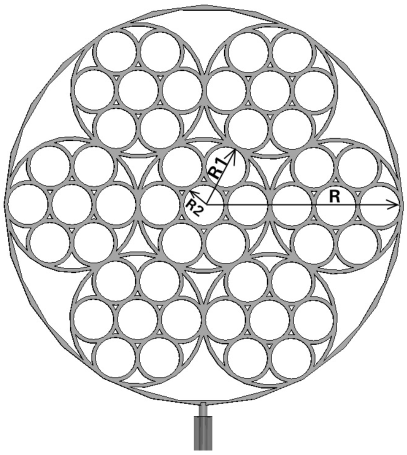

Figure 2. Fractal circle monopole of second order

2.2. ***The antenna characteristics***

The computational modeling **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.** was made over the frequency range of 0.1Ghz – 20 Ghz. The obtained frequency depending of transition-loss matrix (S11) show in the Figure 3. On the figure present three wideband which has given fractal antenna. Also the frequency depending of SWR and impedance was obtained an shown in the Figure 4 and Figure 5.

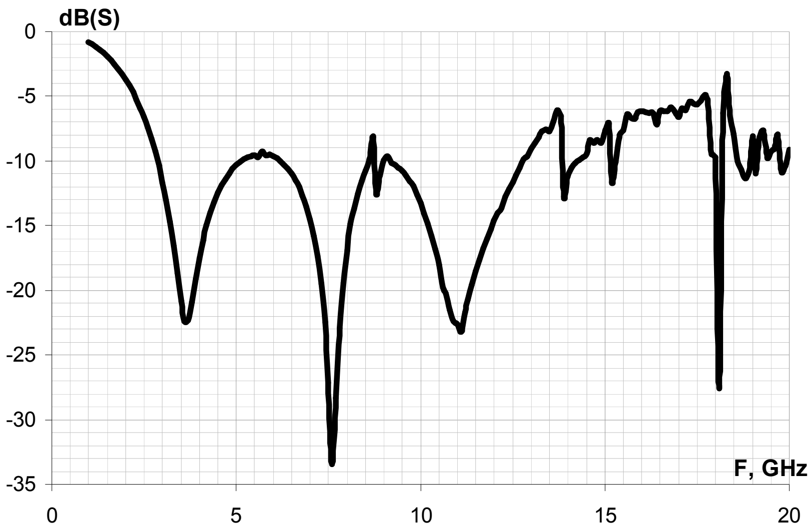

Figure 3. Frequency depending of S_{11} (transition) of the first order fractal circle monopole

In the Figure 4. several resonant frequency presents: 2.8 Ghz, 3.9 Ghz, 7.5 Ghz which coincides with widebands of S_{11} dependce. There is a good confirmaty of SWR occurs at the resonant frequency (2.8 Ghz, 3.9 Ghz, 7.5 Ghz) of the given fractal circle monopole.

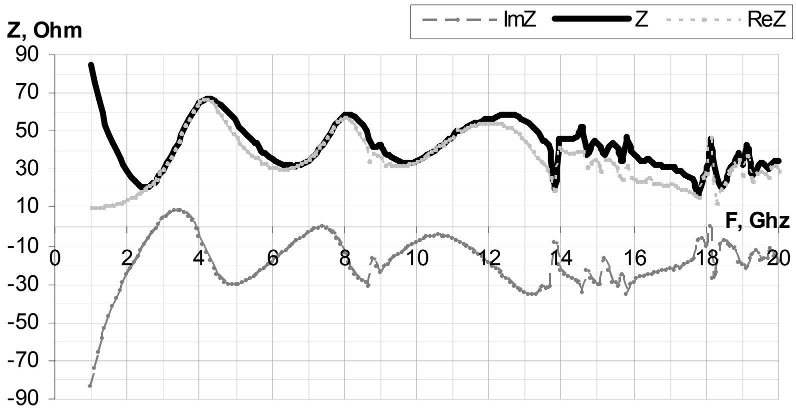

Figure 4. Frequency dependce of impedance of the first iteration.

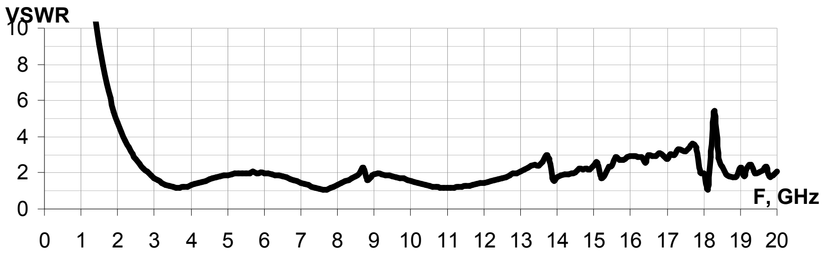

Figure 5. Frequency dependce of SWR of the first iteration.

So we can say that this fractal antenna has a good multi wide band features. The same frequency dependencies for the second iteration of circle fractal monopole are was modelled and analized.

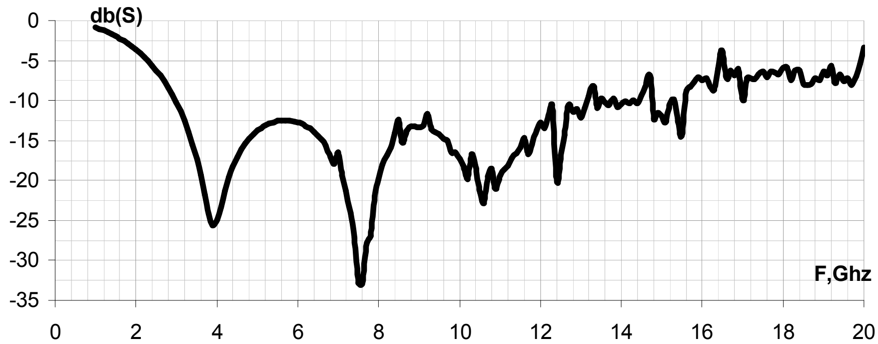

Figure 6. Frequency dependce of impedance of the iteration.

3. The fractal geometry: circle monopole

The second kind of fractal antenna geometry is Life-Flower, which presents a series of circels nested to each other in differ order then first antenna. The outer circle has a radius 11 mm. All other circles inside the outer ones have a radius three times less. More carefully you can introduce to the geometry of this antenna in the Figure 7. this antenna feeded at the center of the outer circle. Due to each circle gets in touch to the next circles the current is distributed over the hole antenna circles.

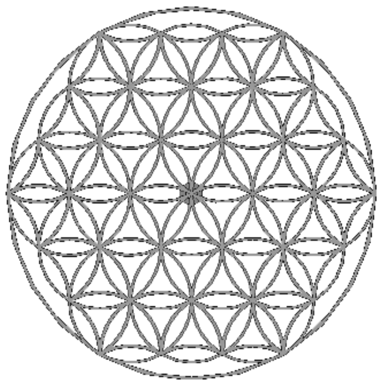

Figure 7. The Life-Flower geometry antenna

Computational modeling give us the interesting results. Life-Flower antenna has a several resonant frequency with wide bands over the range 0.1-20 Ghz.

4. Conclusions

In this paper we examined the two new kinds of fractal antennas with circle monopole geometry and Life-Flower geometry. The computational modelling allows us to verify in specific features of fractal antennas: multi- and wide-band. These properties makes fractal antennas high effective and applicable in cellular communications and microwave transit-recieve devices.

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