Guidelines for Student Reports

Creation of a tool based on PSO optimizer and CST e.m. simulator for the synthesis of a Sierpinski Carpet fractal antenna in the time domain

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Abstract

Nowadays, a large number of electronic devices exploits multiple wireless standards. Moreover, the dimensions of such products (e.g., mobile handsets) are becoming smaller and smaller following the users needs and thanks to the progress of the modern integrating circuit technology. In this framework, it is usually necessary to integrate the RF-part (i.e., the whole set of wireless interfaces) in only one antenna.

Such a requirement becomes even more challenging when also a high degree of miniaturization is required. It has been demonstrated that fractal shapes are suitable solutions for both miniaturization and multi-band issues. These results are enabled by two important properties of fractal geometries: the space-filling capability and the self-similarity. The former refers to the ability of fractal curves to be very long occupying a compact physical space. The other indicates that small regions of the geometry are copies of the whole structure, but on a reduced scale, with an expected similar electromagnetic behavior at different frequencies. Moreover, it has been found that by perturbing a reference fractal shape (i.e., introducing some additional degrees of freedom), it is possible to tune the locations of non-harmonic resonance frequencies. The use of a Particle Swarm Optimizer (PSO) algorithm has been validated as an efficient (and clever) way to tune the antenna resonances by modifying its geometrical descriptors.

The project aim is to develop a tool that allows the synthesis of a fractal Sierpinski Carpet shaped patch antenna. The tool will use the combination of a well-known Particle Swarm Optimizer (PSO, already developed) algorithm and CST e.m. simulator to analyze the fractal geometry in the time domain. The main advantage of this approach is that one can obtain the entire frequency response of the simulated antenna with a single simulation, while frequency-domain synthesis tools allow the analysis on a very small number of frequencies. The goal is to obtain a multi-band antenna, that can be used to accommodate different wireless communications standards.

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