Guidelines for Student Reports

Implementation of Orthogonal Array technique in order to initialize the PSO opimization of a planar Sierpinski Gasket multi-band antenna

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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.

Orthogonal Arrays (OAs), which have a profound background in statistics, play an essential role in Taguchi s optimization method. Orthogonal Arrays were introduced in the 1940s and have been widely used in designing experiments. They provide an efficient and systematic way to determine control parameters so that the optimal result can be found with only few experimental runs.

The goal of this project is to implement the theory of Orthogonal Arrays in order to build the initial swarm for the optimization process, and to analyze what is the impact of such a modification with respect to the standard case, in which the initialization of the problem is performed in a completely random way.

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