UNIVERSITY "POLITEHNICA" of BUCHAREST
DOCTORAL SCHOOL of APPLIED SCIENCES
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ABSTRACT OF PhD THESIS

DETERMINISTIC CHAOS AND FRACTALS IN COMPLEX NETWORKS MODELING

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BUCHAREST 2020

Objects with a shape seemingly difficult to describe by classical Euclidean geometry, can be analyzed completely and complex today with the help of fractal geometry, developed by mathematician Benoit Mandelbrot, having as technical support contemporary technology through which features of the environment are captured and processed.

In this paper, the fractal dimension of a complex arterial network from a lung radiograph was analyzed. The radiographs were processed in MATLAB R2017a to highlight only the arteries extracted from the context of a complete lung. In addition, the comparison between the results obtained in the MATLAB environment and the Harmonic and Fractal Image Analyzer Demo software version 5.5.30 did not show any significant difference.

One technique that can provide characterizations or predictions about the diseases of several organs of the human body is lacunarity calculation. Thus, depending on its values over time, optimal decisions can be made.

This article presents two algorithms developed based on two different techniques, from the clustering theory, namely the k-means algorithm, respectively the Fuzzy C-means technique. In this context, the study provides a sustained comparison of the two algorithms to correctly choose one of them, depending on the image to be analyzed and the desired solution. Algorithms are used in image processing, respectively as an application of image processing techniques in the analysis of computed tomography. The results obtained by running the algorithms with a different number of centroids were also compared, as well as the execution times of each algorithm. Image processing and obtaining the results presented in this document were possible by using the MATLAB R2018b environment. This is possible because some components of the brain, such as the blood vessel network or the neural network, have a fractal arrangement, which makes it easier to analyze their structure to provide the most accurate predictions or treatments for patients with brain disease. serious.

Artificial fractal shapes can also be involved in the design of modern telecommunications system modules such as antennas. Among the advantages of this type of antennas we note the possibility to have a compact antenna and resonance in several frequency bandwidths. This thesis presents a way to achieve such antennas and results obtained for operation in frequency bandwidths for PPDR communications, in 5G technology, according to ANCOM.