MATHEMATICAL MODELING AND DIAGNOSING BY ECG

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Reports of World Health Organization show that approximately 33 percent of all death in the world is caused by cardiovascular diseases. One of the most effective methods of diagnosing heart diseases is electrocardiography (ECG), which allows you to record the electrophysiological activity of the heart using electrodes placed on the skin.

However, the training of relevant specialists requires significant costs and time. In addition, huge amounts of data are generated daily, which is very difficult to analyze manually. Due to this, there is a need to develop and implement automatic methods for effective diagnosis of heart disease.

One of the interesting areas of research in cardiology is the study of fractal properties of ECG. Studies have shown that the physiological signals generated by complex self-regulating systems under healthy conditions may have a fractal temporal structure [1]. It has been reported [2] that ECG signals are well modeled as fractal processes which properties can be characterized by fractality indicators that allow detecting changes in heart rhythm.

Therefore, we decided to advance research in this area by studying the possibility of creating an algorithm for diagnosing only by fractal indicators of the ECG signal.

The task was accomplished using the Python high-level programming language and the Neurokit2 [3] open source signal processing library in the Google Colaboratory development environment.

During the exploration we collected own dataset of short signals from second ECG-lead. Then we calculated fractal dimension for signals from dataset by different algorithms. Results of calculations show us that it is impossible to diagnose at least short ECG-signal by its fractal dimension.

Such results can be caused by dataset of short signals that are not enough long to measure fractal properties of heart rhythm. That is why we decided to continue research with longer signals.

References (translated):

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