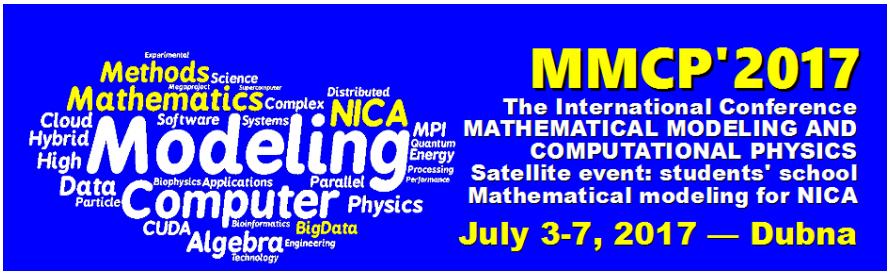

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PHASE SPACE OF INSTANTANEOUS CARDIAC RHYTHM IS A FRACTAL

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In this paper we present the instantaneous cardiac rhythm (ICR) function and its difference derivative constructed based on the data of day-long Holter monitoring. These functions contain complete patient cardiovascular system state information. In order to analyze the behavior of these functions, there was introduced a concept of phase space (PS) of ICR the points of which had coordinates and in space R2 and moved along the phase trajectories. In order to visualize the ICR dynamics, there was introduced a concept of extended phase space (EPS) of ICR. The examples of PS and EFS of ICR for specific patients of the Tver Cardiology Health Center are shown visually.

Within 24-48 hours we calculated the volumes of PS and EFS filled with the phase trajectories of ICR with different sizes of cells covering the phase trajectories. The calculation results showed that a phase volume of ICR had a power law dependence on cell size within the accuracy of 1-2%. That established the fractality of PS of ICR.

Taking into account the fractal properties of PS of ICR, volume Γ of PS of ICR is introduced. Γ is a volume filled with the phase trajectories of ICR in the D-dimensional space. As in statistical physic, the log Γ can be referred to as fractal entropy of ICR.

We undertook a study of and behavior dynamics for several patients the results of which are given in the tables.

We argued in favor of use of parameters Γ and S as cardiovascular system state markers.

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