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Chaos theory as a bioinformatics promissory instrument for a human organism systemic response in-depth study

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Motivation and Aim: The complexity of biological systems generates a need for involving of various mathematical, statistical and information instruments for their detailed analysis. Each separate research method usually gives new and original results that expand the knowledge about the subject of interest. Since most physiological systems have a nonlinear dynamic nature, an adequate and convenient tool for their study is the chaos theory. In the context of this theory, physiological processes initiated in the living organism in response to sudden external impact meet the requirements of dynamic chaos phenomena [1]. The aim of this study is the chaos theory-based analysis of a human organism systemic response emerged in reply to various transient external interventions that the organism is exposed to.
Methods and Algorithms: The dynamic characteristics of respiration, thermoregulation and cardiovascular system were synchronously measured using modern experimental methods, including focal plane array-based infrared thermography. External interventions were realized using local heating of the extremities, short-term clamping of the shoulder vessels, forced modulation of the respiration rate, etc. The heart rate was measured with the 200-Hz signal acquisition rate using microphone-based original pulsometer connected to the Biopac MP 100 measurement system. Skin temperature was measured with the 100-Hz frame rate using TKVr-IFP/SVIT infrared camera. Breathing rate was also measured with the above-mentioned infrared camera using original Sorption-Enhanced Infrared Thermography (SEIRT) method [2]. Computer-assisted quantitative analysis of the synchronously obtained experimental data was made using mathematical statistics and chaos theory algorithms.
Results: Drawn on the 2-dimensional or 3-dimensional phase planes, the experimental dependences, reflecting the dynamic change of the human organism physiological characteristics, reveal the hidden features and patterns that are not visible when standard methods of analysis are used.
Conclusion: The prospects of using the theory of chaos-based analytical instrument in the biomedical and physiological studies are shown.
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