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Research Article

An Autonomic Nervous System Model Applied to the Analysis of Orthostatic Tests

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Abstract

One of the clinical examinations performed to evaluate the autonomic nervous system (ANS) activity is the tilt test, which consists in studying the cardiovascular response to the change of a patient's position from a supine to a head-up position. The analysis of heart rate variability signals during tilt tests has been shown to be useful for risk stratification and diagnosis on different pathologies. However, the interpretation of such signals is a difficult task. The application of physiological models to assist the interpretation of these data has already been proposed in the literature, but this requires, as a previous step, the identification of patient-specific model parameters. In this paper, a model-based approach is proposed to reproduce individual heart rate signals acquired during tilt tests. A new physiological model adapted to this problem and coupling the ANS, the cardiovascular system (CVS), and global ventricular mechanics is presented. Evolutionary algorithms are used for the identification of patient-specific parameters in order to reproduce heart rate signals obtained during tilt tests performed on eight healthy subjects and eight diabetic patients. The proposed approach is able to reproduce the main components of the observed heart rate signals and represents a first step toward a model-based interpretation of these signals.