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New Approach on Cardiac Autonomic Control Estimation Based on BCG Processing

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Abstract:
The work presents a biomedical instrument for unobtrusive heart rate variability measurement, using ballistocardiographyc (BCG) signal based on electromechanical film sensors (EMFi sensor). The ballistocardiogram acquired signals from subjects sitting on a chair is processed in order to improve its signal-to-noise ratio (SNR) using adaptive neuronal network filtering. The accuracy of beat-to-beat intervals detection using ballistocardiography was tested by comparing the heart rate obtained by simultaneously monitoring the electrocardiogram (EKG) and pulse frequency in young healthy subjects. The results show no statistically relevant differences between the heart rate obtained by BCG in comparison with EKG and pulse frequency measurement. By including wavelet analysis of the heart rate variability (HRV), the prototype system permits a more natural lifestyle monitoring of physiological parameters.

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I. Introduction

The heart rate obtained using electrocardiography (EKG) impedance cardiogram (ICG) or pulse measurement gives information on several physical and mental stresses, emergency situations, such as a cardiac arrest, and also on neural control of the heart in various real-life conditions. An unobtrusive alternative to the electrocardiography and impedance cardiogram is ballistocardiography (BCG) defined as a method by which body vibrations caused by heart activity are registered. As one of the first methods for heart and respiration rate measurements [1], [2] BCG was characterized in early times by important limitations related to the force and vibration sensors, data acquisition and data processing capabilities. The latest developments in those three domains [3], [4], [5] made the BCG an interesting method with good results [6], [7] on cardiac activity monitoring.