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IMPROVED SIGNAL PROCESSING TECHNIQUES FOR THE DETERMINATION OF CARDIAC PARAMETERS USING THORACIC BIOIMPEDANCE

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Noninvasive determination of stroke volume, cardiac ouptut and the systolic time intervals though of great interest in both diagnostic and medical research, still lacks the necessary reliability and precision mainly due to severe shortcomings of the commonly used signal processing techniques. Due to the poor results, even the principle of cardiac output determination based on impedance cardiography remains controversial.

High levels of noise and motion artifacts in the signals call for sophisticated signal processing techniques in order to provide beat-to-beat detection of the single cardiac events, especially in case of exercising patients. So far, simple bandpass filters and threshold detectors have been used for event detection at the beginning and end of electric and mechanical systole. Ensemble averaging of cardiac parameters, increases the reliability but only at the expense of information about transient responses, short-time fluctuations and respiratory modulation.

In order to overcome these problems we have used beat-to-beat detection techniques, such as adaptive matched filtering and phase-sensitive event detection. The phase-sensitive method is based on the assumption that sudden events within a biological signal source, such as the onsets of slowly changing signals or small local extrema (as the opening of the aortic valve), lead to a sharp change of signal spectrum. The analysis of the momentary frequency or phase has resulted in obtaining a reliable marker for each event. As a result of adaptive matched filter and phase-sensitive event detection, both the reliability and precision have been substantially improved. In order to process the data at sufficiently low cost and to gain clinical acceptance without sacrificing precision, we have developed analysis to be run on a personal computer (PC-AT).