Selective Heartbeat Template Location in the Sliding Window Autocorrelation Phonocardiogram Segmentation Algorithm

Sankua Chao, Adrian D.C. Chan
Department of Systems and Computer Engineering - Carleton University

Diagnosis of heart valve conditions using a phonocardiogram (PCG) involves analyzing individual heartbeats in the PCG to detect and identify murmurs. Individual heartbeats must first be located in the PCG before they can be analyzed. This can be achieved by PCG segmentation, which locates the boundaries between individual heartbeats in the PCG. Hence PCG segmentation is an essential step prior to further PCG-based analysis.

The Sliding Window Autocorrelation (SWA) is a PCG segmentation algorithm, which aims to perform automated synchronous segmentation of a wide range of complex PCGs. The SWA is composed of three stages: Heart Rate Estimation (HRE), Heartbeat Template Location (HTL), and Heartbeat Boundary Prediction (HBP). Given a PCG, the HTL stage attempts to localize a single heartbeat in the PCG, which is used as a template that is representative of all the heartbeats in the PCG. The HBP stage correlates the template with "search windows" in the remainder of the PCG. This correlation process locates portions of the PCG similar to the template, and hence predicts locations of heartbeats in the PCG.

The overall success of the SWA depends on the performance of the HTL stage. In general, if the HTL stage does not correctly localize a template in the PCG (for example, if a partial heartbeat is localized instead of a complete heartbeat), then the HBP stage may not correctly predict locations of heartbeats in the PCG. This paper will propose additional techniques for improving the localization of a template in the HTL stage.