Optimal Delineation of PCG Sounds via False-Alarm Bounded Segmentation of a Wavelet-Based Principal Component Analysis Metric

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The aim of this study is to describe a new false-alarm probability (FAP) bounded unified framework for segmentation of the phonocardiogram (PCG) signal sounds registered by an electronic stethoscope board. To meet this end, after application of appropriate pre-processings, a fixed sample size sliding window is moved on the selected scale and in each slid, six feature vectors namely as summation of the nonlinearly amplified Hilbert transform, summation of absolute first order differentiation, summation of absolute second order differentiation, curve length, area and variance of the excerpted segment are calculated to construct a newly proposed principal components analyzed geometric index (PCAGI) (to be used as the segmentation decision statistic (DS)) by application of a linear orthonormal projection. Next, using an adaptive smoothing filter (ASF), the obtained metric is modulated and is freed from the fast fluctuations. Afterwards, histogram parameters of the filtered DS metric are used to regulate the -level Neyman-Pearson classifier for FAP-bounded delineation of the PCG events. To assess performance quality of the proposed PCG segmentation algorithm, the method was applied to all 85 records of Nursing Student Heart Sounds database (NSHSDB) including stenosis, insufficiency, regurgitation, gallop, septal defect, sound split, rumble, murmur, clicks, friction rub and snap disorders with different sampling frequencies. Also, the method was applied to the records obtained from an electronic stethoscope board designed for fulfillment of this study in the presence of high-level power-line noise and external disturbing sounds and as the results, no false positive (FP) or false negative (FN) errors were detected.