Robust Assessment of Photoplethysmogram Signal Quality in The Presence of Atrial Fibrillation

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A big deal of algorithms currently available to assess the quality of photoplethysmogram (PPG) signals is based on the similarity between pulses to derive signal quality indices. This approach has limitations when pulse morphology become variable due to the presence of some arrhythmia as in the case of atrial fibrillation (AFib). AFib is a heart arrhythmia characterized in the electrocardiogram mainly by an irregular irregularity. This arrhythmicity is reflected on PPG pulses by the presence of non-uniform pulses and poses challenges in the evaluation of the signal quality. In this work, we first test the performance of few algorithms from the body of methods reported in literature using a dataset of PPG records with Afib, and demonstrate their limitation. Second, we present a novel SVM-based classifier for PPG quality assessment in 30s-long segments of PPG records extracted from pulse oximetry data of 13 stroke patients admitted to the UCSF medical center neuro ICU. 40 time-domain, frequency domain and non-linear features were extracted from all segments. Using an independent test set, the classifier reached a 0.94 accuracy, 0.95 sensitivity and 0.91 specificity. These results demonstrate the robustness of the proposed method in properly evaluating PPG signal quality in the presence of atrial fibrillation. The distinction between waveforms with normal sinus rhythm and with atrial fibrillation in the training of the classifier proved to improve the end performance of PPG quality assessment.