Obstructive Sleep Apnoea using Photoplethysmography-based Dynamic Features

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Recently, photopletysmography (PPG) signal has been developed for home Obstructive sleep apnea (OSA) monitoring, being an easily acquired measurement, that provides a measure of the tissue blood volume, in particular, whenever an apneic episode occurs, sympathetic activity increasingly produces vasoconstriction that is reflected by decreases in the PPG amplitude fluctuation. Therefore, PPG events can indirectly quantify apneas during sleep. However, other physiological events such as artifacts, movements and deep inspiratory gasp produce sympathetic activation, and consequently, decrements in PPG envelope amplitude, which are unrelated to apnea. As a result, its high sensitivity can produce misdetections and overestimate apneic episodes. To cope with this shortage, nonstationary techniques of signal processing are required to analyze the time evolution of the autonomic control mechanism. Even that different approaches have been developed (Time Frequency, TimeVarying, and Time Scale analysis, etc.), still without accurate models to describe sympathetic activation, the application of aforementioned approaches often fails to provide satisfactory results because of imposed stationary assumptions. Mostly, it is assumed that each extracted feature is generated independently and identically, instead of treating the data as stochastically dependent, and thus providing a possible approach, capable of capturing the evolving information of the structure. This paper explores the training methodology for OSA detection, which is based on relevance analysis of dynamic features extracted from nonparametric time-frequency representation of PPG envelope. The methodology consists of four phases: (1) preprocessing is carried out, with a segmentation process, followed by an artifacts removal and a clustering algorithm; (2) the dynamic features are extracted from nonparametric timefrequency representation based on spectrogram; (3) both linear transformations (namely, Principal Component Analysis and Partial Least Squares) are used to perform dimensionality reduction; (4) the results are validated through cross validation using a k-nn classifier. For two classes (normal, apnea) the results for PCA are: specificity 81:82%, sensibility 100% and for PLS specificity 81:82%, sensibility 88:57%. Achieved results related to performed accuracy and dimension reduction are comparable with respect to outcomes reported, and clearly show that the proposed methodology can be focused on finding alternative methods for OSA diagnosis.