8^{th} European Medical and Biological Engineering Conference (EMBEC 2020)

29 November – 3 December, Portorož, Slovenia

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ABSTRACT BOOK

Tomaž Jarm, Samo Mahnič-Kalamiza, Aleksandra Cvetkoska, Damijan Miklavčič (Editors)

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Assessment of least square boosting to estimate apnea-hypopnea index from at-home oximetry recordings

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Polysomnography (PSG) is the standard diagnostic test for sleep apnoea-hypopnoea syndrome (SAHS), but it has been proven technically complex, costly, and time-consuming. Favoured by the high prevalence of SAHS, it helps increase waiting lists and delays access to treatment of the affected population. In this context, the diagnostic assessment of automatic machine-learning techniques applied to a reduced set of the signals involved in PSG has become a common investigation field. We hypothesise that the information obtained from portable nocturnal oximetry along with the generalisation ability of the ensemble-learning methods could be useful to simplify SAHS diagnosis. Particularly, our aim is the analysis of 322 overnight single-channel oxygen saturation signals (SpO2) recorded at patients' homes. First, each SpO2 recording is characterised by the extraction of 32 features from different analytical approaches (clinical, statistical, spectral, and non-linear). Then, the fast correlation-based filter is used along with a bootstrap procedure to select the most relevant but non-redundant among them. The optimum set of selected features from a training set (N=200) is used to obtain a least squares boosting model (LSBoost) with ability to estimate the apnoea-hypopnea index (AHI), which is the clinical measure used to establish SAHS and its severity. Then, the model is validated on a previously unseen test set (N=122). Our results show that 4 SpO2 features were considered relevant and non-redundant: 3% oxygen desaturation index (clinical), kurtosis of the SpO2 time series (statistical), Wootter's distance of the spectrum (spectral), and the scale with the maximum value of the multiscale entropy (non-linear). Using these features, the LSBoost training process ended up in an ensemble of 100 decision trees. The automatically estimated AHI showed an intra-class correlation coefficient of 0.918 with actual AHI, as well as 0.658 Cohen's kappa when using it to classify SAHS into the common 4 severity degrees (no SAHS, mild, moderate, and severe). Moreover, the binary assessment of its performance on each of the 3 AHI thresholds that defines these severity degrees (5 e/h, 15 e/h, and 30 e/h) resulted in the next respective accuracies: 94.3% (99.1% sensitivity, Se, 40.0% specificity, Sp), 86.9% (84.8% Se, 93.3% Sp), and 92.6% (84.6% Se, 98.6% Sp). Thus, our results suggest that LSBoost could be used to automatically estimate AHI from at-home SpO2 to simplify SAHS diagnosis. Funding: MINECO and FEDER (DPI2017-84280-R) and CIBER-BBN

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