Automatic Scoring of Non-apnoea Arousals using the Polysomnogram

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In this study, we develop automatic algorithms that identify periods of non-apnoea arousals by processing polysomnogram signals. The training and testing data from the PhysioNet/Computing in Cardiology 2018 Challenge was used.

Our initial system processed the electrocardiogram (ECG) and oxygen saturation (SaO2) signals only. The ECG was first processed to remove the baseline wander by using two median filters. Following this, a Hilbert-transform based QRS detector algorithm was applied to detect R-waves and the RR-intervals were calculated. RR-intervals that were greater than 4 seconds or less than 0.25 seconds were identified and removed from the analysis. The SpO2 and RR signals were then segmented into 15 seconds non-overlapping epochs and features were extracted for each epoch. For the SpO2 signal, we extracted a single feature which was the logarithm of the variance of the epoch SpO2 value. For the ECG, we calculated the interval-based power-spectral-density (PSD) of the RR intervals corresponding to the QRS detections within an epoch and used the logarithm of the PSD values as features. The feature set for each epoch was then expanded by including information from features from the surrounding eight epochs to boost the classification performance. Features were processed with a linear discriminant classifier.

We applied leave-one-record-out cross-validation on the training data and obtained an area under the receiver operator curve (AUROC) of 0.774 and an area under the precision recall curve (AUPRC) of 0.148 for detecting non-apnoea arousals. When our system was tested on the test data we obtained on AUROC of 0.739 and an AUPRC of 0.119.

Future ideas include adding features based on the EEG, EOG and EMG signals as these markers are used clinically to identify arousals. Time-frequency, statistical and entropy features of the EEG will be considered as well as amplitude-based variations in the EMG and EOG signals. Further, we will apply preprocessing to the signals to reduce the undesired components of the signals. Information from the different sensors will be combined using multi-modal signal methods.