USING SWITCHING MULTIPLE MODELS FOR THE AUTOMATIC DETECTION OF SPINDLES

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Keywords: Spindles, EEG segmentation, switching multiple models

Sleep EEG data is characterised by various events that allow for the identification of the different sleep stages. Stage 2 in particular is characterised by two morphologically distinct waveforms, specifically spindles and K-complexes. Manual scoring of these events is time consuming and risks being subjectively interpreted; hence there is the need of robust automatic detection techniques. Various approaches have been adopted in the literature, ranging from period-amplitude analysis, to spectral analysis and autoregressive modelling. Most of the adopted techniques follow an episodic approach where the goal is to identify whether an epoch of EEG data contains an event, such as a spindle, or otherwise. The disadvantage of this approach is that it requires the data to be segmented into epochs, risking that an event falls at an epoch boundary, and it has low temporal resolution.

This work proposes the use of an autoregressive switching multiple model for the automatic segmentation and labelling of Stage 2 sleep EEG data characterised by spindles and K-complexes. When this modelling technique was used to identify spindles from background EEG, quantitative results based on a sample by sample basis gave a sensitivity score between 72.39% to 87.51%, depending to which scorer performance was compared. This score corresponds to a specificity that ranges between 78.89% and 90.55% and which increases to a range between 75.52% and 94.64% when performance is measured on an event basis instead [1]. This performance compares well with other spindle detection techniques published in the literature [2,3].

The advantage of the proposed technique is that it allows for the continuous segmentation of EEG data, it offers a unified framework to detect multiple events with little training data, and it can also be extended to a semi-supervised approach. The latter, which has also been applied to Stage 2 sleep EEG data, can identify new states in real time, providing a solution that not only replaces the time consuming manual scoring process but it may also provide the clinician with new insights on the data that is being analysed.

References

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