Estimation of Localized Ideal Oximetry Sensor Lag Via Oxygen Desaturation-Disordered Breathing Event Cross-Correlation

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ESTIMATION OF LOCALIZED IDEAL OXIMETRY SENSOR LAG VIA OXYGEN DESATURATION-DISORDERED BREATHING EVENT CROSS-CORRELATION

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Introduction: In previous work, we attempted to identify events using sensor data from full-night polysomnography studies using a global 20-second oximetry sensor lag across all studies. However, we observed that oxygen desaturation onset trailed the corresponding human expert-labeled events by varying amounts of time, even within the same study. In this work, we estimate the localized ideal oximetry (SpO₂) sensor lag using the cross-correlation between the labeled disordered breathing event and the observed desaturation.

Methods: We used a corpus of 15 human-expert scored full-night clinical polysomnography studies collected at Oregon Health & Science University’s sleep lab. For each study, we first estimated the baseline SpO₂ by computing the 95th-percentile SpO₂ value across the entire night. Then, we calculated the SpO₂ desaturation from baseline by subtracting the baseline from the observed SpO₂.

For each event label, we generated an aperiodic pulse wave yielding a 5-minute signal containing a single pulse at the center having a duration equal to that of the labeled event. We then performed cross-correlation between the corresponding SpO₂ desaturation signal and the generated pulse wave signal. We calculated the localized ideal oximetry sensor lag (τ) as the lag corresponding to the maximum correlation value for that event.

Results: We calculated the mean τ for each study and analyzed the τ-values for the entire corpus. We found τ ranging from 16.6 to 31.2 seconds (µ = 25.6, σ = 4.3), supporting our hypothesis that τ varies considerably across studies.

Conclusion: We conclude that our cross-correlation-based method successfully estimates the localized lag τ not only across studies, but also within a single study. We expect our estimated τ to increase the accuracy of future machine learning efforts to automatically identify disordered breathing events by providing a more accurate SpO₂ disordered breathing event time alignment.

Support (If Any):