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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 (SpO_2) 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 SpO_2 by computing the 95th-percentile SpO_2 value across the entire night. Then, we calculated the SpO_2 desaturation from baseline by subtracting the baseline from the observed SpO_2.

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 SpO_2 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 ($\mu = 25.6$, $\sigma = 4.3$), 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 SpO_2 disordered breathing event time alignment.

Support (If Any):