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Unlocking Oxycardiorespirograms to Identify Preterm Breathing Patterns: An Exploratory Baseline Classification Study

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Introduction

Detecting central apneas and assessing cardiorespiratory stability are crucial in preterm neonates. Although polysomnography remains the diagnostic gold standard, its routine use is limited. Multi-channel oxycardiorespirograms (OCRG) offer a non-invasive alternative, capturing respiratory patterns, heart rate variability, and oxygen saturation; however, their automated analysis remains underdeveloped. This study explored whether baseline machine-learning approaches can differentiate term-like and preterm breathing patterns as markers of respiratory maturation.

Methods

We retrospectively analyzed 75 OCRG recordings (January 2021–June 2025) from 75 infants with corrected age <52 weeks. A nasal flow-based preprocessing pipeline was developed. As a baseline, we employed both a one-nearest-neighbour classifier using Dynamic Time Warping (DTW) and a random forest classifier to differentiate term-like and preterm breathing patterns. Model performance was evaluated using stratified group 5-fold cross-validation with subject-wise splitting.

Results

The one-nearest-neighbour model achieved a mean accuracy of 0.641, precision of 0.656, recall of 0.641, and an F1-score of 0.648. The random forest model showed a mean accuracy of 0.751, precision of 0.643, recall of 0.751, and an F1-score of 0.665. Classification performance varied by group: term-like breathing patterns were identified with ~75% (one-nearest-neighbour) and ~97.6% (random forest) accuracy, while preterm patterns were identified with lower accuracy (~30% and 2.6%, respectively).

Conclusion/ Future Aspects

While 1-NN showed a differentiation between term and preterm patterns, the random forest correctly identified only ~2.6 % of preterm patterns. The limited detection of preterm patterns highlights the impact of class imbalance, small sample size, and heterogeneity of preterm respiratory physiology. With the need for a more representative dataset, future work will focus on building a more balanced dataset based on selected apnea-linked bradycardial events, and integration of additional physiological monitoring channels to improve robust detection of clinically relevant respiratory instability.

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