

T Bakkes ; A Van Diepen ; M Mischi ; P Woerlee ; S Turco

Eindhoven University of Technology, Electrical Engineering, Eindhoven, Netherlands

Introduction:

Patient-ventilator asynchrony (PVA) is difficult to detect consistently since it relies on visual inspection of the waveforms. However, the development of automatic detection methods is hampered by the lack of properly labelled ventilation data. One solution would be to utilize artificially generated data. In this study, we compared the performance of a detection method based on clinical data to a detection method based on simulated data.

Methods:

The detection method was based on a neural network that was trained to detect the start and end of the patient breathing efforts, as described in [1]. In our work, two different datasets were utilized to train the network. The first dataset consisted of clinical data and the second consisted of simulated data obtained from the model in [2]. The detection method was trained and tested in four different settings. As a baseline, only the clinical data was utilized. In the second to the fourth setting, the training data was extended with simulated data. Three different ratios of clinical to simulated data were utilized in each setting. To prevent overfitting the model was cross-validated (CV) with each patient being one-fold of the cross-validation.

Results:

The quality of the detection for each of the trained networks was evaluated by comparing the detections to the ground truth, and the subsequent results can be seen in Table I.

Conclusion:

The results from Table I show that the inclusion of simulated data during the training resulted in a marginal improvement of detection quality. A maximum improvement of roughly 1% in both precision and recall was achieved with a mix-ratio of 1:2. In future research, further improvements in the simulations, e.g. including higher variability and more realistic triggering and cycling, can possibly lead to improved detection performance.

References:

[1] Bakkes et al. EMBC 2020 150-153, 2021

[2] van Diepen A et al. arVix, 2021

Table:

Trained on	Clinical	Clinical & Sim (1:1)	Clinical & Sim (1:2)	Clinical & Sim (1:3)
Tested on	Clinical (CV)	Clinical (CV)	Clinical (CV)	Clinical (CV)
PPV	96.0%	96.0%	96.9%	96.6%
TPR	95.4%	95.7%	96.5%	95.9%

Detection results of the four different settings. The ratios denote the number of simulated data points to clinical data points. Results are given in positive predictive value (PPV) and true positive rate (TPR).