smart mechanical ventilators.

DATA SCIENCE & MACHINE LEARNING

Use cases in machine learning for time series.
Critically ill patients who are unable to breathe (sufficiently) on their own receive respiratory support using a mechanical ventilation system. During the weaning process, the spontaneous breathing effort of the patient is required. It is essential that the ventilator support is synchronized (in time) with the patient's spontaneous breaths. A mismatch in this timing is referred to as Patient-Ventilator Asynchrony (PVA). To improve the patient's comfort and recovery this PVA must be prevented. A key step in this process is the detection and classification of PVA.

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Long Short-Term Memory cells for detection

In current practice, experienced clinicians are able to detect PVA using the measured flows and pressures. However, this is a very time-consuming and challenging task. Therefore, with the help of Machine Learning, we have developed an algorithm that automatically detects and classifies PVA.
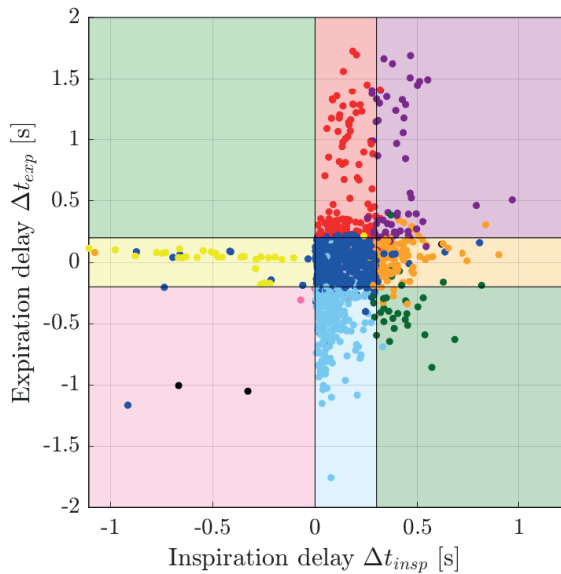
More specifically, a Recurrent Neural Network (RNN) with Long Short-Term Memory (LSTM) cells is used for the detection and classification of PVA. These types of models are the current state-of-the-art in recognizing patterns in time-series data.

Unlike any feedforward neural network, LSTM cells have feedback connections. These feedback connections enable the recognition of patterns over time in sequenced data. This allows LSTM networks to process entire data sequences. Making it perfect for the detection and classification of PVA using the measured time-series data.

Improving the treatment using AI

Using the developed network, asynchrony between the ventilator and the patient can be detected in real-time. In turn, this information can be used to adjust the patient's treatment and eliminate PVA – enabling faster recovery. Eventually, the algorithm should be able to automatically adjust the ventilator settings (in terms of provided flows and pressure) to eliminate PVA.

"improving respiratory support for ICU patients with self-learning assisted ventilation"

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