### Hypoventilation risk in postoperative patients

Hypoventilation has a high risk of happening during the first 24 hours after the initiation of opioids (drugs used for treating pain) in postoperative patients. Current techniques to detect airway obstruction either have high false positive rate, delay indicator or ineffective cost. Our solution is to build a reliable respiratory depression monitoring technique integrated from pulse oximeter waveform pattern signal and its frequency.

### Changes in heart rate waveform pattern and frequency during obstruction

Changes in heart rate waveform pattern and frequency can be used to detect postoperative airway obstruction. Using chest band, nasal pressure, and thermistor signals to identify partial and complete airway obstruction (PAO and CAO).

MATLAB program.

#### Extracting and analysing process

Using chest band, nasal pressure, and thermistor signals to identify partial and complete airway obstruction (PAO and CAO).

#### Pattern recognition solution

The fundamental conditions below of the pulse oximeter pattern and frequency will be established and used as an input machine learning technique for pattern recognition, in order to build a specific airway obstruction detecting alarm system.

- **PAO**: Peak at ~1Hz increases in amplitude
- **CAO**: Peak at ~0.2Hz increases in amplitude
- **Pattern matches PAO/CAO pattern criteria**

### Figure 1:
Pulse oximeter waveform has visually different pattern during PAO and CAO compared to normal breathing.

Patterns Criteria:
- **PAO**: A rise and fall of 1.5 to 2 similar cycles for at least 30 seconds.
- **CAO**: A rise and fall of 2.5 to 3.5 similar cycles for at least 30 seconds.

#### Figure 2:
The peak at ~1Hz increases in amplitude when PAO occurs but did not increase during CAO period. This peaks’ difference represents the energy of the cardiac frequency increases during PAO, which due to the increasing in the amount of blood goes back to the right atrium of the heart.

#### Figure 3:
The peak at ~0.2 Hz increases in amplitude when CAO occurs. This peaks’ difference at 0.2 Hz represents the energy of the respiratory frequency increases as thoracic muscles and diaphragm contract harder for patient to breathe.

### REFERENCES