Baxter

Master Thesis Project Description

Separate the Arterial and Venous Components From a Pulse Oximeter Signal

Background

Monitoring of hemodynamic stability is vital in both intensive care and dialysis clinics. Patients with end stage kidney failure are dependent on dialysis to survive. During dialysis, blood is purified from metabolic waste products, and excess fluid is removed. Dialysis often causes decreased blood volume and hemodynamic instability manifested in hypotensive episodes. Hemodynamic stability is only supervised a few times per dialysis treatment using cuff based blood pressure measurements. In intensive care units, arterial pulses and oxygenation is commonly monitored using pulse oximetry [1]. The pulse oximeter signal mainly contains an arterial component, but a venous component has also been shown to be present [2]. The amplitude of the venous component is related to amount of fluid overload or the position of the patient. In some positions (the Trendelenburg position) the venous pulsations may be strong enough to cause falsely low SpO_2 values [3]. Today's pulse oximeters do not separate the arterial and venous components from each other. Separating the signals may lead to more accurate SpO2 values and the venous signal may be of interest for monitoring of hemodynamic stability [2].

Objective

The objective of this master thesis is to extract the arterial and venous components from a pulse oximeter signal, using digital signal processing. The extracted arterial and venous signal components should be compared to the diameters of the arteries and veins as measured by ultrasound. We think this master thesis is suitable for students from E, BME, F, Pi, or N and skilled in signal processing and Matlab.

Plan

1. Literature study. 2. Recording of pulse oximeter signals together with wall movements of veins and arteries as reference. 3. Evaluation of different signal processing methods for signal separation. 4. Report and presentation.

Supervisors

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References

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[2] Kirk, H. et Al., "The detection of peripheral venous pulsation using the pulse oximeter as a plethysmograph", Journal of Clinical Monitoring, vol. 9, pp. 283-287, 1993.
[3] Chan E. D., et Al., "Pulse oximetry: Understanding its basic principles facilitates appreciation of its limitations," Respiratory Medicine, vol. 107, pp. 789-799, 2013.