Algorithm development for multimodal wearable sensor garment

Host:
RISE Acreo AB, Department of Sensor Systems, Göteborg

Background:
RISE Acreo, part of RISE Research Institutes of Sweden, is a research institute within the areas of electronics, optics and information technology. The department of Sensor Systems in Göteborg is focused on research and development of high performance sensors and sensor system in a wide range of application areas. Acreo is a partner in the SSF project "Wearable sensors in smart textiles", which aims to develop functional garments with built-in sensors to improve and simplify diagnosis and treatment of the most common neurodegenerative diseases. As a part in this project, Acreo develops a wearable multimodal sensor platform in the form of a garment. The platform contains inertial motion sensors and sensors for electrical and optical hear rate measurements.

Problem description:
An important indication of the physical state of patients with neurological diseases is the heart rate (HR) and heart rate variability (HRV), which are controlled by the autonomous nervous system. The heart rate is measured using electrocardiography (EKG) and photoplethysmography (PPG) using wearable sensors in the garment. Estimates of the heart rate and its variability will be derived from the multimodal measurements. In addition, rapid changes in the blood pressure (BP) can also contain significant information regarding the state of the patient. Detecting such changes using the multimodal and spatially distributed sensor setup will also be considered.

Project objectives:
The primary objective is to use the redundancy in heart rate measurements in combination with the motion measurements to develop a robust and accurate HR algorithm. To achieve this, the student will collect measurement data using the garment, develop signal processing, and develop an algorithm based on the literature and previous work at Acreo. The algorithm will be evaluated under different conditions and patient states relevant for the application to neurological diseases. The secondary objective is to develop algorithms for the estimation HRV during continuous measurements and investigate the feasibility of detection of rapid BP changes using the HR estimate and the available multimodal measurements.

The thesis work will consist of the following parts:
- Literature study on available pulse algorithms
- Creation of data acquisition software for garment
- Collection of data set using the garment
- Signal processing development
- Development of HR algorithm
- Development of HRV algorithm
- Investigation of BP change detection
- Evaluation of algorithms under various conditions

Start time:
January 2018, 6 months.

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