Title
Wearable Monitoring for Obstructive Sleep Apnea

Main supervisor
Gabriele Papini, MSc, (g.p.papini@tue.nl)

Other involved staff members
Dr. ir. Rik Vullings, prof. Sebastiaan Overeem, MSc Marina Nano

Location
Eindhoven University of Technology (BM/d Labs) and Philips Research (High Tech Campus)

Background
Obstructive sleep apnea (OSA) is a sleep-related breathing disorder, characterized by intermittent disruptions of normal breathing patterns during sleep. The OSA causes sleep fragmentation leading, for instance, to an increase of daytime sleepiness and, more importantly, it is an important cause of increased cardiovascular risk and even all-cause mortality. Moreover, OSA afflicts around 100 million people worldwide and it is estimated that 90% of OSA patients remain undiagnosed. The underdiagnosing of OSA is principally related to the obtrusiveness and expensiveness of the current diagnosis technique, i.e. polysomnography (PSG).

There is a clear need for new technologies to detect, monitor and characterize OSA. Fortunately, new wearable technologies are becoming extremely popular, such as smart-watches, and they can be used for unobtrusive monitoring. Photoplethysmography (PPG) and accelerometry can characterize the cardio-respiratory system and the body movements of the subject during sleep. Thanks to this information, using wrist-worn sensors to detect, monitor and characterize OSA is becoming a tangible development in the biomedical sleep research field.

Description
The goal of this project is to investigate the possibilities of wearable sensing in relation to OSA. In general, the project has three possible main deliverables:
- Extraction of new features/signal relevant for OSA research (e.g. respiratory effort signal from PPG).
- Development of a machine learning algorithm for OSA research (e.g. algorithm to determine apnea duration)
- Physiological characterization of OSA events (e.g. signal morphology changes related to apnea).

The exact scope of the project will be defined based on the status of the research in the department and according to the student interest. The project could involve some limited data collection to test the developed methods.
Keywords
Photoplethysmography (PPG), Healthcare/Sleep, Accelerometry, Signal analysis, Machine learning, Algorithm development and simulation, Jointly with industry

Elective courses
5LSB0 Monitoring of respiration and circulation
5LSL0 Machine learning for signal processing