MSc project

Title:
Automatic detection and characterization of sleep spindles (A collaboration between DTU, Danish Center for Sleep Medicine, Rigshospitalet, Glostrup, and Center for Advanced Research in Sleep Medicine, Centre de Recherche de l'Hospital du Sacré-Caeur de Montreal, QC, Canada)

Introduction:
The basic understanding and classification of sleep staging relies on a classification dating back to 1968 by Rechtshaffen and Kales. It divides sleep stages into Rapid Eye Movement (REM) and Non-REM (NREM) sleep. Central to this classification is polysomnography (PSG) which assess complex electrophysiological signals including brain activity measured by electroencephalography (EEG), eye movements measured by electrooculography (EOG), motor activity by electromyography (EMG) and several other physiological modalities. The current sleep classification relies on visual identification of specific patterns in the PSG signals, and traditionally, the huge amount of data recorded is tremendously downsized to a simple diagram (called a hypnogram) summing up the overall sleep architecture of the recording night. Therefore, the simplistic analysis performed in the PSG data does not take into account important but unexploited macro and micro sleep events. This results in limitations for both diagnosis and a deeper understanding of the disease pathophysiology.
This project will exploit the micro sleep event *sleep spindle* that has been known for decades, but recently has attracted a lot of research due to its strong association to cognition, memory consolidation and sleep maintenance. Understanding and detecting *sleep spindles* is of utmost importance in understanding sleep, but the manual assessment is time consuming and subjective, which may be the reason why the majority of automated detectors fail when validating against manual identification.

Objectives:
Center for Advanced Research in Sleep Medicine, located in Montreal, QC, Canada, has facilitated the development of improved spindle algorithms by presenting a large, high quality database of PSG with annotated and confidence-rated spindles: The massive Online Data Annotation (MODA) sleep spindle database. In collaboration with this center, the Danish Center for Sleep medicine, and DTU, this project will aim 1) to develop a high-performance automated spindle detector, and 2) to characterize the spindles in relation to their confidence scores.

Supervisors:
Assoc. Professor Julie A. E. Christensen, DTU Elektro/Danish Center for Sleep Medicine
Assoc. Professor Simon C. Warby, Center for Advanced Research in Sleep Medicine, Centre de Recherche de l'Hospital du Sacré-Caeur de Montreal, QC, Canada
Professor, MD Poul J. Jennum, Danish Center for Sleep Medicine, Rigshospitalet, Glostrup

Prerequisities:
Experience with Matlab, signal processing and machine learning is required.
The project may/will include a 2-4 months external stay at the Center for Advanced Research in Sleep Medicine in Montreal, Canada.

Contact:
Assoc. Professor Julie A. E. Christensen, DTU Elektro/Danish Center for Sleep Medicine: jaec@elektro.dtu.dk