MSc project

Title:
Automatic detection and characterization of the transition period from wake to sleep (A collaboration between DTU and Danish Center for Sleep Medicine, Rigshospitalet, Glostrup)

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 not well-defined transition period from wakefulness to sleep. In this transition period the brain goes from being awake and fully aware of the surroundings to a drowsy period and lastly to a sleep stage (N1 sleep) where the surroundings are not registered any longer; the time of sleep onset. Understanding and detecting sleep onset is of utmost importance in understanding the brain mechanisms controlling wakefulness and sleep, and there is a lot of discussion of when it actually occurs. The greatest inter-scorer variability in the manual assessment of sleep is seen for N1 sleep, which may be the reason why automatic detectors especially fail in detecting this sleep stage, and thereby also fails in detecting the exact time for sleep onset.

Objectives:
In the investigation of hypersomnia, a diagnostic test called the Maintenance of Wakefulness Test (MWT) is performed, where a subject monitored by PSG is instructed to stay awake while sitting passively and still in a dark room. The test is performed multiple times, giving a mean sleep latency measure in the end. In this way, a lot of wake-to-sleep transition periods (including sleep onsets) are recorded. In a collaboration between the Danish Center for Sleep Medicine and DTU, this project will aim 1) to develop a detector for detecting wakefulness with eyes closed, with eyes open and light sleep (N1 sleep), and 2) to use this detector to further investigate the transition period from wakefulness to sleep, including the time of sleep onset.

Supervisors:
Assoc. Professor Julie A. E. Christensen, DTU Elektro/Danish Center for Sleep Medicine
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Prerequisities:
Experience with Matlab, signal processing and machine learning is required.

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