MSc-project

Detection of the semi-defined autonomic arousal in sleep and analysis of its clinical application

Introduction

Arousals in sleep are naturally occurring micro-events, which reflect the reversibility of sleep. Despite their vital function, arousals have been found to be associated with the pathophysiology of several sleep disorders.[1] The American Academy of Sleep Medicine (AASM) states that scoring of arousals must be attained through electroencephalographic (EEG) analysis, and cannot be based on alternative bio-signals alone.[2] However, this definition neglects to address the diversity of arousals and their systemic cohesion. Autonomic arousals have been postulated to be related to the cardiovascular and neurocognitive dysfunction associated with sleep-disordered breathing, independent of their relation to cortical arousals. However, most studies to date have explored experimentally-induced autonomic arousals only in healthy/control populations. There is an unmet need for redefining arousals such that the systemic cohesion is considered.

Objective

The main objective is the clinical impacts of naturally occurring automatic arousals, by correlating the severity, length, and/or number of autonomic arousals with physiological outcome measures, such as sleepiness, daytime function, increased blood pressure, etc. Furthermore, arousals are not randomly scattered but appear structurally distributed within sleep representing state-specific arousals responses. A sub-objective is to make a thorough analysis of the arousals in different contexts, e.g. arousals appearing in relation to other events such as leg movements, cortical arousals and apnea events, or if it appears isolated, as well as an analysis of the distribution of arousals, i.e. arousals appearing in different sleep stages.

Description

In this project, the main challenge is to design a system to identify a semi-defined sleep event, the autonomic arousals. Due to the vague definition of autonomic arousals, choosing an appropriate model design and which bio-signals to implement is open but a critical point, and both supervised and unsupervised learning frameworks are possible. Furthermore, a choice on what bio-signals to include must be included. One is encouraged to validate the model by the clinical outcome measures of the sleep recording (sleepiness, daytime function, increased blood pressure, etc.) to justify the design choice. The project is performed in research collaboration with Rigshospitalet Glostrup.

Max number of students: 2

Prerequisites:

Signal processing, experience in Matlab and profound mathematical skills.

Supervisors:

Assoc. Professor MSK PhD Helge B.D. Sørensen, DTU Elektro

PhD student Mads Olsen, DTU Elektro

Professor Chief Physician DMSc Poul Jørgen Jennum, Rigshospitalet, Glostrup

Contact:

Assoc. Professor MSK PhD Helge B.D. Sørensen, DTU Elektro hbs@elektro.dtu.dk

Medicinsk signalbehandling