SYMPOSIUM: NOVEL NEUROSCIENTIFIC TOOLS FOR FIGHTING SLEEP DISORDERS AND BREATHING-RELATED SLEEP DISORDERS (COPD, ASTHMA)

Presenters

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Short description

The role of sleep is crucial for preserving optimal physical and mental well-being. There is concrete scientific evidence demonstrating a reciprocal relationship among sleep quality and cognitive functioning. Sleep is also affected by our life-style preferences and may be deteriorated due to reduced mobility/exercise, obesity and alcohol consumption or smoking. It is also degraded prior to neurodegeneration or mental/psychiatric disorders, providing a valuable marker of the symptoms' severity and disease progression. Sleep is also dependent of environmental conditions and extreme environments such as weightlessness, isolation and confinement. Sleep quality is often assessed by polysomnographic (PSG) recordings which typically involve a minimum number of electroencephalographic (EEG), electrocardiograhic (ECG), electroculogrammic (EOG) and electromyographic (EMG) sensors. The studies employing the aforementioned modalities usually focus on the identification of sleep stages, macro-architecture (latency, duration), main sleep characteristics (spindles, K-complexes, arousals, awakening events) and breathing disorders (apnea/hypopnea events). Although this type of analysis may quantify the majority of pathologic conditions associated with sleep, it provides minimal knowledge on a system level and the dynamic nature of the functional interactions among brain regions during sleep as well as their deviations from normal functioning.

Objectives and Outline

Network neuroscience and contemporary mathematical tools when combined with advanced data acquisition modalities (high-density EEG, functional Magnetic Resonance Imaging / fMRI) may map the functional connectome with excellent temporal and spatial resolution. This approach is hypothesized to provide robust connectivity and network features which are often correlated with biomarkers and could identify pre-clinical pathological patterns. They could also serve as an objective outcome measure of interventions aiming to ameliorate disease symptoms. Recent advances in unobtrusive sensorial data acquisition give rise to a plethora of wearable or textile devices which map activity and daily living patterns. Sensorial features are usually fused with neurophysiological recordings for providing multi-modal, biomedical engineering, computational frameworks within the context of precision medicine for assessing sleep and sleep-related breathing disorders at early stages. This heterogeneous data fusion results in a big data problem which employs advanced deep learning techniques (e.g. computational networks) for providing novel sleep analytics for pathology prediction and therapy recommendations. Therefore, we welcome studies that answer fundamental neuroscientific and biomedical questions like (but not limited to) the following:

•How physiological aging, neurodegeneration and psychiatric disorders affect sleep neurobiology, macro-architecture and brain functioning?
•How sleep quality is affected by extreme environments (e.g. isolation, weightlessness, immobility)?
•Is it possible to predict forthcoming sleep quality patterns correlated with the daily lifestyle and activity patterns?
•Could we develop robust machine learning approaches for automatic sleep staging based on polysomnographic and/or sensorial data information?
•Which are the most appropriate biomedical engineering approaches for assessing sleep quality by contactless recordings and/or heterogeneous data fusion?
•How sleep mechanisms promote learning and neuroplasticity? Can we propose novel (beyond the art) ways for enhancing sleep quality and/or dream mapping?

Keywords

Extreme environments, Functional connectivity, Mental disorders, Neuroplasticity, Sleep quality