MOMILAB

Sleep, Plasticity,
and Conscious Experience

[SPACE] Research Group

IMT SCUOLA ALTI STUDI LUCCA

STAFF

Prof. Giulio Bernardi
Prof. Emiliano Ricciardi
Dr. Monica Betta
Dr. Giulia Avvenuti
Dr. Adriana Michalak

LABORATORIO

SPACE - MOMILAB

Research activity

Mission. The research activity of the SPACE Laboratory, belonging to the MOMILAB research unit, focuses on the study and characterization of the mechanisms that regulate sleep and wakefulness and of their interactions with psychophysical well-being. Our approach combines the collection of experimental data through a wide range of techniques for the recording of physiological signals and the development of procedures and algorithms for signal analysis and interpretation. In fact, alterations of the mechanisms that regulate wakefulness and sleep are observed in numerous pathological conditions including psychiatric and neurological disorders, but also cardiovascular and metabolic disorders. We therefore collaborate regularly with clinical centres.

Experimental research:

- Analysis of sleep physiology and of sleep functions in physiological conditions;
- Study of the relationship between brain and cardiovascular activity during sleep;
- Identification of indices reflecting brain fatigue and cognitive performance.

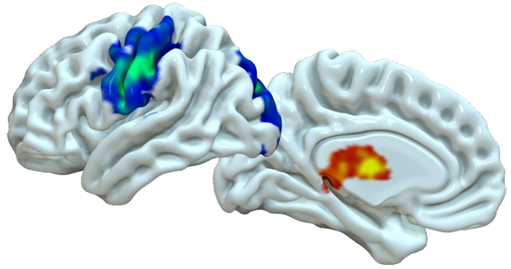
Applied research:

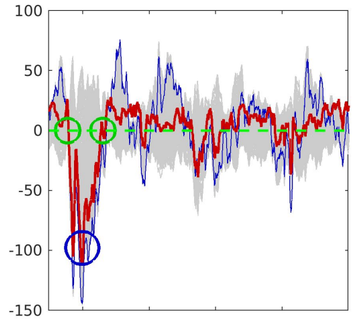
- Development of procedures and algorithms for the analysis and interpretation of physiological signals;
- Development of methods for influencing the quality and functions of sleep;
- Development of approaches for the identification of sleep alterations in pathological conditions.

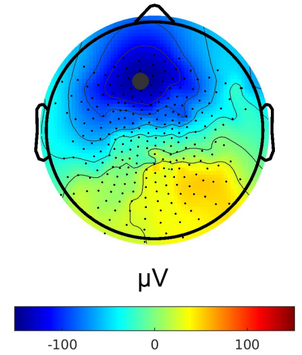
Images
and plots

Analysis of central and peripheral signals

- Using and combining different recording techniques and signals, including:
  - ✔ Standard and high-density electroencephalography – 1 to 257 electrodes;
  - ✔ Structural and functional magnetic resonance imaging with evaluation of cortical and deep structures;
  - ✔ Electrocardiogram, Electromyography, Electrooculogram, Photoplethysmography, Respiratory activity.
- Calculation and extraction of a wide range of features from the collected signals;
- Comparison between conditions or groups.

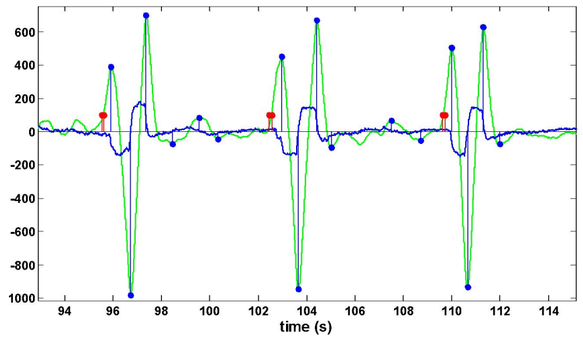


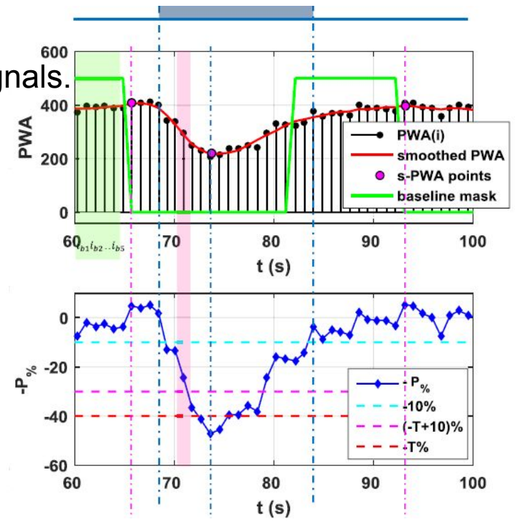




Development of procedures and algorithms for the analysis of different signals

- Removal or reduction of artifactual components in the collected signals;
- Study of the correlation and interaction between different signals;
- Extraction and analysis of quantitative parameters derived from one or more signals.





Tools, Technologies and Services

Sleep plays a central role in maintaining the functional efficiency of the brain and the body as a whole. Scientific evidence indicates that sleep has several important functions, including the **consolidation of recently acquired memories**, the **regulation of mood and emotional reactivity**, and the **removal of metabolites accumulated in the brain during wakefulness**. In other words, the **psychophysical well-being** of the individual and his/her individual and social behavior directly depend on the **quality and quantity of his/her sleep**.

The study of sleep functions and of their regulation allows us not only to understand the impact of sleep, or its loss, on health and behavior, but also to develop approaches that may grant the possibility to **"strengthen" the functions of the sleep or restore them in case of pathological alterations**. Such applications can have **clinical, social and economic implications**.

The **SPACE group**, within the MOMILAB research unit, develops **knowledge and tools** aimed at characterizing sleep in physiological and pathological conditions. It also develops and tests approaches and tools aimed at intervening on sleep to modify its efficiency and functions.

Possible applications and collaborations

Clinical applications

Development and validation of indices with potential diagnostic and/or prognostic value, and investigation of the possible synergy between such indices and already existing and validated indices and markers. Alterations of sleep and dreams are extremely common in pathological conditions and their assessment through simple indices could increase the efficiency and accuracy of diagnostic and prognostic processes. Given the relationship between sleep, experience-dependent plasticity and learning, the study of sleep may also find application for the monitoring of patient rehabilitation or for the evaluation and comparison of different rehabilitation strategies.

Industrial/commercial applications

States of cognitive fatigue and sleepiness may have important consequences for the individual and those around him/her, for example by increasing the risk of driving or work accidents, or by increasing the probability of antisocial behavior. Therefore, the identification of markers reflecting cognitive fatigue through sensors that are as simple and non-invasive could have applications in various fields. In addition to the identification of potential fatigue-related risks, the development of approaches aimed at improving the individual's awareness of his/her actual state of tiredness and/or at improving the individual’s resistance to fatigue may also be considered.

Contact

Ufficio Ricerca e Trasferimento Tecnologico -Scuola IMT Alti Studi Lucca

Sede: Piazza San Ponziano 6 - 55100 Lucca, LU
Sito web: https://www.imtlucca.it/
E-mail: projects@imtlucca.it

Contact

Ufficio Regionale di Trasferimento Tecnologico

Sede: Via Luigi Carlo Farini, 8 - 50121 Firenze, FI
E-mail: urtt@regione.toscana.it

IMT SCUOLA ALTI STUDI LUCCA

REGIONE TOSCANA

URTT