Politecnico di Torino
Dipartimento di Automatica e Informatica

PhD in Computer and Control Engineering
XXXVI cycle

Supervisor
Gabriella Olmo

Sleep and Motor Disorder Biomarkers in Neurodegenerative Diseases Exploiting Physiological Data

PhD Candidate: *Irene Rechichi*

SYSBIO GROUP
SYSTEMS BIOLOGY AND BIOINFORMATICS

1. Context

REM Sleep Behaviour Disorder (RBD) is regarded as one of the earliest markers of neurodegeneration, with a 90% conversion rate to Parkinson's Disease at a 14-year follow-up. Prodromal RBD offers a window for disease-modifying interventions: early detection is pivotal for adopting prevention strategies. The state-of-the-art RBD diagnosis is a challenging task, relying on cumbersome instrumentation and manual and visual-based metrics. This suggests the need for a faster diagnosis, as well as an objective assessment of the degree of impairment to overcome inter- and intra-rater variability.

2. Goal

This PhD project aims at building a framework for minimally-invasive sleep studies, to carry out the automatic detection and continuous monitoring of RBD, allowing for faster diagnosis and the quantitative assessment of the disease progression.

3. Methodology

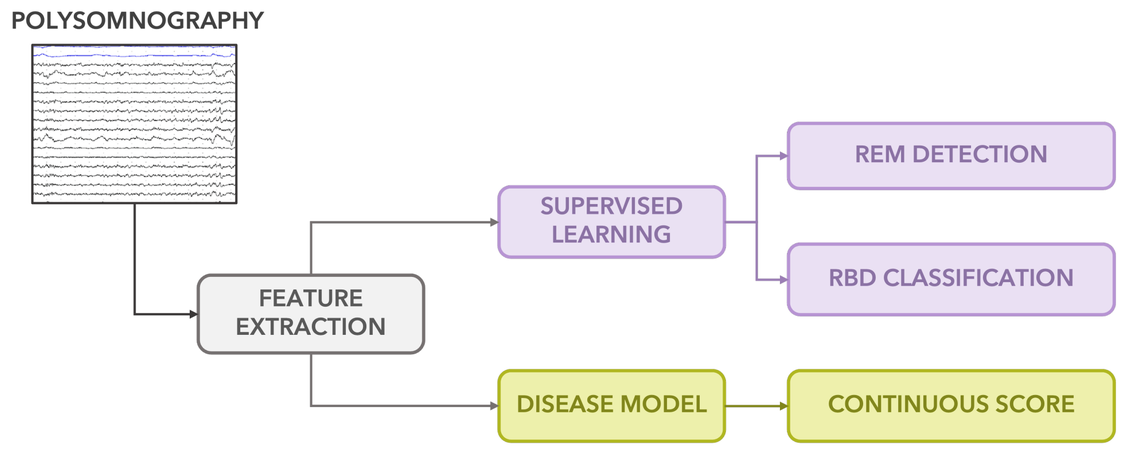
Bio-signals collected during sleep (EMG, EEG) are analysed to attain:

- **Automatic detection of RBD**

Supervised Machine Learning is employed for the automatic classification of subjects. This aims at finding the minimal set of sensors for lightweight scoring.

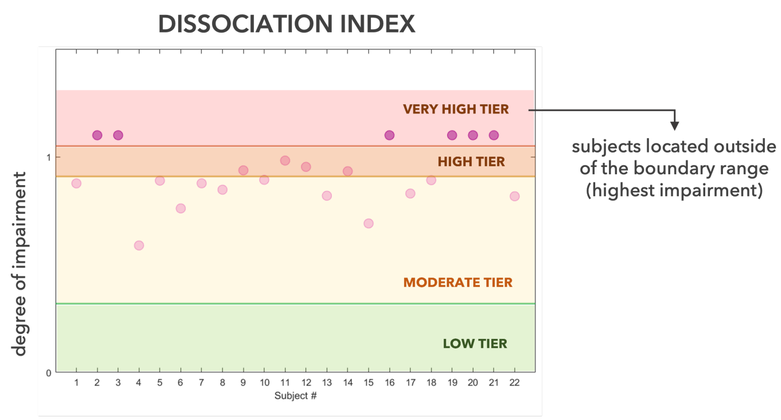
- **Assessment of the disease progression**

A user-independent continuous metric is designed to allow for personalized follow-up procedures. RBD subjects are compared to a healthy model and a disease progression score is computed.



4. Outcome and Conclusion

Automatic detection of REM sleep was obtained with an overall accuracy of 93%. Single-channel classification of RBD achieved a sensitivity of 86% (EMG-based) and 98% (EEG-based). As for disease progression, four impairment tiers are proposed to describe the degree of REM dissociation. The prototyped index will be included in longitudinal studies for validation in clinical practice.



5. References

1. Rechichi, I., Zibetti, M., Borzì, L., Olmo, G., & Lopiano, L., "**Single-channel EEG classification of sleep stages based on REM Microstructure**", 2021, Healthcare Technology Letters, 8(3), 58-65
2. Rechichi, I., Iadarola, A., Zibetti, M., Cicolin, A., & Olmo, G., "**Assessing REM Sleep Behaviour Disorder: from Machine Learning Classification to the Definition of a Continuous Dissociation Index**", 2021, International Journal of Environmental Research and Public Health, 19(1), 248
3. Rechichi, I., Amato, F., Cicolin, A., & Olmo, G., "**Single-Channel EEG Detection of REM Sleep Behaviour Diosrder: The Influence of REM and Slow Wave Sleep**", 2022, International Work-Conference on Bioinformatics and Biomedical Engineering, pp 381-394