

Master Thesis:

# Analysis of Sleep-related Symptoms of Parkinson Patients with Ambient Sensors

**Motivation:** Parkinson's disease (PD) is one of the most common neurodegenerative disorders with more than 4 million people living with the disease worldwide. Sleep disorders are one of the most common non-motor symptoms in the development of the disease. They also impair the quality of life of the patients and must be addressed with the proper treatments.

Following-up on the evolution of sleep disorders in PD patients is of high clinical importance to provide adequate healthcare solutions. Neurological exams only capture a specific time point, which may be influenced by patient fatigue or other confounding factors. Auxiliary monitoring tools that objectively assess the reality of the symptom and reflect continuously the impairment suffered from the PD patient can be of help, for instance, to measure the impact on sleep of missed or non-responsive medication.

**Task:** The goal of this thesis is to analyze the bio-signals of a pool of PD patients collected from ambient sensors to detect sleep disorders, and study the impact of sleep disorders on the PD patients. The bio-signals are provided by a bed sensor (ballistography-based sensor, Emfit QS) and a set of motion and door sensors (PIR sensors and magnetic door sensors, DomoSafety). Information about drug intake as well as from medical certified questionnaires is also collected to support medical assessment of the patient's state and correlate with the bio-signals.

Specific tasks involve but are not limited to the following.

- Design algorithms to detect high-level and low-level patterns of sleep disorders in PD patients from bio-signals collected from bed sensors.
- Design algorithms to track the nightly behavioural patterns of PD patients (*e.g.*, toilet usage at night, night wandering) from ambient door sensors.
- Analyze correlations between the above patterns and medical questionnaires and investigate the abnormal patterns that correlate with the OFF phase of the patients (*i.e.*, the patient is off medication or the medication is ineffective).

The expected outputs include (*i*) programs to process the ambient sensory measurements and detect sleep disorders in PD patients (in Python or Matlab) and (*ii*) reports on the in-field deployment and usage studies, and (*iii*) potential medical findings.

**Requirements:** Knowledge of signal processing and machine learning; Proficiency in programming for data analysis (Python/Matlab).

**Collaborators:** CHUV, EPFL, DomoSafety.

**References:** Daytime sleepiness and other sleep disorders in Parkinson's disease (2001), W. G. Ondo, K. Dat Vuong, H. Khan, F. Atassi, C. Kwak, J. Jankovic.

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