

## Master 2 Internship - 2023

### Network-based biomarker discovery of Parkinson's disease at various stages

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Scientific environment: Empenn U1228, IRISA, Campus de Beaulieu, Rennes -  
<https://team.inria.fr/empenn/>

Duration: 5-6 months

Starting date: early 2023

**Keywords :** Neuroimaging, neuroinformatics, Functional MRI, Diffusion MRI, tractography, biomarkers, graph theory

#### **Context**

Parkinson's disease (PD) is a common, complex, progressive multi-system neurodegenerative disease mainly affecting older people. The pathological processes leading to Parkinson's disease start decades before the onset of the typical clinical symptoms. However, current diagnosis comes quite late in the course of the disease, while evidence underlines the multiple benefits that would be associated with earlier diagnosis.

Several neuroimaging studies have reported various structural abnormalities, involved in the pathophysiological mechanisms of Parkinson. It is well acknowledged that PD displays a progressive multifactorial disruption of cerebral networks. Advanced MRI techniques have shown a great potential to highlight subtle changes of brain connectome and to investigate the neural mechanisms that may contribute to the emergence of PD. Integrating simultaneously these modalities could yield a powerful tool to exhibit robust biomarkers of each stage.

#### **Scientific objectives**

The goal of this approach will be to identify the pattern of progression using the Parkinson's Progression Markers Initiative (PPMI) database, which is a longitudinal multi-site study of newly diagnosed untreated PD patients. To do so, the student will first analyze the functional and structural connectivity metrics at each stage. Then, the second objective for this position will be to look at how the integration of the functional and structural MRI data may allow a better definition of the brain change patterns that are related to classical pathways involved in Parkinson disease. After that, the student will develop a multi-stage approach using innovative machine learning methods, to provide non-invasive, reliable and easy-to-track candidate biomarkers for PD.

**Location:** The recruited person will work at Inria/IRISA, UMR CNRS 6074, among the Empenn U1228 team. The work will be in close link with a neuropsychologist from the Neurology Department of Rennes University Hospital (Neurology Dept.), associate researcher in the Empenn team.

**Requirements:** We look for candidates strongly motivated by challenging research topics in machine learning and neuroimaging. The applicant should present a good background in machine learning and applied mathematics. Basic knowledge in image processing would be a plus. Good knowledge of computer science aspects is also mandatory, especially in Python and Matlab.

**References:**

Jones JD, Kuhn TP, Szymkowicz SM. Reverters from PD-MCI to cognitively intact are at risk for future cognitive impairment: Analysis of the PPMI cohort. *Parkinsonism Relat Disord*. 2018 Feb;47:3-7. doi: 10.1016/j.parkreldis.2017.12.006. Epub 2017 Dec 9. PMID: 29233608; PMCID: PMC5803409.

Burciu, R. G., Ofori, E., Archer, D. B., Wu, S. S., Pasternak, O., McFarland, N. R., ... & Vaillancourt, D. E. (2017). Progression marker of Parkinson's disease: a 4-year multi-site imaging study. *Brain*, 140(8), 2183-2192.

Zuo, C., Suo, X., Lan, H., Pan, N., Wang, S., Kemp, G. J., & Gong, Q. (2022). Global Alterations of Whole Brain Structural Connectome in Parkinson's Disease: A Meta-analysis. *Neuropsychology Review*, 1-20.