Neuripides Scientific Abstract:

We will develop a new treatment modality for Parkinson's disease, neurofeedback with functional magnetic resonance imaging (fMRI) signals, which emulates the effects of deep brain stimulation (DBS) on brain networks.

New neuromodulation treatments are needed in the field of neurodegenerative disorders (as recognised by this call for proposals). Current invasive neuromodulation protocols with DBS provide good symptomatic relief for motor symptoms of Parkinson's disease (PD) but have inconsistent effects on the often equally disabling non-motor symptoms. Non-invasive brain stimulation alternatives have so far only had limited clinical success. In order to emulate the success of DBS on motor symptoms non-invasively we need to measure its effects directly with fMRI and target these fMRI signal patterns with neurofeedback. Similarly, for better relief of non-motor symptoms we need to map the relevant network both functionally and anatomically and identify the relevant neurofeedback targets. Finally, we need to show that patients with PD can indeed self-regulate activation in these networks through neurofeedback training.

This project will thus include simultaneous DBS-fMRI studies and anatomical connectivity mapping of the cortico-subcortical networks supporting symptom relief, classification analysis of therapeutic activation patterns, and proof of concept of the feasibility of neurofeedback with these signals. In WP (work package) 1 we will scan PD patients during DBS of the subthalamic nucleus (STN) and compare "on stimulation" (with motor symptom improvement) and "off stimulation" with classification analysis of functional connectivity patterns. We will also use online fMRI during DBS in patients who show improvement of non-motor symptoms and combine this information with the knowledge of anatomical connectivity of the non-motor portion of the STN.

This WP will also entail corresponding analysis of existing DBS-fMRI data and extensive cross-validation. We will develop neurofeedback protocols targeting these functional connectivity signals with a focus on motor symptoms and the non-motor symptoms depression and anxiety (WP2) and evaluate clinical effects in a multi-centre trial (WP3). This work will lay the foundation for further clinical trials of this promising non-invasive neuromodulation strategy that can be used both in patients without implanted DBS electrodes and as an add-on to DBS.