NoTremor

Virtual, Physiological and Computational Neuromuscular Models for the Predictive Treatment of Parkinson's Disease

What is Parkinson's Disease

Parkinson's is a progressive neurological condition. People with Parkinson's don't have enough of a chemical called dopamine because some nerve cells in their brain have died. Without dopamine people can find that their movements become slower so it takes longer to do things. The main symptoms of Parkinson's are tremor, rigidity and slowness of movement.

There's currently no cure for Parkinson's and we don't yet know why people get the condition.

Parkinson's disease (PD) is the second most common neurodegenerative disorder after Alzheimer's disease and is expected to impose an increasing social and economic burden on societies as populations age.

The NoTremor Project

The overall aim of the project is to provide **patient specific computational models** of the coupled motor and neuromuscular system that will be subsequently used to improve the quality of **analysis, correlation (of novel and established indicators) and progression of Parkinson's disease**. In this way, NoTremor will be able to provide **clinical decision support** through a powerful parametric simulation engine, able to monitor the progression of the disease for individual patients, based on the specific **neurological and behavioural state of the user**.

The project's approach

NoTremor will integrate computational models of the basal ganglia and brainstem into a unique **multi-scale parametric computational model** that can be subsequently simulated in the NoTremor simulation engine in a physics-based manner.

NoTremor will revolutionize research in the pathophysiology of neurodegenerative movement disorders and provide a **novel approach for their analysis founded on a solid computational modelling** basis that links midbrain degenerations to motor behavior. The computational models will be quantified and validated through **test campaigns** with a very large cohort of PD patients.

Main Objectives

Provision of novel patient-specific parametric computational models

Research and development on virtual patient models, i.e. patient-specific, parametric, computational models of: **(i)** The **subcortical motor system**, **(ii)** Sufficient **cortical motor systems** to represent the tasks of interest, **(iii) The neuromuscular system** to allow (i) and (ii) to express behavior in sufficient depth.

Coupled cognitive-motor simulation engine

Development of a **simulation engine** that will **replicate motor behavior** based on specific physiological input in a **multi-parametric** and **patient-specific** approach to modelling. In this way, **biomechanical simulation of the patients will be driven by their low level neurological state** through the modelling of neural pathology.

Inverse simulation for clinical state assessment and progress monitoring

The NoTremor simulation engine will allow for **inverse modelling**, that is the estimation of the internal parameters of an individual patient's neuropathology, based on detailed observations of their motor behavior. This will allow to **observe and monitor the progression of future disease states**, and **determine the pharmacological basis of some of the modelling parameters.**

Analytics and new metrics for simulated evaluation and monitoring of medical treatment

The NoTremor visual analytics module will serve as the front end of the NoTremor **simulation-based clinical decision support tool** and will provide **visual tools to identify correlations among any parameters under study**.

Test campaigns with beneficiaries

Evaluation and quantification of the patient specific computational models will be made in two test campaigns with patients, both in terms of their motor abilities and neurological characteristics.

Consortium

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