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THE TECHMED EVENT

Pioneering Perspectives:
Innovation and Technology in Early-Stage Clinical Drug Research

Ciska Heida, University of Twente

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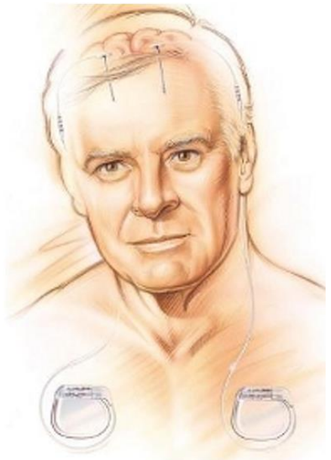
MEASUREMENT OF THERAPEUTIC EFFECTS IN PARKINSON'S DISEASE

CISKA HEIDA

BIOMEDICAL SIGNALS & SYSTEMS

Deep Brain Stimulation



Aim:

- Gaining insight into the central mechanisms of human motor control, motor disorders, and neuromodulation
- Developing novel and optimizing existing therapeutic methods aiming at closed-loop (on-demand) application

Cueing

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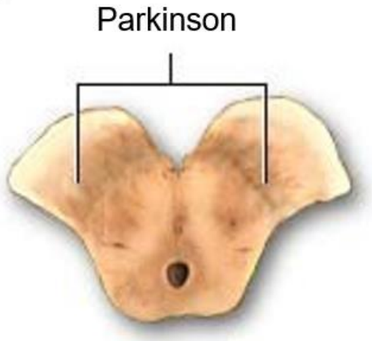
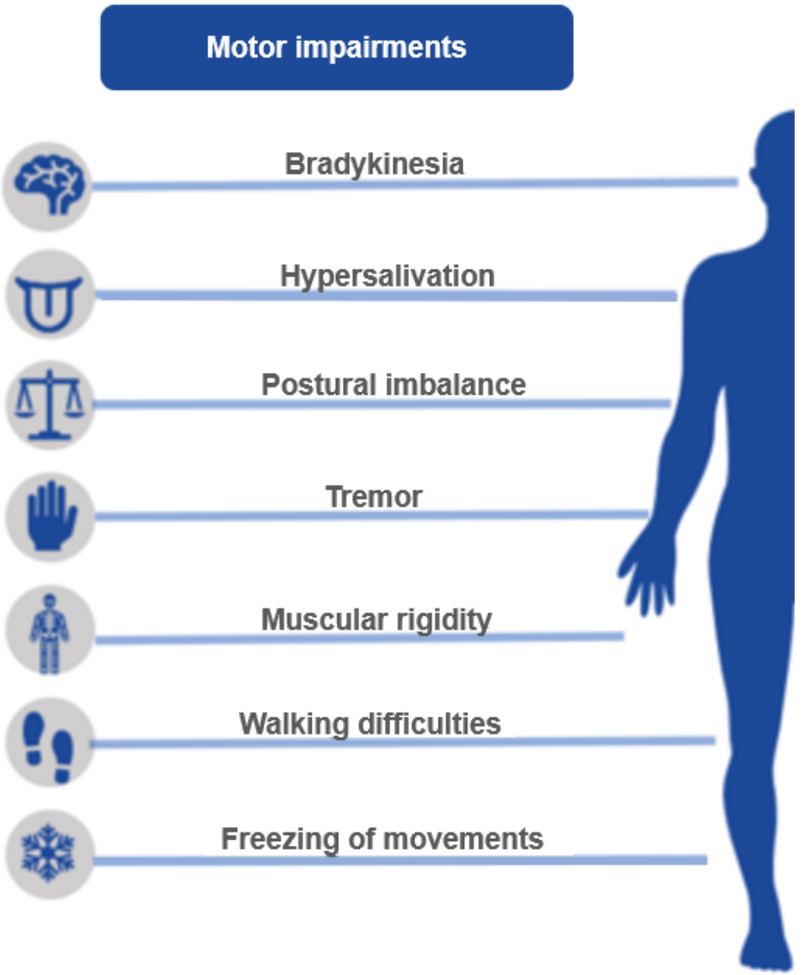
PARKINSON'S DISEASE

Neurodegeneration in Substantia Nigra leading to a loss of dopamine





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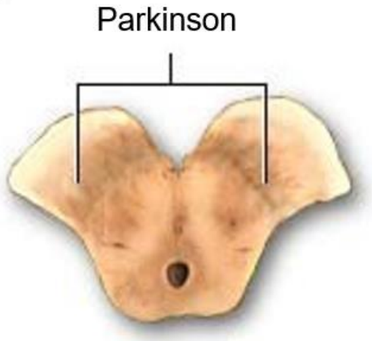

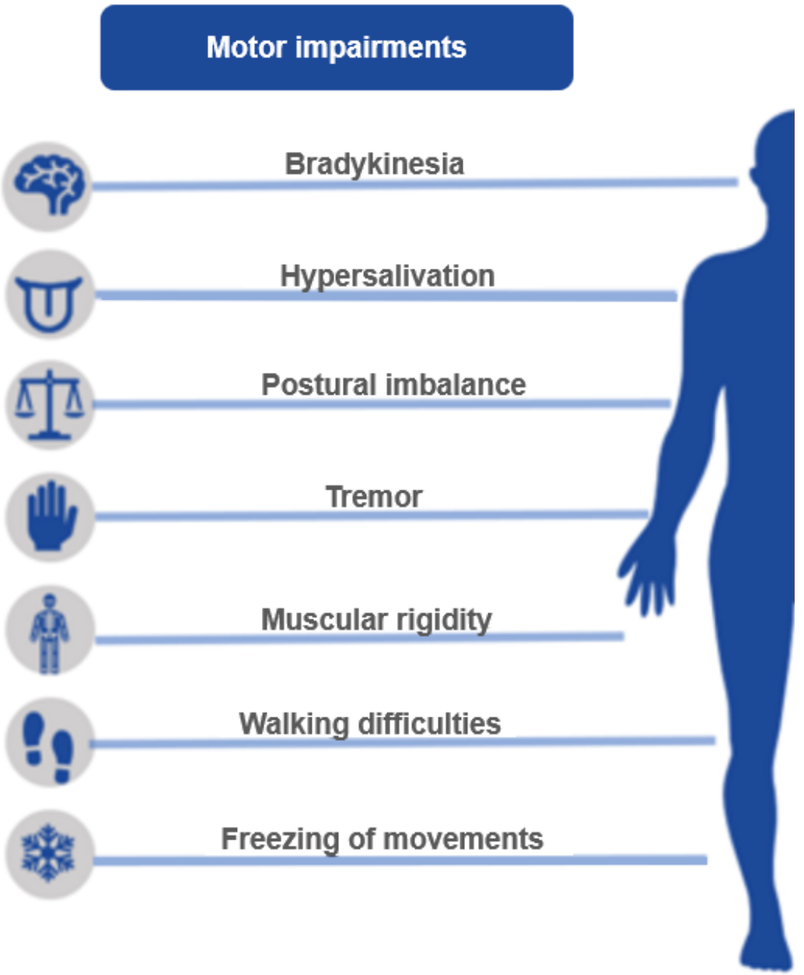

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PARKINSON'S DISEASE

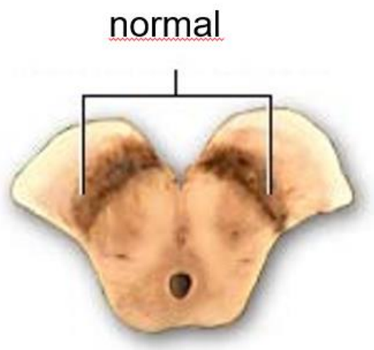
Neurodegeneration in Substantia Nigra leading to a loss of dopamine

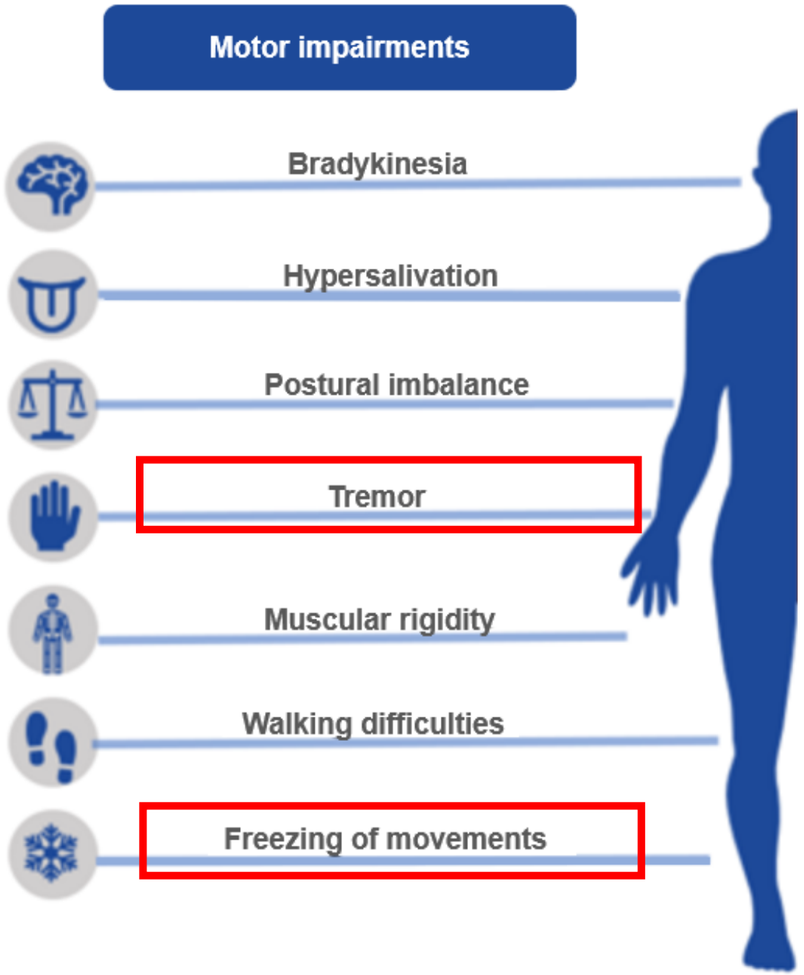
Medication

- **Levodopa**, precursor of dopamine
- Dopamine agonists to stimulate dopamine receptors
- MAO-B / COMT inhibitors to inhibit the activity of enzymes that break down dopamine / Levodopa
- Anticholinergics to restore neurotransmitter balance

Complications of long-term use of Levodopa

- progressive shortening of duration of action
- involuntary movements (dyskinesias)
- fluctuations from mobility (ON) to immobility (OFF) more frequently, more abrupt, more disabling
- response becomes more unpredictable





Symptoms respond differently to Levodopa

- **Tremor:** response to medication is unpredictable and less efficient than for akinetic-rigid symptoms
- **Freezing of Gait** (FOG):
  - occurs exclusively or worsens when dopaminergic medication wears off (OFF state)
  - does not improve at all in some patients
  - dopaminergic medication may sometimes induce FOG (ON state)

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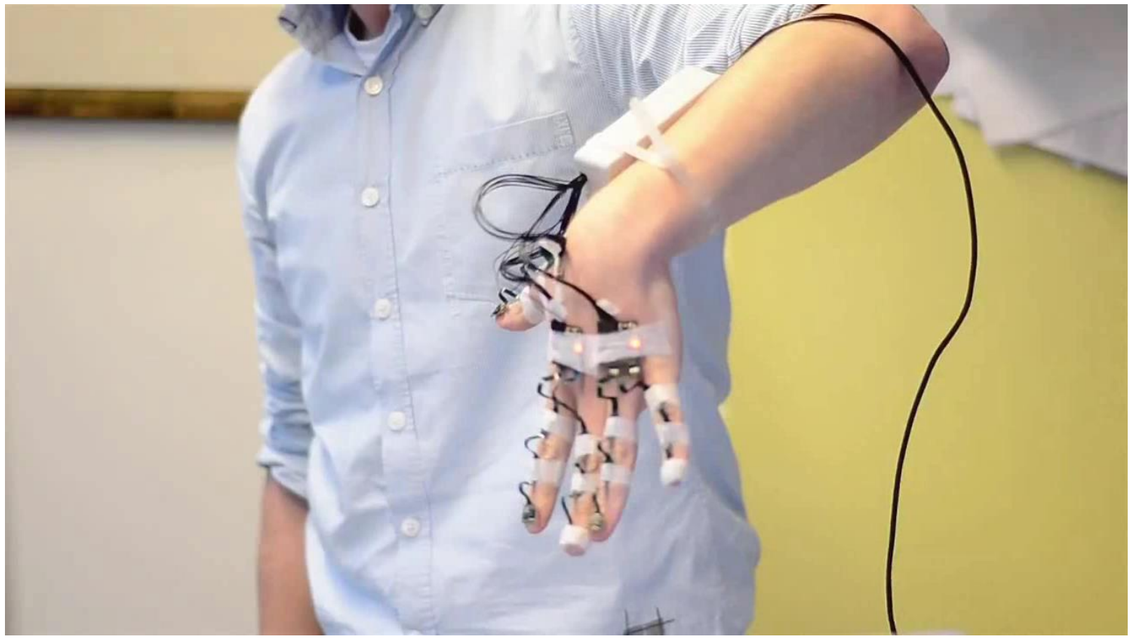
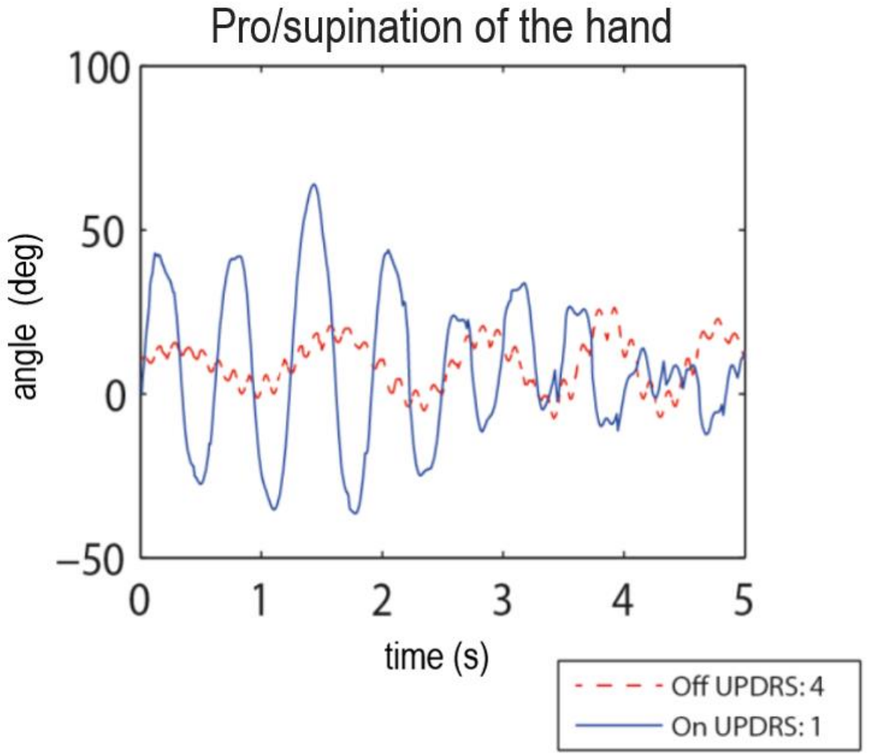
MEASUREMENT OF HAND MOVEMENTS

Objective (long-term) quantification of motor symptoms using a “PowerGlove”





Van den Noort et al. Annal Biomed Eng 2017

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DETECTION / PREDICTION OF FREEZING OF GAIT (FOG)

Freezing of Gait (FOG): a brief, episodic absence or marked reduction of forward progression of the feet despite the intention to walk

FOG DETECTION / PREDICTION IN DAILY LIVING SITUATIONS

eHealth House

movements

heart rate / HRV
skin conductance

empatica

foot pressure profile

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(Ko-)finanziert von der Europäischen Union
(Mede) gefinancierd door de Europese Unie

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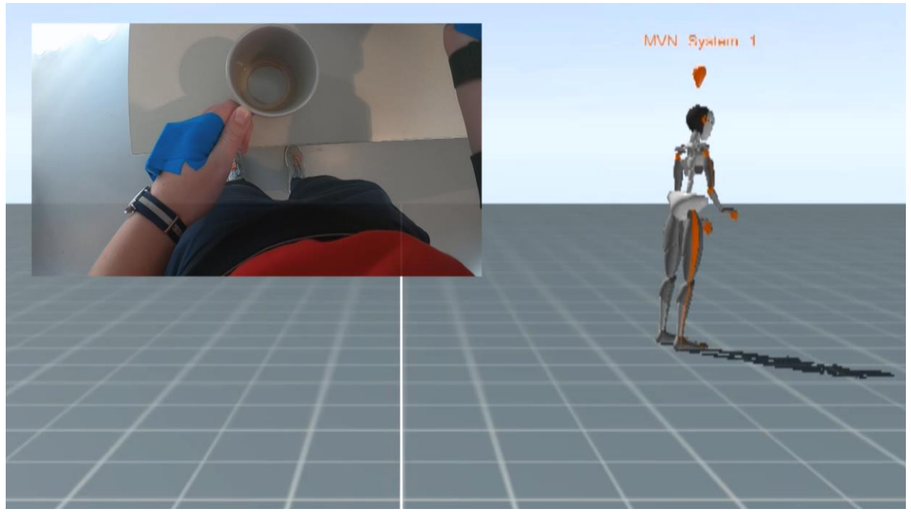

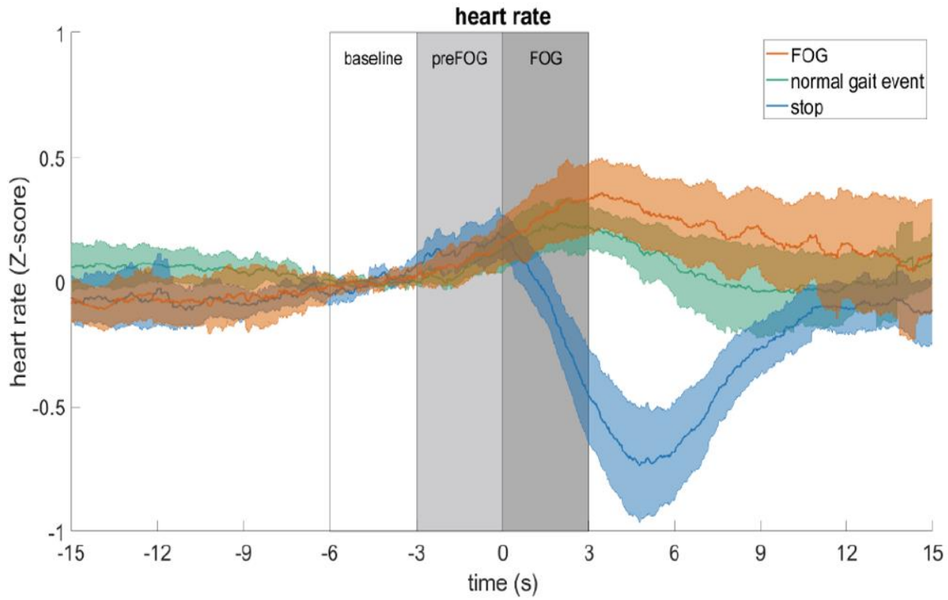

movements

Movella™

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MOTICON SCIENCE

Helena, Cockx et al. J Neural Eng Rehab (2021/10/05 2021)

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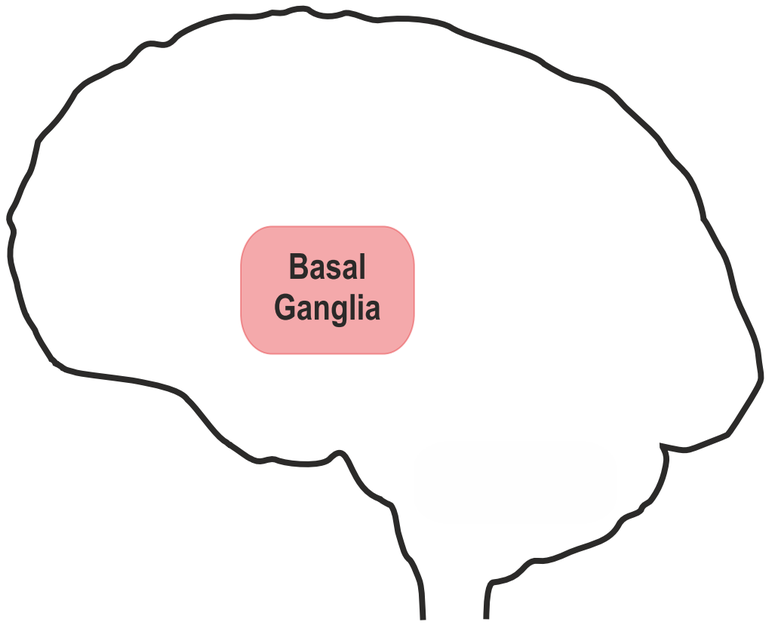
IMPROVE OUR UNDERSTANDING OF PARKINSON'S SYMPTOMS

Computational modeling of neuronal network behaviour



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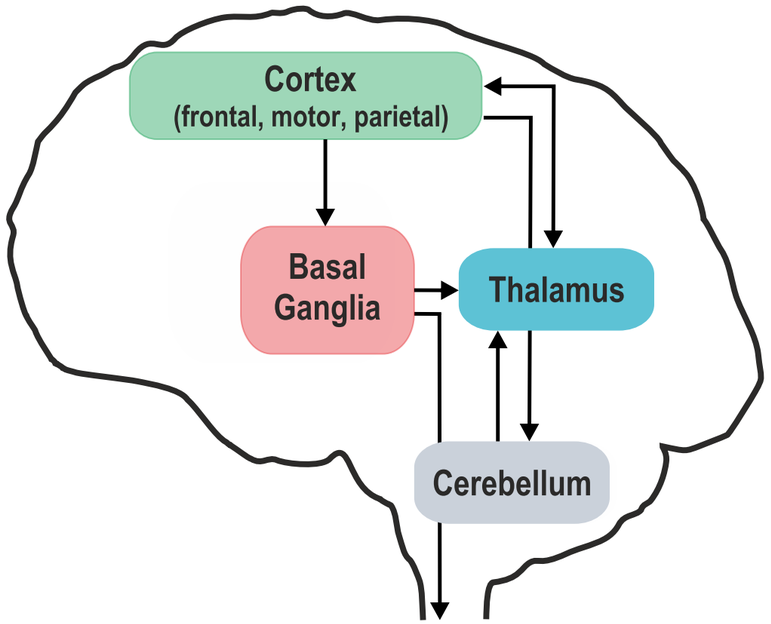
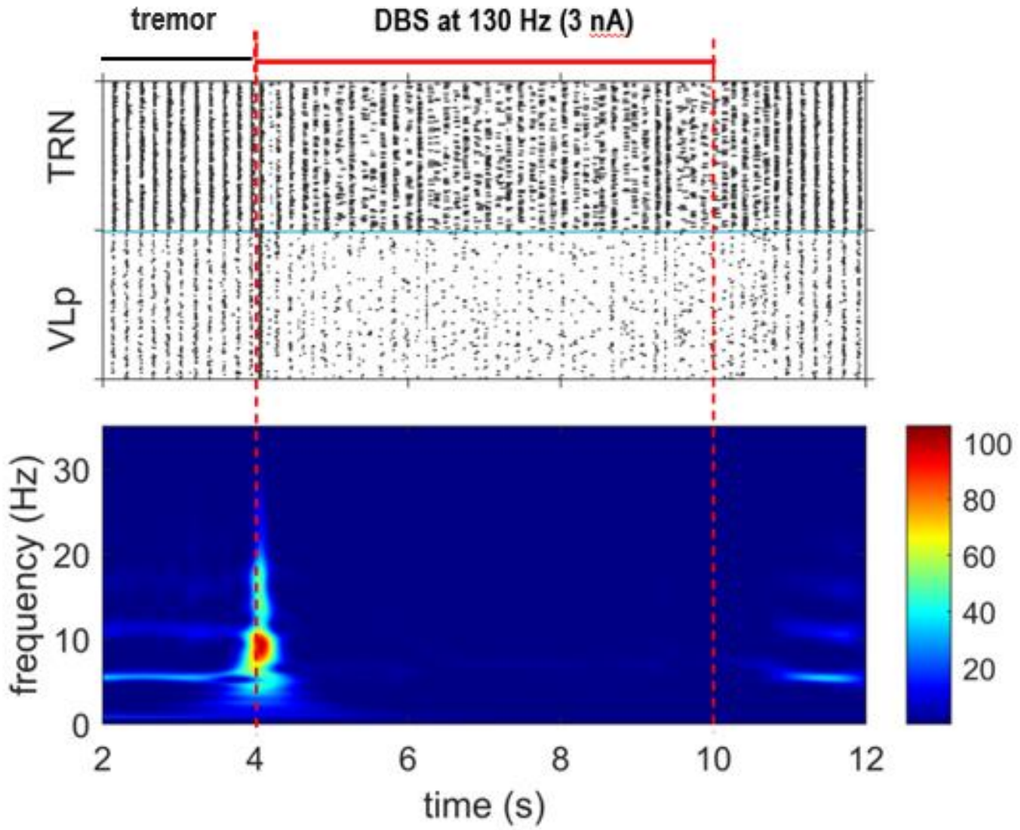
Computational modeling of neuronal network behaviour

Tremor – cerebello-thalamic circuit





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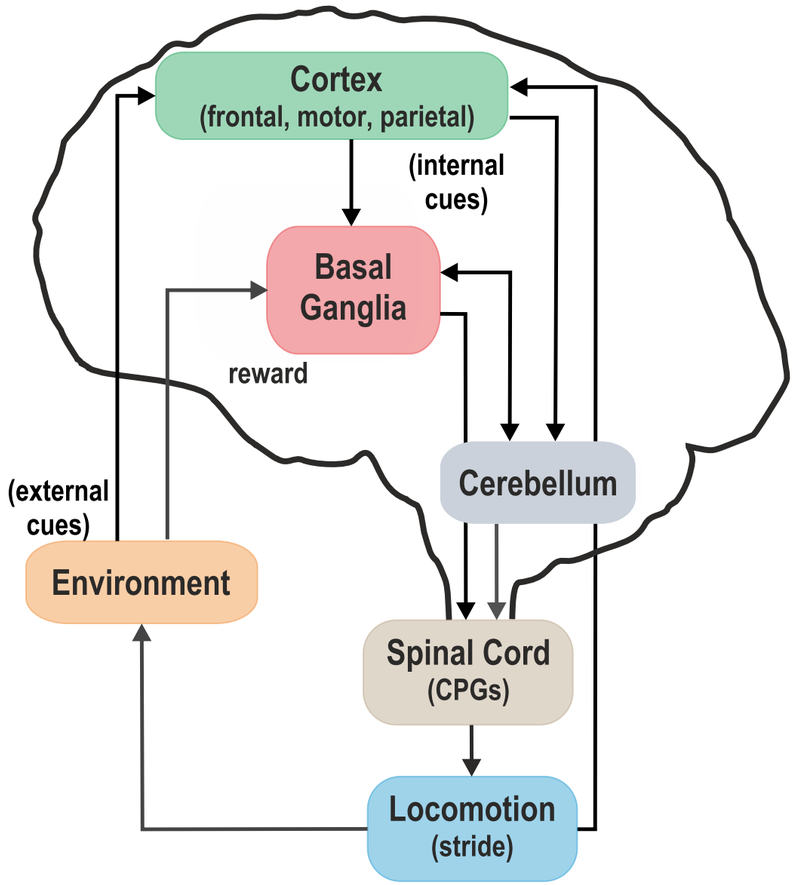
IMPROVE OUR UNDERSTANDING OF PARKINSON'S SYMPTOMS

Computational modeling of neuronal network behaviour

Freezing of Gait – cortico-basal ganglia network



Goal: To develop patient-specific mechanism-based therapy

Hypothesized mechanisms of FOG

1) Loss of automaticity
2) Impaired action selection mechanisms
3) Excessive inhibitory control
4) Impaired scaling of movements
5) Impaired timing of movements

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THANK YOU FOR YOUR ATTENTION

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