Imperial College London

Literature review and thesis proposal
MRes. Neurotechonlogy

Investigating plasticity in Cortico-Basal Ganglia-Thalamus models for improving stimulation-based treatments

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Contents

1 Introduction / Abstract?

Stylistically, I would prefere to do an abstract here and breakdown the concepts in the following section

2 Background and literature review

start this off nicely with a diagram of the research gap

2.1 Parkinson's Disease

Outline

** 1. Loss of SNc dopaminergic neurons.**

** would be nice if this had a diagram** ** 2. Strengthening of indirect GPe → STN pathway,
weakening of hyperdirect Cortex → STN pathway. (?dimmer switch model [Helmich et al., 2012], [West et al., 2022])**

** 3. Hypersynchrony in the Basal Ganglia.**

2.2 DBS: theory and practice

DBS as the state of the art in treatment

Limitations of DBS (invasiveness, side effects, it needs to be on permenently, why 130Hz? when tremors are $\sim$ 20Hz)

$\Rightarrow$ plenty of things to be improved

2.3 Stimulating at the right time?

important [Cagnan et al., 2017] [West et al., 2022]

2.4 Plasticity to recover network states

here I need to checkout some literature, ??how have I not done this already yet??

2.5 Mean-field vs. Single Neuron models

briefly, in general and expand in the context of plasticity

important [Duchet et al., 2023] [Shupe and Fetz, 2021] [Schwab et al., 2020]

2.6 **Other ways of improving stimulation-based treatments**

stimulation parameter optimizations, closing the loop (e.g. aDBS [Beudel et al., 2018])

3 Project Plan

Aims

1. Model neuroplasticity in a Parkinsonian CGBT network

2. Investigate the viabillity of harnessing plasticity to remove the system from the pathological state and analyze the dynamics that follow

   here i care about things like for how long, how does the network change.

3. Try to link potential results to potential stimulation protocols?

Methodolgy **How indeed?** HH/IF Pakrkinsoni model + plasticity rules, trying different stimulation-based protocols (link with experimental data?)

3.1 Timeline

Gant chart thingy

References

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