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Modelling Response of Brain Activity to Perturbations

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Understanding the brain's response to transcranial magnetic stimulation (TMS) is crucial for advancing both basic and clinical neuroscience. This study applies neural mass modelling to analyze TMS-evoked potentials (TEPs) through electroencephalography (EEG). Building on Momi et al. (2023) [1], who used source-localized TMS-EEG analyses to disentangle local from network dynamics, we aim to replicate and extend these findings by modelling the response from the resting state.
We adopt the whole-brain Hopf model proposed by Ponce-Alvarez and Deco (2024) [2], adapting it to EEG data [3]. Our results show that this model can reproduce resting state activity in the Fourier domain, while the TMS-evoked dynamics are accurately captured in the EEG trajectory space. This highlights the model's potential in bridging spontaneous and perturbation-driven brain activity.
Current efforts focus on integrating site-specific effective connectivity into the model, estimated for different TMS stimulation targets. This approach aims to capture how local connectivity profiles shape both spontaneous and evoked activity. By combining resting state dynamics with region-dependent effective connectivity, we aim to predict perturbation responses more accurately across stimulation sites. This direction holds promise for informing stimulation strategies and improving individualized neuromodulation protocols.

REFERENCES

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[3] Fecchio, M., Pigorini, A., et al. The spectral features of EEG responses to transcranial magnetic stimulation of the primary motor cortex depend on the amplitude of the motor evoked potentials, PLOS One 12 e0184910 (2017)

Presenter: VERONESE, A.

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