Canadian Association of Physicists
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Contribution ID: **4296** Type: **Poster not-in-competition (Graduate Student) / Affiche non-compétitive (Étudiant(e) du 2e ou 3e cycle)**

(G) (POS-31) A Physics inspired probabilistic model of neuroimaging data analysis and modelling.

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In computational neuroscience, understanding the multifaceted dynamics within neural networks remains a pressing challenge, particularly in the context of the brain's staggering complexity, comprising approximately 100 billion neurons. While traditional models have focused on local coupling and function, there is a growing consensus that a network-centric approach is indispensable for a comprehensive understanding of brain function. Against this backdrop, this study introduces a groundbreaking approach that leverages the mathematical principles of quantum mechanics to scrutinize neuroimaging data.

Our quantum-inspired model offers a novel framework for investigating network dynamics, complementing, and extending existing network science methodologies. It provides a nuanced perspective on neural information flow, enabling a deeper understanding of brain network topology. A significant feature of this model is its ability to integrate neuro-energetics, thereby enriching our understanding of metabolic processes within these intricate networks. Particularly salient is the model's utility in examining the temporal dynamics of resting-state networks, which are key to understanding the brain's baseline functional connectivity. Using predefined neural networks as a template, our model dynamically tracks network behaviour, aligning with the focus on neural network inference from imaging data.

Significantly, this approach uses source-localized electroencephalography (EEG) data, allowing for a broader application in both clinical and research settings. A significant expansion of this research is the incorporation of Physics-Informed Neural Networks (PINNs) to extend the capabilities of the quantum-mechanical framework. PINNs serve as a computational bridge, facilitating the integration of physical laws into the modelling process, thus enhancing the model's predictive accuracy and interpretability.

Keyword-1

Medical Physics

Keyword-2

EEG

Keyword-3

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