Machine Learning optimization of Dysconnectivity Index (DCI) in fMRI

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

The dysconnectivity index in fMRI and machine learning measures aberrant brain connectivity patterns, aiding in the diagnosis and understanding of neurological disorders and cognitive impairments.

Background and Motivation

fMRI, combined with machine learning, is transforming the study of brain disorders. Dysconnectivity indices, measuring brain connectivity patterns, play a pivotal role in this research. The brain's complex network underpins its function, but disruptions in this connectivity are linked to neurological and psychiatric disorders. fMRI offers insight into functional connections between brain regions. Understanding dysconnectivity is critical for diagnosis and treatment. Dysconnectivity indices provide objective metrics to evaluate the extent and severity of connectivity abnormalities in brain disorders, enhancing our understanding of their pathophysiological mechanisms. Developing a robust dysconnectivity index using fMRI data is the challenge. This index must distinguish healthy and affected individuals, identify the most impacted brain regions, and uncover distinct patterns associated with different disorders. Prior research has demonstrated the effectiveness of dysconnectivity indices in characterizing connectivity alterations in various disorders. Machine learning techniques, such as SVM and CNNs, have enhanced classification accuracy. Ongoing research aims to standardize and expand the applications of these indices. The integration of dysconnectivity indices and machine learning in fMRI studies offers promising insights into brain disorders. These tools could revolutionize diagnosis, treatment, and understanding of conditions previously shrouded in mystery. Future research will refine these indices and broaden their applicability, potentially transforming the field.

Student's Tasks Description

- Evaluate the Dysconnectivity Index with different machine learning methods

- Apply the most successful approach and different diseases with fMRI data such as pain, brain tumor etc.

Technical Prerequisites

Python, neuroimaging experience is a plus

Please send the completed proposal to tianyu.song@tum.de, shervin.dehghani@tum.de and felix.tristram@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.

References

https://pubmed.ncbi.nlm.nih.gov/32107555/

https://pubmed.ncbi.nlm.nih.gov/37385680/

https://link.springer.com/article/10.1007/s00117-022-01051-1