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BIOMARKERS

POSTER PRESENTATION

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BIOMARKERS (NON-NEUROIMAGING)

Detection of Mild Cognitive Impairment Using Convergent Cross-Mapping Based on Resting-State EEG Signals among Community-Dwelling African American Participants

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Abstract

Background: Accurate and early detection of mild cognitive impairment (MCI) is critical for interventions to promote cognitive resiliency. EEG-based detection of MCI is attracting considerable attention from the research community due to its accessibility, affordability and increasing accuracy.

Method: Our research is based on resting-state EEG (64-channel, eye-closed). The current dataset includes 90 consensus-diagnosed, community-dwelling African Americans (ages 60-90 years, 51 normal cognition, NC; 39 Mild Cognitive Impairment, MCI) recruited through the Wayne State Institute of Gerontology Healthy Black Elders Center and the Michigan Alzheimer's Disease Research Center, all with subjective cognitive complaints.

From an information-theoretic perspective, causality measures the effective connectivity or directed information transfer from one brain region to another. Convergent cross-mapping has attracted considerable attention recently since it was proven to be able to detect causal coupling in both deterministic and random settings. In this research, we propose to develop an EEG-based MCI detection model by exploiting cross-mapping causality analysis.

We first derived the current source density (CSD) from EEG signals and performed cross-mapping based causality analysis between the CSD signals of all the possible pairs across the selected EEG regions of interest. We then conducted joint time-frequency-spatial analysis on the cross-mapping causation and selected features which are likely to reflect the differences between NC and MCI. The selected features were then fed into a machine-learning algorithm for discrimination of NC and MCI.

Result: By tuning the observing window size and the number of features used, we obtained a series of different configurations of the discrimination model between NC and MCI, each with its own estimation accuracy. The overall result is a combined output of the model under different configurations, which improve the reliability and sensitivity of the discrimination model. For the 90-sample dataset we are working with, the leave-one-out cross-validation accuracy of our model is 97.78%.

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Conclusion: Our analysis indicates that, potentially, EEG-based cross-mapping causality analysis may serve as a promising assessment tool for early detection of people at risk of MCI and dementia, even when just relying on resting state EEG.

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EEG-based discrimination of NC and MCI using cross-mapping (90 Subjects: 51 HC and 39 MCI): leave-one-out cross-validation accuracy

		Predicted Class		Recall (or Sensitivity)
Actual Class		NC	MCI	
	NC	50	1	98.04%
	MCI	1	38	97.44%
Precision		98.04%	97.44%	ACC=97.78%

ACC stands for discrimination **accuracy**.