Using Machine Learning to Detect Sequential Patterns in the Temporal Ordering of Dynamic States as Candidate Biomarkers for Parkinson's Disease

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This study investigates the relationship between the sequential organization of the brain, measured by functional magnetic resonance imaging (fMRI) scans, and both rest and task-based differences in individuals with neurodegenerative diseases. The project uses an artificial neural network trained on sequences of repeating states of dynamic functional connectivity among neural networks to match pairs of different event vectors from subjects. The potential significance of this research is that it could provide evidence for the effectiveness of fMRI tools such as GIFT and FSL in analyzing resting state networks along with dynamic networks and could be used to approach bigger problems, such as diseases like Parkinson's, from a new perspective. The study used a cohort of patients with Parkinson’s imaged at UAMS, which includes data from over 12 subjects with 2 task and resting state scans, and utilized ICA-AROMA to reduce motion artifacts. The hypothesis is that if the accuracy of the trained classifier is greater than chance, it will support the idea that the sequential organization of brain states could be further mapped to find possible biomarkers. The classifiers in this experiment were able to match individuals across resting and non-resting pairs based on the sequential organization of resting state and dynamic networks with an accuracy well over chance. These results provide statistical evidence to support the notion that patterns in the sequential organization of dynamic functional connectivity in the brain can be reliably measured across resting and task conditions. This novel approach could be used to identify candidate biomarkers in the dynamic expression of brain states that would assist researchers in understanding the biological bases of Parkinson's disease.