Investigating resting-state fMRI for Alzheimer's disease identification through functional data analysis

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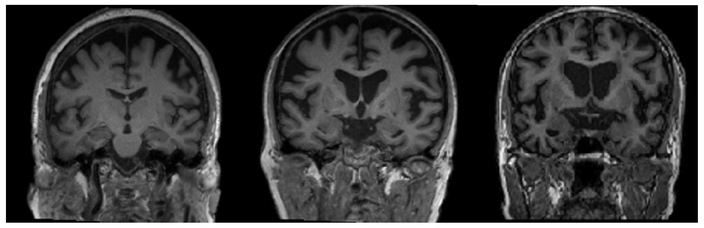
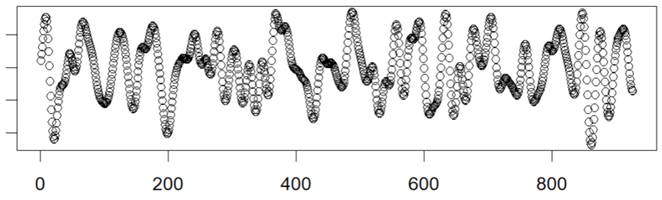
Motivation



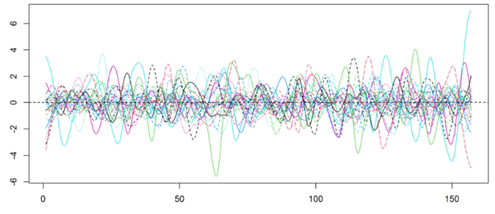
CN MCI Dementia

- Dementia shows 3 progressive stages.
  - CN : Cognitively Normal
  - MCI : Mild Cognitive Impairment
  - Dementia : Most of them were Alzheimer's Disease
- Each stage shows different **brain atrophy**.
- Hence, their **functional activity** from resting-state fMRI (RS-fMRI) should be different.

Functional Data Analysis



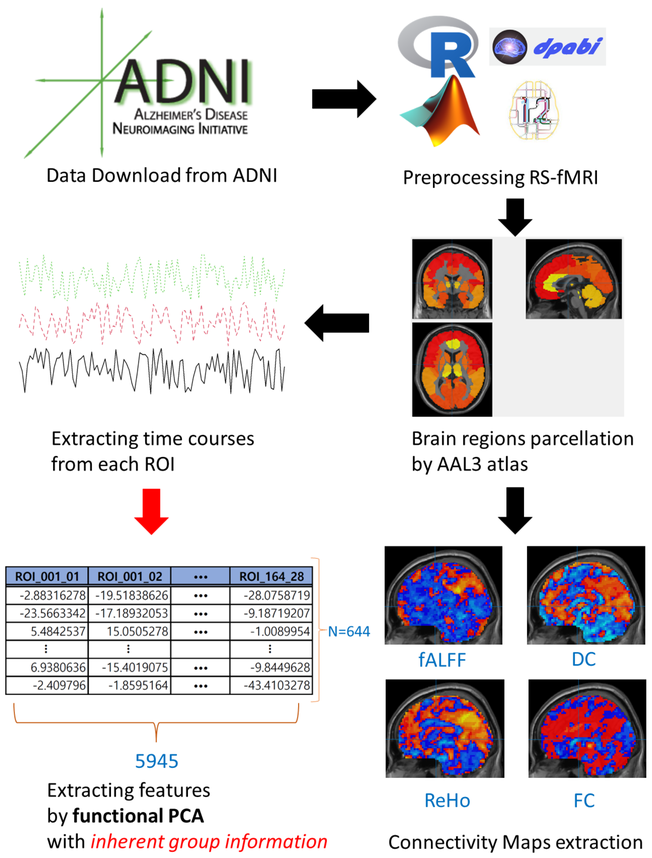
- From RS-fMRI, we can obtain **blood-oxygen-level-dependent (BOLD) times courses** for each region of interest (ROI) on brains.
- These signals could be considered as "**functions**" due to their continuous nature.



- Therefore, **B-spline basis expansion** can be applied to them.

$$f(t) \approx \sum_{j=1}^{J} c_j \phi_j(t)$$

Data Acquisition



Demographics

Category	Female	Male	Total
Number of Participants	332	312	644 CN = 376 MCI = 207 Dementia =61
Age (Mean ± SD)	72.02 ± 7.77	75.43 ± 7.73	73.67 ± 7.93

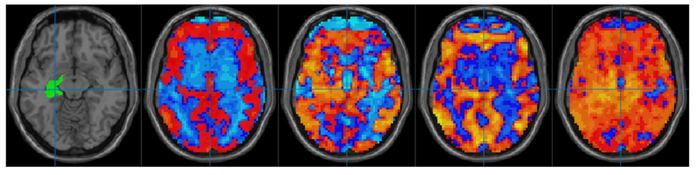
Classification Models

To take advantage of the **inherent group information** defined by ROIs, I employed the following classification models. In the modeling, only features from fPCA were used.

- Multivariate Bayesian Sparse Group Selection with Spike and Slab (MBSGS)
- Multinomial logistic regression with sparse group lasso (MSGL)

Results

- **Selected Coefficients' Regions**
  - Entorhinal Cortex
  - Temporal and Parietal Lobes
- **ANOVA**
  ANOVA on these selected ROIs of Regional Homogeneity (ReHo), Degree Centrality (DC), Amplitude of Low Frequency Fluctuations (ALFF)and Functional Connectivity (FC) were significant(<0.05).
- **Example : Left Hippocampus**
  Active region on MRI is L-Hippocampus, and we can check how this region is affected on the other FC maps.
  - Blue : negative effects
  - Red : positive effects



MRI ALFF DC ReHo FC

Ackowledgement

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