**BrainPrint: Identifying Subjects by Their Brain**

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**Introduction**

- Is it possible to identify an individual based on their brain?
- Challenges:
  - Morphological changes due to aging and disease
  - Scanning artifacts, inhomogeneities, imaging protocols
  - **BrainPrint**, a brain signature focusing on shape
    - Insensitive to imaging properties
    - Holistic, includes cortical and subcortical structures
  - **BrainPrint**, a useful framework for working with large datasets

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**BrainPrint Overview**

- **FreeSurfer**
- **MRI scan**
- **Shape Descriptor**
- **Classifier**
- **Results**
  - Over 3000 scans from almost 700 subjects each with 3-6 longitudinal scans
  - Data from the Alzheimer’s Disease Neuroimaging Initiative (ADNI)
  - Leave-one-scan-out experiments
  - Variation of number of eigenvalues
  - Variation of sets of structures:
    - Cortical Triangular (4), Cortical Tetrahedral (4), Cortical Both (8), Selection (15), All (44), All+Difference (48)

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**Shape Descriptor**

\[ \lambda = (\lambda_1, \ldots, \lambda_44) \]

Shape Descriptor (Reuter et al., 2006)

**Classifier**

- Robust classifier that handles missing information
- Classification per structure as weak classifier
- Each subject in database as class, 3-6 points per class

Find subject class \( C_k \) for new scan with **BrainPrint** \( \Lambda = (\lambda_1, \ldots, \lambda_{44}) \)

\[ p(\Lambda_a|C_k) \sim N(\mu_a; \mu_a \Sigma_a) \quad a = 1, \ldots, 44 \]

\[ p(C_k|\Lambda) \propto \prod_{a=1}^{44} p(\Lambda_a|C_k) \]

**Results**

- Collection of best structures:
  - Cortical structures [8]
  - Ventricles
  - Corpus Callosum
  - Cerebellum
  - Hippocampus
  - Left lateral ventricle
  - Right lateral ventricle

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**Conclusions**

- Extensive characterization of brain anatomy
- Compact characterization for handling large datasets
- Identification of subjects with very high accuracy
- Launched for more detailed follow-up analysis
- **BrainPrint** does not interfere with anonymization of publicly available data because it does not connect to private information

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**Future Work**

- Concept of brain similarity
- **BrainPrint** in CADementia challenge for AD prediction
- Longitudinal scans over 36 months, similar results over longer periods?
- Quality control of FreeSurfer segmentations
- Detect anonymization errors in longitudinal studies

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