Collaborative Computational Anatomy: The Perfect Storm for MRI Morphometry Study of the Human Brain via Diffeomorphic Metric Mapping, Multidimensional Scaling and Linear Discrminant Analysis

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Abstract

This paper describes a large multi-institutional experiment on the shape and structure of the human hippocampus in the aging brain as measured via MRI. The study was conducted on a sample of 101 controls and Alzheimer's disease patients with imaging data collected at Washington University in St. Louis, hippocampal structure segmented at MGH via Freesurfer, and anatomical shapes embedded into a metric shape space using large deformation diffeomorphic mapping at the Johns Hopkins University. Working directly from the upwards of 10000 metric distances between hippocampal shapes, clustering is performed template free using multidimensional scaling and linear discriminant analysis on the metric distances between each hippocampus. We demonstrate that a single data analysis pipeline allows for the direct metric analysis of human hippocampus shape going directly from the MR image to quantitative measures of morphometric shape change revealing the class conditional structure associated with cohorts of aging populations including cohorts of patients with Alzheimer's disease and semantic dementia.