The Johns Hopkins University

Whiting School of Engineering

Department of Electrical and Computer Engineering

Fusion and Inference of Geometric Information and Functional Contrast in Computational Anatomy

Dissertation Defense by

Jianqiao Feng

Graduate Research Assistant

Electrical and Computer Engineering

Abstract

Magnetic resonance imaging (MRI) has been widely used as a noninvasive clinical and research modality for the study of human anatomy. In the past decade, Computational Anatomy (CA) has emerged as a discipline to study the neuroanatomical variability via morphometric mapping algorithms. Quantitative analysis of anatomy has thus become possible.

This dissertation discusses feature extraction, fusion and inference of geometric information and functional contrast from MRI scans in the computational anatomy framework. An important application of the methodology presented here is the diagnosis of human brain neurodegenerative diseases, e.g. Alzheimer's diseases. Through this dissertation we consider the problem of distinguishing between healthy controls (HC) and Alzheimer's disease (AD).

The Human brain with its highly complex anatomy is composed of a number of subregions, or subcortical structures. It is known that different diseases affect different regions of human brain. As a result, this dissertation focuses on regions of interests (ROI), i.e. subcortical structures instead of analysis of whole brain. To capture morphological changes of a certain subcortical structure affected by AD, a surface-based statistical analysis is firstly presented. This approach is extended to multiple structure analysis to combine discriminative information from different structures. The result shows that different structures carry complementary information.

Besides the geometric feature, functional contrast feature can be extracted and added to the classification procedure. All 3D structural images are transformed into a common template coordinate system.
Jacobian of deformation field and intensity value at each voxel are used as geometric and functional contrast features respectively. The feature selection is performed to avoid potential over-training. Data fusion methods are employed to combine feature vectors of different categories extracted from different structures. This data analysis pipeline is validated using a public medical image database. Higher performance is observed compared with that using geometric feature alone, which indicates fusion of geometric and functional contrast can improve classification performance.

Wednesday, October 15, 2014
10a.m.
Clark Hall 314

FOR DISABILITY INFORMATION CONTACT: Janel Johnson (410) 516-7031 janel.johnson@jhu.edu