Introduction

- Alzheimer’s Disease (AD) More than 4.5 million Americans are believed to have Alzheimer's disease and by 2050, the number could increase to 13.2 million. Brain shrinkage (atrophy) is one of the major characteristics of Alzheimer's Disease (AD), but the regional specificity and tissue class specificity of this loss is unclear. Imaging and biomarker metrics, if successfully identified, would potentially provide a reliable guideline for AD diagnosis and treatment.

- Parkinson’s Disease (PD) Depression is a common and potentially serious complication of PD. Approximately 40 percent of PD patients are depressed. Despite the widespread toll on emotional health posed by PD, few studies have undertaken a comprehensive examination of the neural underpinnings of Parkinsonian depression.

B. Brain structure segmentation for Parkinson’s Disease
This project is in collaboration with the University of Kentucky Sanders-Brown Center on Aging. Our primary hypothesis is that depression in PD is linked to structural and functional abnormality in cortical and subcortical structures such as medial frontal cortex, caudate, mamygdala etc. Brain structure segmentation algorithms and software packages are developed to measure the volume changes for these areas. This project is funded by University of Kentucky, Whole brain tissue classification

C. CT/MR registration for neurosurgical planning Different modalities usually contain complementary info. For the information to be effectively combined, to align the images is the prerequisite.

D. Multiple Sclerosis lesion detection from multi-sequence (T2-weighted and FLAIR) images. We have developed a fully automatic system for MS lesion that requires minimum user interaction. The separation of the lesion class from other normal tissue types is achieved by minimizing a statistically robust measure called L2E criterion. This project is funded by the Sanders-Brown Center on Aging at University of Kentucky.

Software Packages Developed
T-AND: Toolbox for Analysis of Neurodegenerative Diseases. Major components
a. Whole brain tissue segmentation (LGAC)
b. Subcortical structure segmentation (LGAC)
c. Registration assisted cortex parcellation (CortexP)
d. Individual Structure-Based Morphometry (iSBM-MS)

MITK: Medical Imaging ToolKit. Major functionalities include CT/MR rigid body registration, MRI/MRI non-rigid registration, etc.

Future Directions (current efforts)
- Brain anatomical analysis using 3D medial representation, in collaboration with University of Kentucky.
- Robust segmentation and registration algorithms for image-guided lung surgery, in collaboration with the Department of Radiology at Washington University in St Louis.

Related Publications