Biomedical Informatics Research Network: Integrating Multi-Site Human Neuroimaging Data Acquisition, Data Sharing, and Brain Morphometric Processing

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Introduction

The Biomedical Information Research Network (BIRN, www.nbirn.net) is an NIH consortium comprised of 15 medical research institutions in the U.S. that aims to create technical infrastructure and guidelines to enable acquisition, databasing, sharing, analysis and mining of multi-institutional biomedical data. In its first phase BIRN is focused on clinical neuroscience through the coordinated work of the following testbeds: Functional Imaging Research in Schizophrenia Testbed BIRN (integration and analysis of functional MRI data), Mouse BIRN (integration of multi-scale neuroimaging and genetic data from mouse models of neurological and psychiatric disorders), BIRN Coordinating Center (support for network infrastructure, grid computing, data integration, interaction environments and general coordination of the project), and Brain Morphometry BIRN (discussed in this abstract). The Brain Morphometry BIRN focuses on the integration of multi-site data (both structural MRI and clinical data) with advanced morphometric analysis tools aimed at advancing the use of biomedical imaging in the diagnosis and treatment of neuropsychiatric illness, such as Alzheimer's and depression. Challenges of this effort include calibrating data acquired from multiple sites, sharing human data according to federal regulations and integrating software analysis and visualization tools developed at different sites.

Brain Morphometry BIRN: Preliminary Results

Multi-site structural MRI calibration: The calibration is necessary to allow cross-site comparisons of brain MRI morphometry results minimizing dependence on site-specific factors, like image distortions. The calibration was performed using a special purpose phantom and human volunteers scanned at all participating sites. Results show that site-to-site reproducibility errors can be reduced from 12% (no distortion correction) to 0.5% (with distortion correction).

Human data sharing: To protect the privacy of personal health information, federal regulations require that all human data be de-identified for sharing across institutions. In the case of structural MRI data this imposes a challenge since facial features can be reconstructed from the images, thus making the data identifiable. A novel computational algorithm has been developed that removes the facial features from structural MRI data while leaving the brain untouched.

Integration of morphometry analysis tools: Brain morphometric analysis and visualization tools from multiple sites have been integrated to operate together on data acquired at different sites. The following analysis pipelines have been enabled for the statistical characterization of clinical and morphometric results: A) T1-weighted brain structural MRI Alzheimer's data 6 can be automatically segmented using Freesurfer, from MGH 1 . The Linear Deformation Metric Mapping tool, from JHU 3 , can then examine the shapes of the segmented structures. The volumetric and shape results can be visualized using 3D Slicer, from BWH 2 . B) T2-weighted brain structural MRI depression data 7 can be co-registered using the LONI 4 tools and then automatically segmented and visualized using BWH 2 tools.

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