Rodent Brain MR Image Analysis Studies

Department of Computer Science | University of North Carolina at Chapel Hill | March 2011

Background

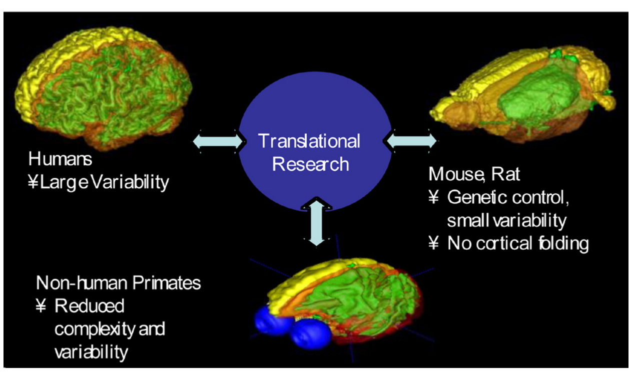
In the last decade, MRI studies of brain morphometry have been used to investigate a multitude of pathologies and drug-related effects in psychiatric research. The morphometric measures that differentiate patient populations or track longitudinal changes are often subtle and require a large number of subjects or repeated studies to detect and statistically model with significance. Cost, patient compilance, risks to the patients, and the rarity of certain diseases often limit traditional, clinical brain studies. These complications have motivated the analysis of rodents and non-human primates.

Goal

We have a variety of projects where we analyze mouse or rat brains in a variety of neurodevelopmental pathologies such as intrauterine cocaine abuse, fetal alcohol syndrome, adolescent binge drinking, or genetic models. The goal is to develop both novel algorithms and analysis platforms for rodent brain MRI scans, from a structural and connectivity based view.

Approach

The typical analysis approach includes automated atlas-based segmentation, tensor-based morphometry, cortical thickness analysis, as well as white matter connectivity analysis. We are also building open-source tools (mostly developed at UNC and Kitware) to develop the web-based image server that allows images, experiment documentation, intermediate results, and final publications to be grouped and made publicly available.



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Research Sponsors

National Institutes of Health (NIH):
- National Institute of Alcohol Abuse and Alcoholism
- National Institute of Drug Abuse
- National Institute of Neurological Disorders and Stroke
- National Institute of Biomedical Imaging and Bioengineering
- National Institute of Mental Health
- National Library of Medicine

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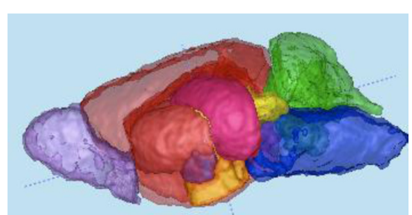

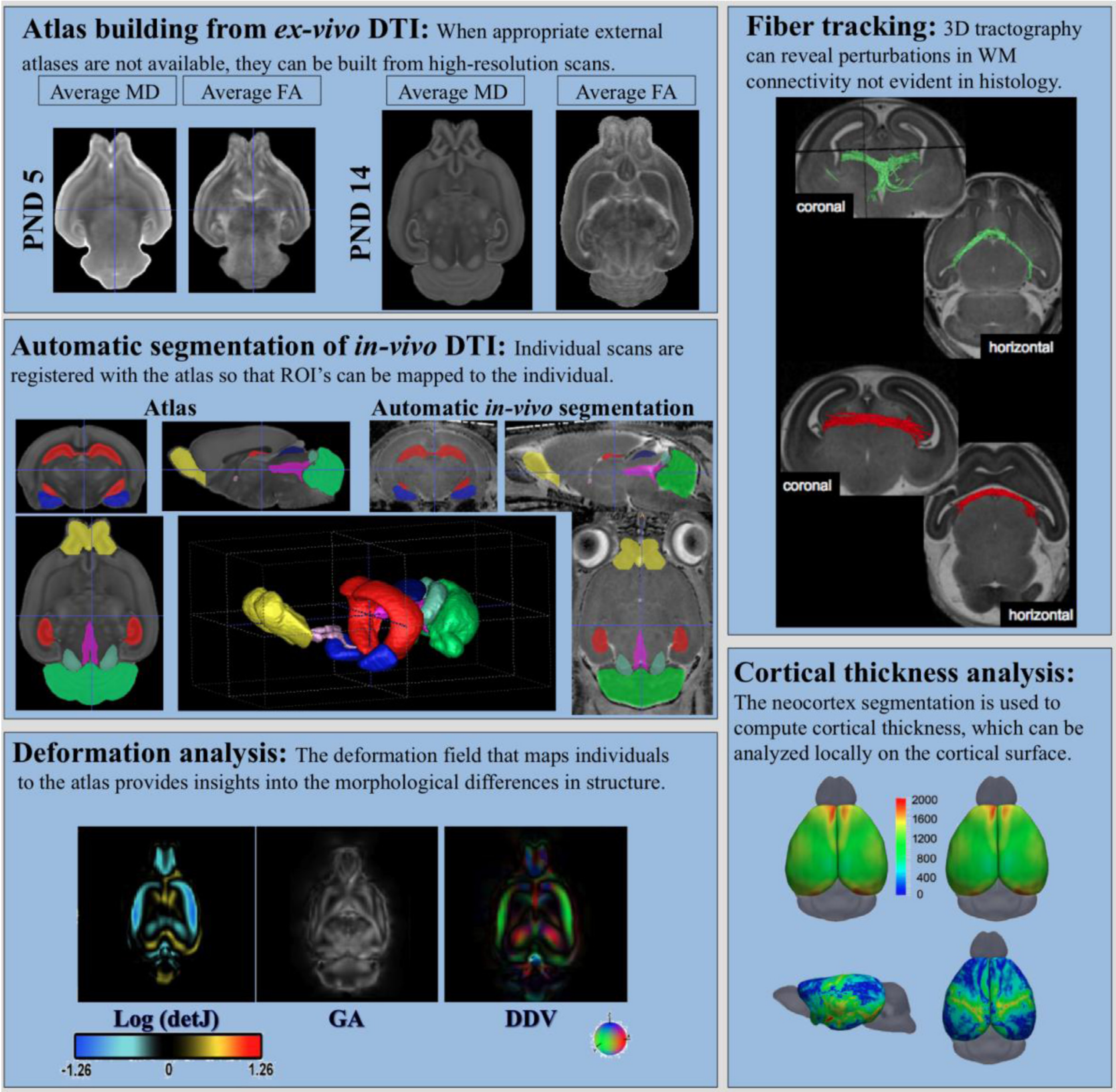
Atlas building from *ex-vivo* DTI: When appropriate external atlases are not available, they can be built from high-resolution scans.
Average MD
Average FA
Average MD
Average FA
PND 5
PND 14
Fiber tracking: 3D tractography can reveal perturbations in WM connectivity not evident in histology.
coronal
horizontal
coronal
horizontal
Automatic segmentation of *in-vivo* DTI: Individual scans are registered with the atlas so that ROI's can be mapped to the individual.
Atlas
Automatic *in-vivo* segmentation
Cortical thickness analysis: The neocortex segmentation is used to compute cortical thickness, which can be analyzed locally on the cortical surface.
2000
1600
1200
800
400
0
Deformation analysis: The deformation field that maps individuals to the atlas provides insights into the morphological differences in structure.
Log (detJ)
GA
DDV
-1.26
0
1.26