Improve Registration Integration for Autoworkup

Project Information

Project Name:	Improved High Dimensional Registration for PREDICT Data Processing		
Project Start Date:	2012-09-17	Project Deadline:	2012-11-17

Project Management Team

Project Manager:	Gary Christensen
Project Sponsor(s):	PREDICT-HD Private Foundation Funds
Primary Customer (s):	Imaging Staff who process PREDICT-HD data (David Welch, Joy Matsui, Ali Gahyoor, Regina Kim, Jessica Forbes, Eric Axelson)
Key Stakeholders(s):	Hans Johnson, Jane Paulsen, David Welch, Ali Gahyoor

Project Description

The hypothesis of the project is that improved high-dimensional registration capabilities will help improve results with many components of the BRAINSAutoWorkup processing pipelines. In order to integrate these high-dimensional registration capabilities, some testing and migrations need to occur with respect integration of the available algorithms with the command line interfacing and linking across several processing tools. One key component is the integration/embedding of available stand-alone algorithms as built in components of other tools. The goal of this project move these effort forward by developing better registration collaboration between engineering registration experts and members of the PINC image processing lab.

Project Justification

These efforts have been on the lab todo list for many months, but have been stalled due to insufficient time or oversight to ensure that the implementations work. The collaboration with Dr. Christensen will provide oversight and intuition so that the high-dimensional registration techniques can be leveraged for better longitudinal results within the existing automated processing framework.

Success Statement (Scope Statement)

This project will be successful completed when 3 tasks have been completed:

1. A set of command line paramaters are found for the ITKv4 antsRegistration program that is shown to produce registrations of similar quality to the ANTS registration program when using the "standard" parameters as defined on the "ANTS conversion to antsRegistration for same data set" wiki page.
2. BRAINSABC is re-written so that multiple images that are nearly co-linear can be provided to BRAINSABC and a covariance matrix based only on images classes is produced to avoid the occasional degenerate covariance matrix case.
3. Document the behavior and benefit/cost of using mask images for itkV4 antsRegistration program (i.e. using brain masks from BRAINSABC to register T1 images).

Project Resources

- Gary Christensen needs access to PINC lab computers via ssh

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  - Disk space on /hjohnson/HDNI
  - Computational resources in PINC
- Ali Gahyoor will work closely with Gary Christensen to improve and test antsRegistraiton

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- Kent Williams will work closely with Gary Christensen to implement BRAINSABC code changes to support multiple images of the same modality.

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configuration.

Timeline/Milestones

2012-09-17 - Build BRAINSTools and become familiar with where applications live, and the programs that are available. BRAINSTools Software (Ali Gahyoor)

2012-09-24 - Run the historical ANTS program, and then determine the command line parameters for running the new ITKv4 antsRegistration program to produce similar quality results. (Ali Gahyoor)

- ANTS conversion to antsRegistration for same data set

2012-10-01 - BRAINSABC makes a bad assumption that each input image is an independent class, when multiple T1's (or T2's) with sufficient co-linearity are given, then a degenerate covariance matrix occurs. Build and then run BRAINSABC with 1 T1, 1 T2, then run BRAINSABC with the same T1 duplicated and a T2 image. --> NOTES: 201208 Starter: BRAINSABC trials (Kent Williams)

2012-10-08 - BRAINSABC - do a code review of BRAINSABC (Kent Williams)

2012-10-15 - BRAINSABC Work with Kent Williams to re-write the code in such a way that the covariance matrices are based on image classes instead of input images. (Kent Williams)

2012-10-22 - (Continue)

2012-10-29 - Determine if the new antsRegistration can produce better results by using the internal masking options, document what algorithmic approach is taken by using masks (Ali Gahyoor)

2012-11-05 - Given a family of rigidly aligned images from a single scan session (i.e. T1,T2,PD images) for two subjects, use the T1 images to define composite (.h5) forward and inverse transforms using antsRegistration, and then apply those composite transforms to the T2 and PD images. (Ali Gahyoor)

2012-11-12 - BRAINSABC - test and verify that BRAINSABC works properly with new refactorings (Kent Williams)

2012-11-19 - (Continue)

Future Work ideas

Integrate itkantsRegistration into BRAINSABC

- antsRegistration program is a thin wrapper around itkantsRegistrationHelper class. This is similar to how BRAINSFit is a thing wrapper around the BRAINSFitHelper class. Add itkantsRegistration to to the co-registration steps available in BRAINSABC
- Test quality of results in BRAINSABC with improved registration.