Region of Interest Shape Analysis Using Computational Anatomy Works

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Introduction

The Center for Imaging Science (CIS) at Johns Hopkins University has developed a multi-functioned software application to support computational anatomy and shape analysis. The capabilities of CAWorks include:

1. Interactive landmark placement to create segmentation (mask) of desired region of interest
2. Specialized landmark placement plugins for subcortical structures such as hippocampus and amygdala
3. Support for multiple Medical Imaging data formats such as Nifti, Analyze, FreeSurfer, DICOM, and landmark data
4. Quadraplanar view visualization
5. Shape Analysis plugin modules such as Large Deformation Diffeomorphic Metric Mapping (LDDMM)

Figure-1: CAWorks Quadraplanar Landmarking Interface

Accessing XNAT in CAWorks

The Extensible Neuroimaging Archive Toolkit (XNAT) is an open source software platform designed to facilitate the management and processing of neuroimaging and related data. XNAT includes a secure web-based user interface, a REST API, and a database backend. The XNAT Browser plugin for CAWorks enables the direct retrieval of medical image data from an XNAT database. It also provides import and export for remote XNAT database storage.

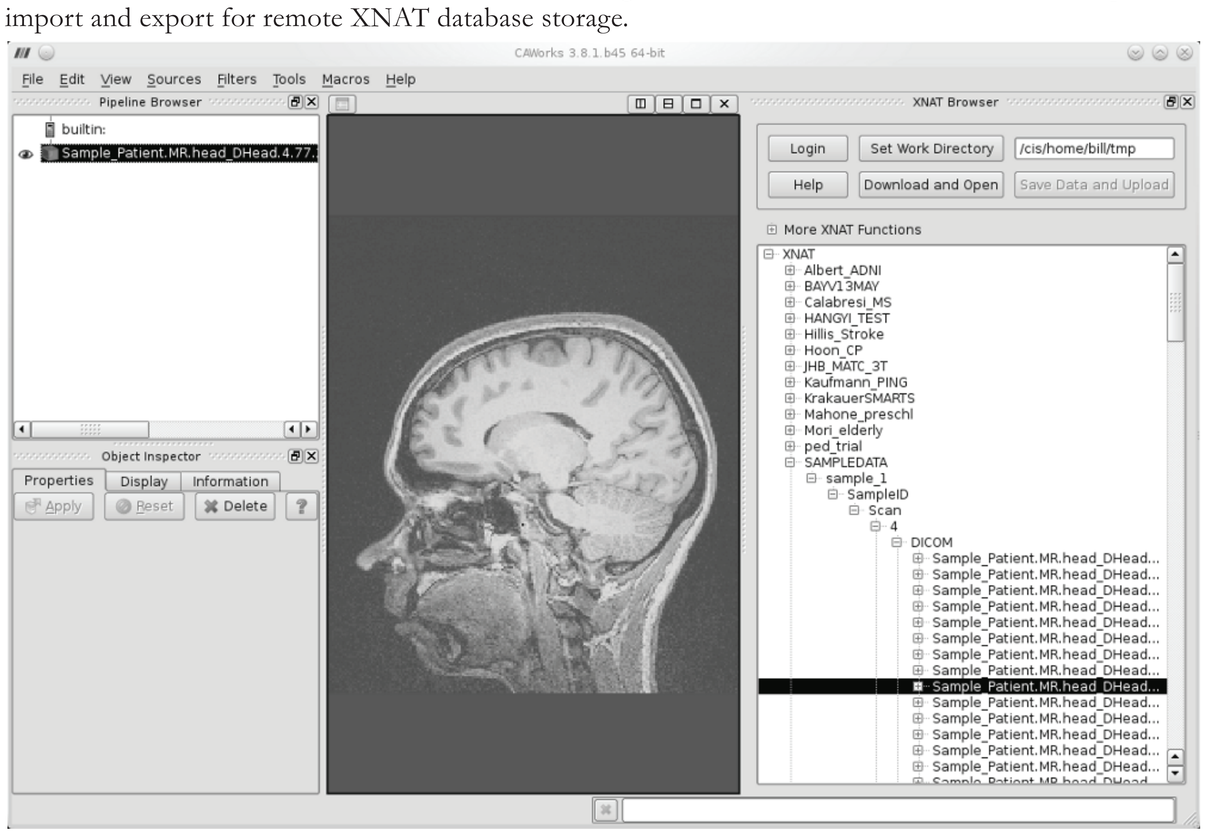

Figure-2: Illustrates the downloading of an MRI brain scan in DICOM format from XNAT to CAWorks. The user selects the file in the XNAT Browser and clicks on the Download and Open button.

References:
[1] Computational Anatomy Works (CAWorks): Enhancing Paraview for Medical Imaging, TeraGrid 2009
[2] Miller, M.I., A. Trouve and L. Younes. "On the Metrics and Euler-Lagrange Equations of Computational Anatomy". Annual Review of Biomedical Engineering 4 (2002):375-405
[3] Marcus, D.S., T.R. Olsen, M. Ramaratnam and R.L. Buckner, "The Extensible Neuroimaging Archive Toolkit (XNAT): An Informatics Platform for Managing, Exploring, and Sharing Neuroimaging Data", Neuroinformatics 5 (1): 11-34 (2007).
[4] Paraview (http://www.paraview.org/)

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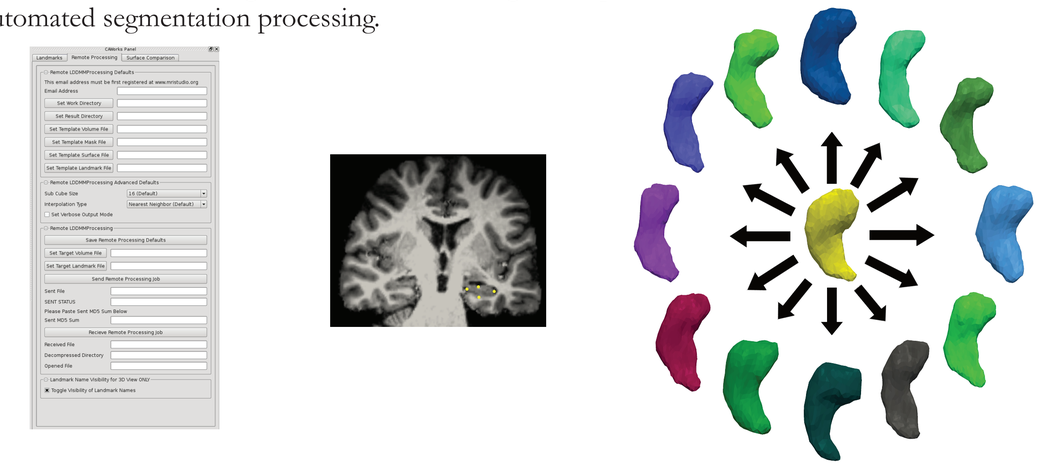
Landmarking and Region of Interest (ROI) Semi-Automated Segmentation and Verification

Current enhancements to CAWorks have focused on interactive support for landmarking of subcortical structures. Specific plugins are available for landmark placement of the hippocampus, amygdala and entorhinal cortex regions. After landmarking is completed, CAWorks facilitates submission for automated segmentation processing.



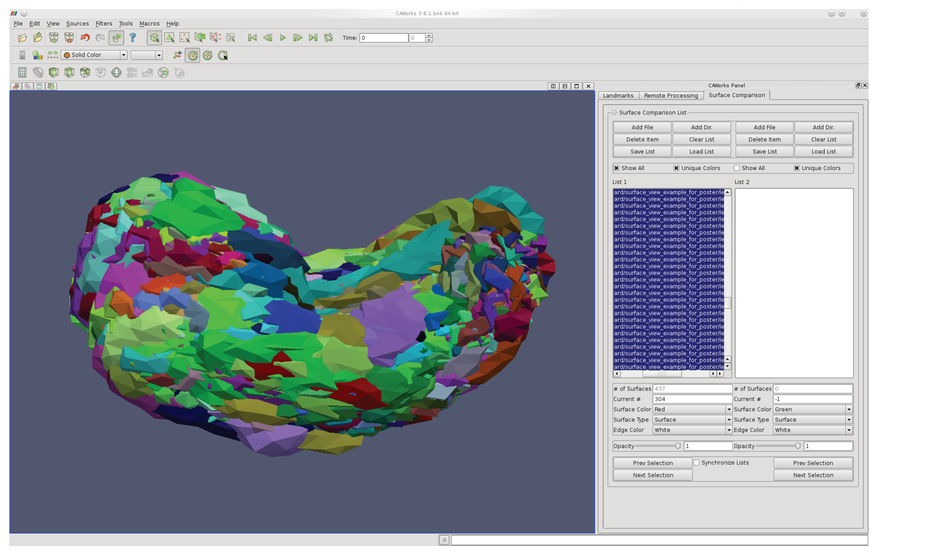


Figure-3: Clockwise from Top Left: CAWorks LDDMM Remote Processing Panel; Hippocampus Landmarks; Demonstration of template based semi-automated method; CAWorks SurfaceView Filter for multiple surface comparison (showing 437 surfaces)

Software Availability & Tutorials

CAWorks software is hosted through MRI Studio (https://mristudio.org) and available for download at **https://www.mristudio.org/download/binaries/caworks/** after registration with MRI Studio. The mailing list mristudio-users@mristudio.org is utilized for discussions regarding the medical imaging software hosted at this site. Visit us on facebook! **http://www.facebook.com/groups/caworks.community/**

The software is available on Windows, Linux and Mac platforms. Tutorials are located at: **http://caportal.cis.jhu.edu/tutorials**

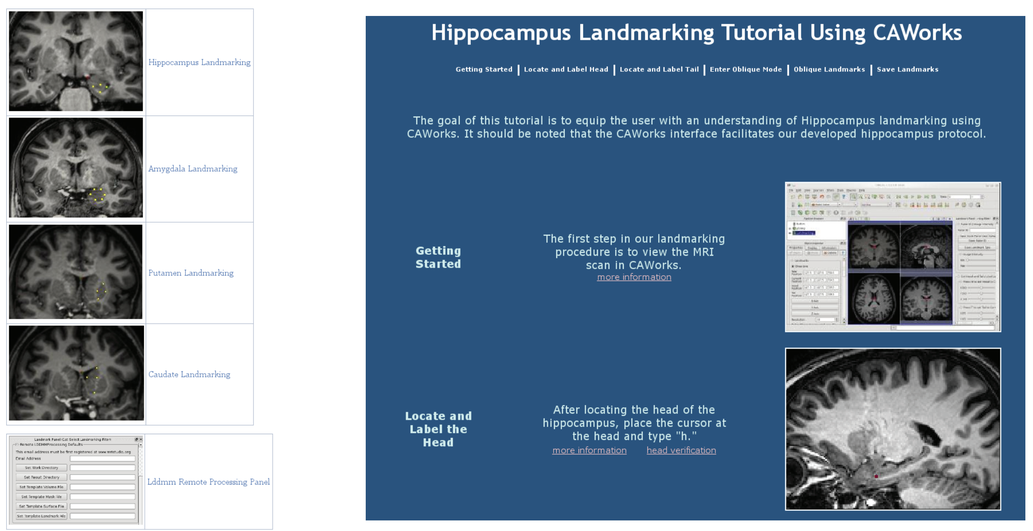


Figure-4: Left to Right: The CAWorks supporting tutorials webpage; Snapshot of the Hippocampus Landmarking Tutorial

Conclusion

CAWorks provides a Region of Interest plugin specialized for the analysis of subcortical Neuroimaging regions. Leveraging the ParaView open source application allows a framework to utilize local visualization resources and provides adaptations to large scale cluster computing. Integration with XNAT and LDDMM Remote processing features will be improved as Neuroimaging workflow statistical analysis becomes more defined.

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