Morphometry BIRN: Milestones for 2005

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2004 All Hands Meeting
Morphometry BIRN: Milestones

Next Meetings:
- Morphometry BIRN ~April 2005 (6 months)
- BIRN AHM ~ October 2005 (12 months)

Morphometry BIRN Cores:
- MRI Calibration (J. Jovicich)
- Analysis, Visualization, Tools (S. Pieper)
- Computational Informatics (D. Kennedy)

Software release applications ~Dec 04
MRI Calibration

- Reminder of delivery goals
- Overview of work plan
- Milestones for year 2004-2005
By the end of 2006 we will provide:

- **Protocol recommendations** for multi-site, multi-fields
  - T1-based structural multi-spectral protocol
  - T2-based structural multi-spectral protocol
  - Diffusion protocol
- **Correction recommendations** that minimize variability
- **Software tools** that perform the recommended corrections
- De-identified human **calibration data**
Phase 1: Clean up + Preliminary evaluations on new methods/platforms
  • Complete data analysis & publication of first MorphBIRN calibration cycle
  • Selected test preliminary protocols and correction methods
  • Obtain preliminary test-retest reproducibility measures (intensity, GM, WM, CSF, FA, ADC)
Phase 2: Implementation of test protocols at all Human BIRN sites
  • Multi-spectral T1, T2, DTI 1.5h protocol
Phase 3: Test-retest data acquisition with common protocols
Phase 4: Data Analysis and Evaluation of reproducibility
Phase 5: Preparation for dissemination (protocols & correction tools)
Reproducibility of $T_1$-based multi-spectral data & derived morphometry

- Multi-site calibration manuscript *(J. Jovicich)*
- Preliminary reproducibility evaluation of MR signal and GM/WM/CSF segmentations as function of $B_0$, $B_1$, unwarping *(A. Dale)*
- Distortion phantom scanned at new sites, unwarping evaluated *(J. Jovicich)*

Reproducibility of $T_2$-based multi-spectral data & derived morphometry

- Multi-spectral acquisitions (1.5T/3T) at Duke (first test-retest round) *(J. MacFall)*
- Preliminary multi-spectral GM/WM/CSF segmentations (unwarping) *(J. MacFall)*

Diffusion: reproducibility of FA and ADC

- Acquisition/analysis of test-retest DTI (3-4 subjects, 1.5T, 4T, SNR effect) *(S. Mori)*
- Preliminary evaluation of $B_0$ correction with field maps *(A. Song)*
- Preliminary evaluation of number/orientation of gradient-encoding directions *(L. Frank)*
Reproducibility of $T_1$-based multi-spectral data & derived morphometry

- Reproducibility evaluation of MR signal and full segmentations as function of $B_0$, $B_1$, unwarping (A. Dale)
- Unwarping code for all human BIRN sites (J. Jovicich)
- Protocol/correction recommendations for multiple platforms (A. Dale)

Reproducibility of $T_2$-based multi-spectral data & derived morphometry

- Complete test retest multi-spectral acquisitions (1.5T/3T) at Duke (J. MacFall)
- Complete multi-spectral GM/WM/CSF segmentations (unwarping) (J. MacFall)
- Protocol recommendation related to specific applications (J. MacFall)

Diffusion: reproducibility of FA and ADC

- Acquisition & analysis of test-retest DTI (1.5T, 4T, TE, b effects) (S. Mori)
- Protocol/correction recommendations that includes # averages, TE, b-value, number/directions of encoding gradients, MRI platforms (S. Mori, A. Song, L. Frank)
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Software release applications ~Dec 04
Analysis, Visualization and Integration Tools

- Segmentation Tools
- Shape Analysis Tools
- Diffusion Analysis Tools
- Integrated Visualization Tools
- Query Atlas Tool
- Machine Learning Tools
### Segmentation Tools

- **A) Protocol Specific (Fischl, MGH)**
  - 6: Develop Atlases for High Field Strength, New Protocol
  - 12: Deploy Segmentation Tools

- **B) Protocol Neutral (Pieper, BWH)**
  - 6: Apply to MS Data
  - 12: Test on mBIRN AD / ADNI Data

- **C) Facial Masking for T2, DTI (Notestine, UCSD / Grimson, MIT / Pieper, BWH / Fischl, MGH)**
  - 6: Behavioral Recognition Test; Machine Vision Analysis
  - 12: Masking T2, DTI (Either 2.1.A or 2.1.B)

- **D) QA for Protocol Specific (Fischl, MGH)**
  - 6: Collect Statistics
  - 12: Deploy QA Tools
• **Shape Analysis**
  - **A) Standardized Representation (Kolasny, JHU)**
    - 6: BIRN Data Grid Segmentation Format (Subcortical)
    - 12: Portal Launching Studies
  - **B) Large Scale Computation (Kolasny, JHU)**
    - 6: Port to Multiple Target Architectures (Intel, AMD…)
    - 12: Local Cluster / Grid Deployment
  - **C) Statistical Metrics (Kolasny, JHU)**
    - 6: Develop Metrics
    - 12: Apply to Subject Populations
  - **D) Visualization Integration (Kolasny, JHU / Pieper, BWH)**
    - 6: Improved Visualization Modes (Integrated with MRML Scenes)
    - 12: DTI LDDMM Visualization
DTI Aims

- **A) Software Interoperability** *(Pieper, BHW / Gerig, UNC)*
  - 6: Collect Sample Datasets
  - 12: Standardized File Formats (BXH, MRML)
- **B) Forebrain White Matter Atlas** *(Fallon, UCI)*
  - 6: Control Populations (Version 1)
  - 12: Depression, MCI, AD Populations (Version 1)
- **C) WM Atlases for Automated Tractography** *(BWH, UCI, UNC)*
  - 6: Discuss
  - 12: Experiment with Initial Atlases
- **D) Expert Review of Automated Atlases** *(UCI)*
  - Minimal work in first year
**Visualization (Pieper, BHW)**

- A) High Performance Interaction with BIRN Data Grid
  - 6: Flexible Portal Launch
  - 12: Images Re-Uploaded to Data Grid
- B) Integrated Display
  - 6: DTI Visualization from Multiple Sites
  - 12: LDDMM Deformations in Anatomical Context
Query Atlas (Pieper, Plesniak, BWH / Brown, UCSD)

A) Ontology Labeling of Analysis Results
   • 6: Determine Gray Matter Ontology
   • 12: Multi-Tool Query Interface

B) Integrate Metadata and Target Multiple Sites
   • 6: Publication of Concept and Status
   • 12: Re-Architect for Version 2

C) Integrate Query Results in 3D Context
   • No direct milestones in year 1
Analysis & Visualization Work Plan

- **Machine Learning** *(Golland, Jaakkola, MIT)*
  - A) Automatic Hypothesis Generation
    - 6: Apply Existing Tools to BIRN Data (MIRIAD)
    - 12: Evaluate Results and Publish
  - B) Incorporate *a priori* knowledge
    - Initial Discussions and Plans this Year for Work to be Done Next Year
  - C) Integration with Visualization (with Pieper, BWH)
    - 12: Experiments to Display Hypotheses in Anatomical Context
  - D) Integration to BIRN Portal (with Grethe, BIRN-CC)
    - 6: Define Architecture
    - 12: First Version Implemented for Use with MIRIAD and other BIRN Statistics Interfaces
Morphometry BIRN Cores:

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Software release applications ~Dec 04
## Informatics Work Plan: Phase 1 Milestones

<table>
<thead>
<tr>
<th>Database Technologies</th>
<th>Name</th>
<th>Date</th>
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<tbody>
<tr>
<td>Beta test XNAT deployment to selected BIRN sites</td>
<td>Dan Marcus</td>
<td>4/1/2005</td>
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<tr>
<td>Controlled release cycles of databases and tools</td>
<td>Jeff Grethe</td>
<td>4/1/2005</td>
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<tr>
<td>Postgres implementation of the HID</td>
<td>Burak/Karen P.</td>
<td>4/1/2005</td>
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<tr>
<th>Workflow</th>
<th>Name</th>
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<tr>
<td>End-to-end uploading improvements (BIRNDUP)</td>
<td>Jonathan Sacks</td>
<td>4/1/2005</td>
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<tr>
<td>CALM / GAME Assessment incorporation</td>
<td>Burak</td>
<td>4/1/2005</td>
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<tr>
<th>Access and query of data</th>
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<tr>
<td>Improve Statistics Interface</td>
<td>David Kennedy</td>
<td>4/1/2005</td>
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<tr>
<th>Knowledge Management</th>
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<tr>
<td>Expand Data Mediation capabilities</td>
<td>Burak/Amarnath</td>
<td>4/1/2005</td>
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<tr>
<th>Data Provenance</th>
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<tr>
<td>Integrate Provenance with XML Upload</td>
<td>Nicole Aucoin</td>
<td>4/1/2005</td>
</tr>
<tr>
<td>Store the Data Provenance in HID</td>
<td>Nicole Aucoin</td>
<td>4/1/2005</td>
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<tr>
<th>Data Curation</th>
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<tr>
<td>Create project registration and data checkout tool</td>
<td>Jonathan Sacks</td>
<td>4/1/2005</td>
</tr>
<tr>
<td>Create Quality Assurance tools</td>
<td>Dan Marcus</td>
<td>4/1/2005</td>
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<tr>
<th>Public Data</th>
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<tr>
<td>Survey of anticipated BIRN data</td>
<td>David Kennedy</td>
<td>4/1/2005</td>
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<tr>
<td>Public release of WashU AD data</td>
<td>Dan Marcus</td>
<td>4/1/2005</td>
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## Informatics Work Plan: Phase 2 Milestones

<table>
<thead>
<tr>
<th>Database Technologies</th>
<th>Integration of XNAT with the HID via XML</th>
<th>Dan Marcus</th>
<th>10/1/2005</th>
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</thead>
<tbody>
<tr>
<td><strong>Access and query of data</strong></td>
<td>Improve Semantic Web (Haystack) general data viewer</td>
<td>David Karger</td>
<td>10/1/2005</td>
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<td></td>
<td>mBIRN service delivery to RPDR</td>
<td>Shawn Murphy</td>
<td>10/1/2005</td>
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<td></td>
<td>Standalone Stats Browser</td>
<td>David Kennedy</td>
<td>10/1/2005</td>
</tr>
<tr>
<td><strong>Knowledge Management</strong></td>
<td>Create a Neuropsychological Ontology prototype</td>
<td>Christine F-Notestine</td>
<td>10/1/2005</td>
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<tr>
<td><strong>Data Provenance</strong></td>
<td>Query by Provenance</td>
<td>Nicole Aucoin</td>
<td>10/1/2005</td>
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<tr>
<td><strong>Continuing support of Clinical Projects</strong></td>
<td>Longitudinal functions for Multi-site Alzheimer Disease</td>
<td></td>
<td>10/1/2005</td>
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