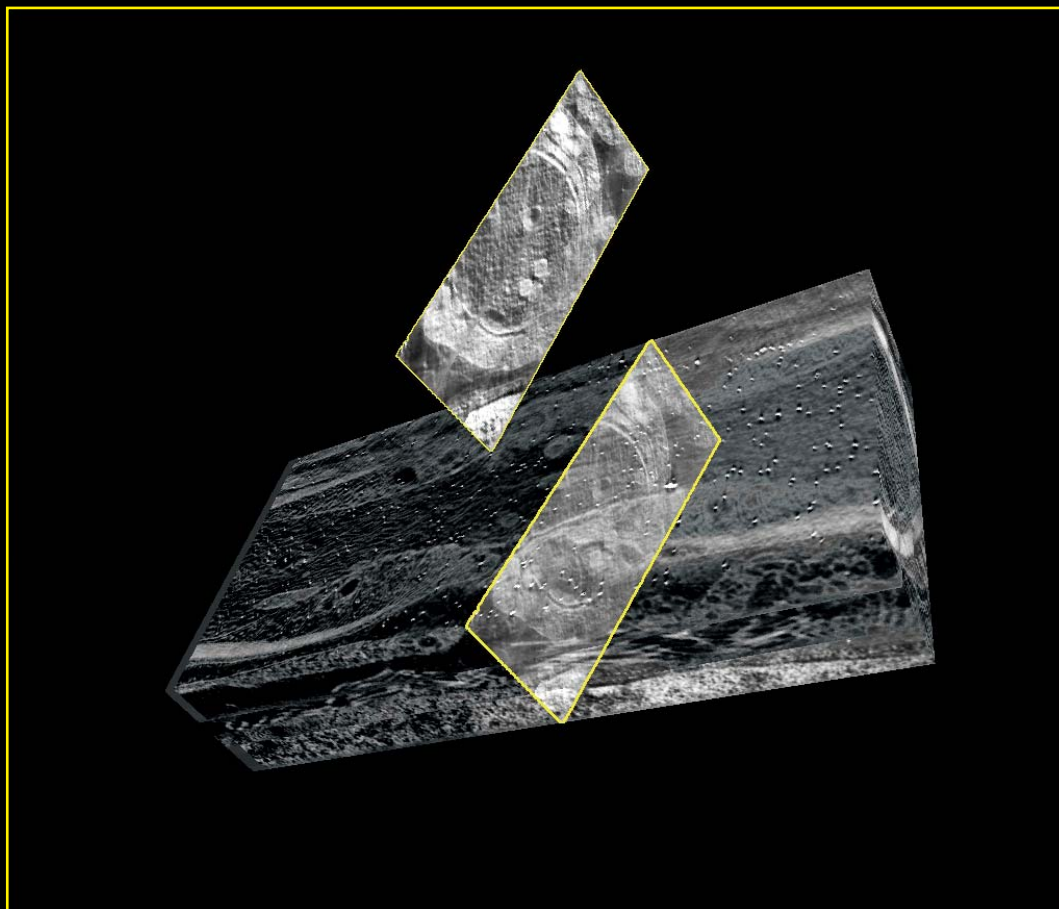


BIRNing issues

BIOMEDICAL INFORMATICS RESEARCH NETWORK



**New Virtual Data Grid Tools
All Hands Meeting and GCRC Workshop 2004**

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BIRN Grid Collaborations Will Enhance Security, Performance, and Scalability

by Mark Ellisman, Director, BIRN-CC and Christine Reilley

From schizophrenia to structural geology to supernovae, the variety of data stored within grids throughout the scientific community is matched only by the challenges faced in constructing those grids. Although diverse branches of science each have their own unique grids, they share similar goals of distributing data, achieving interoperability, and designing applications that leverage collections of heterogeneous resources.

To meet these goals, the BIRN is joining forces with members of the geosciences, life sciences, and high energy physics communities to unify the key grid-based components of their respective architectures.

Security Infrastructure

The BIRN, along with Telescience, the Geosciences Network (GEON), the Science Environment for Ecological Knowledge (SEEK) project, and the GRIDS Center are partnering to build a unified authentication and authorization architecture that will be incorporated into the NSF Middleware Initiative (NMI) software release.

Developing security standards within grid infrastructures is a top priority in this collaboration. Because BIRN must adhere to Health Insurance Portability and Accountability Act (HIPAA) requirements and Institutional Review Board (IRB) policies, it offers key requirements and new perspectives not emphasized in the other projects. For example, unlike other project participants, BIRN must adopt a security model that enforces and protects the confidentiality of human data.

As part of the project, Telescience and GEON are joining with BIRN in authentication efforts and in developing a grid certificate infrastructure, said Chaitan Baru, GEON's co-PI of IT infrastructure, design, and development. "Institutions like GEON and BIRN are working to establish a common core infrastructure, data mediation, and workflow that can be translatable to other projects," Baru said. For example, an emerging

eco-network, the Collaborative Large-Scale Engineering Assessment Network for Environmental Research (CLEANER), can leverage BIRN and GEON grid technologies for the bioengineering domain, particularly for image banking, analysis, and modeling.

Through this effort, BIRN is helping to create a robust security model that can serve many projects, such as the Grid Physics Network (GryPhyN), which is looking to enhance its own security infrastructure, said GryPhyN Principal Investigator Ian Foster. GryPhyN collects and analyzes massive datasets on high-energy particle physics, astronomy, and cosmic gravitational waves. Like BIRN, it operates on a large, distributed infrastructure, processes large quantities of data, and builds virtual data tools that analyze these large datasets. In particular, GryPhyN and BIRN are building on Globus NMI software and sharing experiences for developing requirements for security of next-generation applications.

Ecological Research

Other facets of BIRN's infrastructure have benefited another area of research: ecology. In ecological research, the BIRN's semantic mediator technology is being used to construct a distributed, integrated information system of NEON (National Ecological Observatory Network)-like ecological research. This project will gather and analyze data from lakes and oceans, allowing test beds to develop a richer understanding of land-water interactions. In

(Continued on page 3)



All Hands Meeting and BIRN/GCRC Implementation Session Held in Boston

The annual BIRN All Hands Meeting (AHM) is to be held in Boston on Tuesday, October 12 and Wednesday, October 13 (with ancillary meetings on October 11 and 14). The two-day meeting, consisting of working group meetings, training sessions, and status meetings, will provide an opportunity for national participants to engage in face-to-face brainstorming and problem-solving discussions. More than 120 national participants have registered.

With input from NCCR, the BIRN crossover team, consisting of project managers and scientific coordinators, including Jeffrey Grethe, Mark James, Jessica Turner, Randy Gollub, Jorge Jovicich, Maryann Martone, Jim Fallon and Mike Fehnel, and, has developed a program to meet the needs of the global BIRN community.

Ancillary Meetings

Morphometry, Function, and Mouse test beds will hold working group discussions at the Monday, October 11 meeting. Attendance is strongly encouraged.

BIRN Grid Collaborations Will Enhance Security...

(Continued from page 2)

focusing on oceans, a marine biogeography test bed will examine the factors that affect large-scale patterns of ocean life to help identify marine-protected areas and predict climate-change impacts in the oceans. In the lake test bed, researchers will deposit wireless sensors in lakes around the world to collect minute-by-minute, real-time data of barometric pressure, dissolved oxygen, wind speed, and temperature at various lake

The Thursday, October 14 meeting will offer advanced training and demonstrations oriented towards technical and scientific staff. Topics include

- advanced fMRI statistical analysis
- clinical queries and data integration
- grid implementation and high-performance computing

BIRN/GCRC Implementation Session

Immediately following the AHM, a two-day session will be held to discuss the advantages

of the BIRN infrastructure for other NIH General Clinical Research Centers (GCRCs). These meetings will be led by Bob DiLaura, president of the Association of GCRC Information Technology Profession-

als, Jessica Turner, Jorge Jovicich, and Jeffrey Grethe.

The event will focus on identifying ways for GCRCs to access better visualization and analysis tools and to provide greater coordination among test bed sites. Currently 37 participants have registered.



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Function BIRN Automated Image Processing Tools: An fMRI Analysis Framework

by Jessica Turner, UCI

The analysis of functional imaging data is usually performed in an idiosyncratic manner. Investigators create their own file organization, naming conventions, and specific processing steps that often vary from experiment to experiment. There are several drawbacks to this approach:

- Other users have difficulty finding and interpreting the results
- Comparing data results from separate users analyses is difficult, even for the same dataset
- Results are not searchable

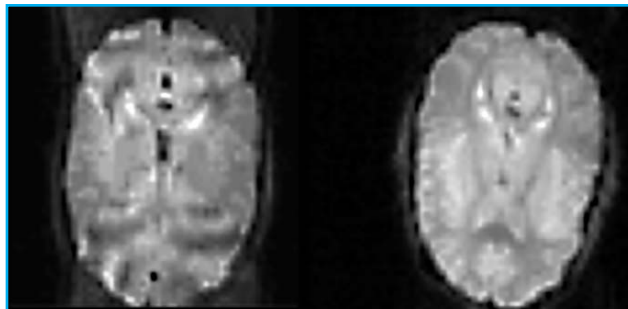
A common functional magnetic resonance imaging (fMRI) analysis framework is needed for consistent initial dataset analysis. The framework is the generalized set of rules and data structures that allow for flexibility in fMRI processing while providing a foundation for the interaction with other BIRN information technology tools (e.g., databasing and visualization) and data. The framework is built on top of an XML schema that is used to describe all aspects of fMRI analysis, specifying where the analysis results are to be stored in the Human Imaging Database, formalizing naming conventions, and identifying the information that must accompany the files.

Initial Pipeline Software

An initial common fMRI analysis pipeline has been applied to the human phantom data acquired by the Function BIRN in its Phase I study. This dataset contains 150 GB of imaging scans from the five subjects scanned over two days at 10 sites (see BIRN-ing Issues, 2.3). We have chosen FMRIB Software Library (FSL, <http://www.fmrib.ox.ac.uk/fsl/>), a comprehensive library of functional and structural brain image analysis tools developed by the Image Analysis Group at Oxford, UK. We chose this computational platform

because it is free, open-source software that requires no licenses and runs on a variety of operating systems. The system is widely used in the neuroscience community, and offers several advanced processing and analysis features. While FSL is being used in this proof-of-concept stage, we intend to create a specification through which other software can become Function BIRN-enabled.

We have bridged the gap between the Function BIRN data hierarchy in the BIRN Data Grid and the FSL routines to analyze a subset of the human phantom data. The subject-level analysis software consists of a series of scripts that perform standard pre-processing steps (such as quality assurance, intensity normalization, and slice-timing correction) and



These images were taken of the same subject on the same day at Brigham and Women's Hospital. Left, the effect of severe ghosting on an EPI image. Right, image without ghosting. "Ghosts," or echoes in the image, are problematic because they overlap with actual brain images, reducing true signal measurements.

subject-level general linear model (GLM) specification and analysis.

The group-level tools have a web interface that allows the user to select an effect of interest (e.g., where is the BOLD activation across the group?), create a group analysis matrix on-the-fly, call FSL routines to perform the desired analysis, then display the results in a web page. This web page shows maps relating significance of the resulting information as and summary tables of clusters of

activity. This pathway is specific to the sensorimotor data collected as part of the human phantom study but can be generalized to test for information such as the effect of a diagnostic, demographic, and genetic variables.

Quality Assurance

RF Spike Detection Algorithm

When dealing with extremely large datasets, it is imperative that automatic and robust techniques be used to ensure that the data are free of major defects. We have developed a RF spike detection algorithm to be used in quality assurance.

RF spikes are events that occur during the acquisition of the data and contaminate an entire image. Our method works by comparing functional images

across time and slice to determine which ones contain spikes. Our algorithm was applied to the human phantom data and found 483 images with spikes out of about 3.5 million images. Obviously, it would be impractical to visually inspect each of those 3.5 million images.

Automated Ghost Detection Software

Functional images obtained with EPI are susceptible to "ghosts," or echoes in the image. Ghosts are problematic because they overlap with actual brain images, reducing true signal measurements. We have developed automated ghost detection software that uses

a series of brain and head masks that extract ghost-only voxels to determine the amount of ghosting. This has been run on all the human phantom data (35 sec/functional volume).

With this pipeline in place, integrated with the Data Grid directory hierarchy and tested on the Phase I data, the Function BIRN Phase II data will be rapidly processed, analyzed, and uploaded for queries and further analysis.

BIRN 2.0 Scheduled for Spring 2005 Public Release

The 2.0 version of BIRN will be released April 2005, marking the beginning of a biannual release cycle on which BIRN will issue updates. Every April and October, users will receive an integrated release of new and enhanced capabilities, bug fixes, and revised documentation. The new emphasis will be on releases of integrated tools to enhance research workflows rather than upgrades of individual components. The test beds play an integral role in these releases by continuing to provide requirements, tools and valuable feedback. By going to a more formal release schedule, the test beds will have a simpler and more predictable mechanism for interacting with the BIRN-CC and planning their own research. "The schedule will provide greater stability for users and developers," said Jeffrey Grethe, project scientist at BIRN-CC.



The 2.0 release will include the following enhancements:

- improved data mediation tools
- standardized security
- portal enhancements
- increased data grid capabilities
- upgraded infrastructure smangement tools

The package, which is undergoing alpha testing at BIRN-CC, will be available for beta testing in January 2005. While moving towards establishing this release cycle, the BIRN CC will continue its current role in improving the existing tools. For example, some components of BIRN 2.0 that provide immediate benefit to the test beds, including Data Grid proxy operations (see Tool Tips, page 6) and the updated portal API, are being made available now.

Highlights of BIRN 2.0 features follow. New items are marked with an asterisk.

• Improved Data Mediation Tools

Faster performance

- * New registration tools and query interfaces
- * Documentation and tutorials
- * Support for BIRN authorization services

• Standardized Security

Grid security infrastructure (GSI)

- * BIRN authorization API and services
- * Enhanced portal security

• Portal Enhancements

Improved performance

Updated portal API

- * Visitor pages and accounts
- Enhanced security
- * Updated look and feel for improved usability
- * Online documentation and tutorials

• Increased Data Grid Capabilities

Improved performance

Proxy operations to support computation on data prior to transfer

Full auditing

- * Data synchronization
- * Data integrity and verification

• Upgraded Infrastructure Management Tools

* Enhanced interoperability of BIRN tools

Improved developer testing and staging environments

Better versioning control

- * Online documentation and tutorials
- * Automated deployment of BIRN systems via Rocks and CVS

BIRN Member on the Move

Morphometry BIRN member and FreeSurfer creator Anders M. Dale, Ph.D. is returning to UCSD, his alma mater, after serving at Harvard as associate professor of Radiology and as principal investigator of the Center for Functional Neuroimaging Technologies at the Massachusetts General Hospital NMR Center.

Dale, a pioneer in structural MRI research, will join the faculty of the UCSD department of neurosciences and the UCSD Center for Functional MRI (fMRI).

While at Harvard, Dale and his colleagues created FreeSurfer, a set of semi-automated tools for reconstruction of the brain's cortical surface and overlay of functional data onto the reconstructed surface. At UCSD, he will continue his neuroscience research, focusing on developing accurate and automated algorithms for evaluation subjects using multi-modality approaches to data collection. He is also conducting studies in animal models using optical imaging, high field fMRI, and electrophysiological recordings that enhance the interpretation of neuroimaging studies.



Anders Dale

BIRN Introduces Data Grid Proxy Operations for Manipulating Images

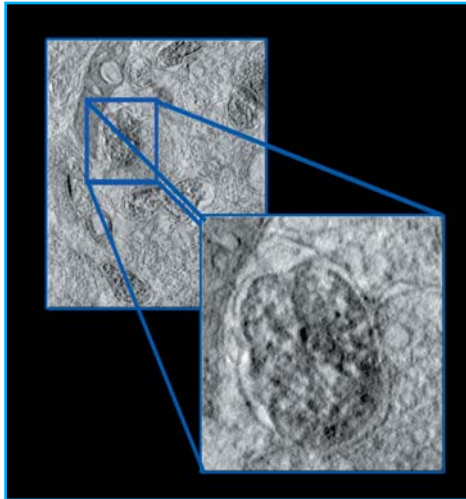
by Roman Olschanowsky, BIRN-CC

The BIRN data grid now supports proxy operations, programs that execute remotely, allowing for computations to be applied where the data resides. This can save precious time that would have otherwise been used for transfer of the original data.

Three data proxy operations, "convert," "anhdrinfo," and "anslex" are now available as part of BIRN 2.0 and can be used for a variety of applications.

- The convert program by ImageMagick facilitates image conversion operations. <http://www.imagemagick.org/>
- Anhdrinfo (Analyze Header Info) returns analyze image header information.
- Anslex (Analyze Slice Extractor) returns a specified slice of an Analyze image (See cover image).

A BIRN client can use the proxy capability to perform on-the-fly image manipulations and download converted images without transferring the original file. All image manipulations occur on the grid, where



An example of a "convert crop" operation. This feature and many more are available through the BIRN Data Grid.

This Purkinje Neuron image, developed by Francisco Capani, shows actin localization in spines of CNS using eosin phalloidin photooxidation.

Image Courtesy of the Cell Centered Database.

the results are dynamically generated and streamed to the user.

For instance, to access a stored tiff file from another site, users can not only download that tiff as a jpeg, but they also can crop, rotate, and resize it (<http://www.imagemagick.org/images/examples.jpg>).

Moreover, to preview an image measuring several gigabytes users can either download a thumbnail or a cropped segment of the image without having to download the original large-scale image. This remote image conversion, the functionality of which is already transparently incorporated into the BIRN portal, is a good example of BIRN's new data grid proxy operation capability.

More data grid proxy operations, including a DICOM image converter, are planned for the coming months. Suggestions are welcome and can be sent to portal@nbirn.net.

Jargon Java Code Example for Performing Data Proxy Operation:

(Jargon is the Java API for data grids)

<http://www.npaci.edu/dice/srb/jargon/index.html>

```
// Via the File Object executeProxyCommand Method:
```

```
srbFile = new SRBFile( srbFileSystem, "/home/Demo/test.jpg" );  
InputStream in = srbFile.executeProxyCommand( "convert", "-rotate 45 rotate.jpg" );
```

```
// Via the File System executeProxyCommand method
```

```
InputStream in = srbFileSystem.executeProxyCommand( "convert", "-rotate 45 rotate.jpg", null,  
    "/home/Demo/test.jpg", SRBFileSystem.PORTAL_STD_IN_OUT );
```

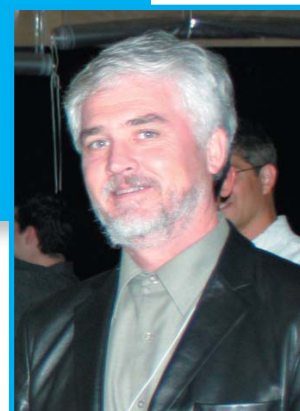
Examples of the command line via S-commands follow:

```
Spcommand -d test.hdr anhdrinfo  
Spcommand -d test.img "anslex -q 1 0 0 0 -d 950 950 199 -D 0.501953 0.501953 0.501953 -o -20"  
> test-slice.tif  
Sconvert test.jpg test.gif  
Sconvert -geometry 25% test.jpg q.gif  
Sconvert -swirl 90 test.jpg swirl.jpg  
Sconvert -rotate 45 test.jpg rotate.jpg  
Sconvert -crop 100x100+90+90 test.jpg sample.jpg
```

The convert application manual, which contains a comprehensive listing of command options, is available online. <http://www.nbirn.net/Resources/Users/Applications/SRB/manpages/Sconvert.1.html>

Greg McCarthy Takes the Cognitive Challenge

Gregory McCarthy is a professor at Duke University in the Departments of Radiology, Neurobiology, and Psychological and Brain Sciences. He directs the Duke-UNC Brain Imaging and Analysis Center (BIAC), a research imaging facility that serves the faculty at both the Duke and University of North Carolina campuses. The BIAC plays a part in both the Morphometry and Function BIRN test beds.



Gregory McCarthy

McCarthy has been leading the Function BIRN Cognitive Challenge working group. This group has been developing and evaluating neuroimaging challenge tasks that reliably activate different brain systems, the results of which can be added to the armamentarium of the BIRN.

BIRning Issues caught up with McCarthy recently to cull his thoughts about life, research, and the BIRN initiative.

Q. Where did you go to college and what were your areas of study?

A. My undergraduate studies were at Rutgers College and my graduate degrees came from the University of Illinois in Champaign-Urbana. I was in the Biological Psychology program at Illinois and worked primarily on human electrophysiology under Emanuel Donchin. This primarily meant recording event-related potentials (ERPs) from scalp electrodes, which I ultimately found to be limiting because the neural

generators for most ERPs are difficult to determine.

I did my post-doc at Yale on intracranial electrophysiological recordings in humans and monkeys with Truett Allison and Chris Wood. I began using MRI when we needed a better way than skull films to plan and confirm the placement of our electrodes. I stayed at Yale for 18 years before taking a position at Duke University in 1998.

Q. What attracted you to the BIRN project?

A. I was attracted to the BIRN project for three reasons. The first was that the BIRN community includes the most clever, productive, and interesting scientists in my field. Being able to collaborate with these individuals on such a significant effort has been both fun and greatly rewarding.

The second reason was more selfish—I wanted to help establish the best practices of the neuroimaging community in

my center at Duke.

The third reason was my impatience with the pace of my own science. I want to see the BIRN infrastructure in place so that I can use it to expedite answers.

Q. How do you think the BIRN can be valuable to the neuroscience research community?

A. It is evident to everyone that neuroscience research—particularly that which addresses clinical issues—is becoming increasingly collaborative and performed on a larger scale. The infrastructure required to support science at this scale is formidable. I have been involved with several multi-center collaborative projects at Duke that preceded the BIRN and that do not take advantage of the BIRN infrastructure. For each project, we had to create a separate infrastructure. This has taken a lot of work, and the product has not been nearly as useful or as comprehensive as we believe the BIRN solution will be. The BIRN has the potential to provide it all—from site calibration and data quality assurance, through data and metadata storage, tool creation and dissemination, analysis and visualization, to governance and data sharing agreements.

While the BIRN has not yet achieved every point, I have been impressed by the progress. A mature BIRN will allow neuroimaging science to move beyond small scale studies with small and hetero-

(Continued on page 8)

Upcoming Meetings

October 12–13, 2004

All BIRN All Hands Meeting, Boston, Massachusetts

<http://www.nbirn.net/AU/Events/AHM2004/index.htm#Hotel>

October 14-15, 2004

BIRN-GCRC Workshop, Boston, Massachusetts

<http://www.nbirn.net/AU/Events/GCRC/index.htm>

October 23–27, 2004

Society for Neuroscience, San Diego, California

<http://web.sfn.org/AM2004Splash.cfm>

November 29–December 3, 2004

Radiological Society of North America Meeting, Chicago, Illinois

<http://rsna2004.rsna.org/rsna2004/V2004/index.cvn>

Greg McCarthy Takes the Cognitive Challenge...

(Continued from page 7)

geneous samples to more reliable and informative large scale studies that can subtype within disease groups. This will enable imaging to become an important component of neuroscientific clinical research, and will aid in the application of imaging data to genetic and drug development studies.

Q. How do you think the BIRN infrastructure will translate to other areas of health care research?

A. Some aspects of the BIRN infrastructure are relatively independent of the particular methods used by the particular science, (e.g., the federated database, the procedures for systematizing metadata collection, the methods for querying, connecting, and summarizing data). These aspects represent the informatics components of the infrastructure. There is also a sociological component of the BIRN that will translate well to other aspects of research. This component concerns the creation and running of working groups, the establishment of governance procedures, the negotiation of intellectual property issues, and the development of rules for sharing data and analysis techniques. The human processes created

and the lessons learned in creating the BIRN seem as important to me as its physical infrastructure.

Q. What are some of the challenges you have experienced in working with the BIRN?

A. My biggest personal challenge has been managing the time commitment. I have been frankly amazed and impressed at how seriously people have applied themselves to the BIRN. I end up feeling like a slacker in comparison.

A more general challenge has been to coordinate the actions of people all over the country who have many other research and institutional commitments in addition to the BIRN. In this regard, the frequent video and teleconferences held by the many working groups have been very helpful, although there has been a learning curve on how to use these communicative tools effectively.

Q. What major challenges do you see on the horizon?

A. Like most people in the BIRN, I want to see the scientific payoff for the effort we have all expended. The BIRN test beds have an unusual dual nature in that they are focused upon creating an

infrastructure while simultaneously trying to use this same nascent infrastructure to investigate significant issues in clinical research. The challenge in the next years will be managing the transition from a focus upon infrastructure to a focus upon scientific results and the communication of those results. I think there are still sociological lessons to be learned about assigning credit in highly collaborative and large scale science. Moreover, I am not certain that our home institutions yet know how to value these individual contributions to large scale science, although I see some evidence that it is now at least being discussed.

Q. What is your favorite “factoid” about yourself?

A. When not devising cognitive challenges for the function BIRN, I like to play guitar. I just bought a sound modeling guitar that precisely duplicates the sound of a few dozen vintage guitars (that I can't afford), and I am having a blast with it. After too many decades of playing folk and rock guitar, I finally got embarrassed by lyrics and have started learning jazz guitar. The chord forms are quite alien, but I'm still working at it. I figure if this neuroimaging stuff doesn't pan out, I can always get work as a busker in a subway somewhere.

Cover Image

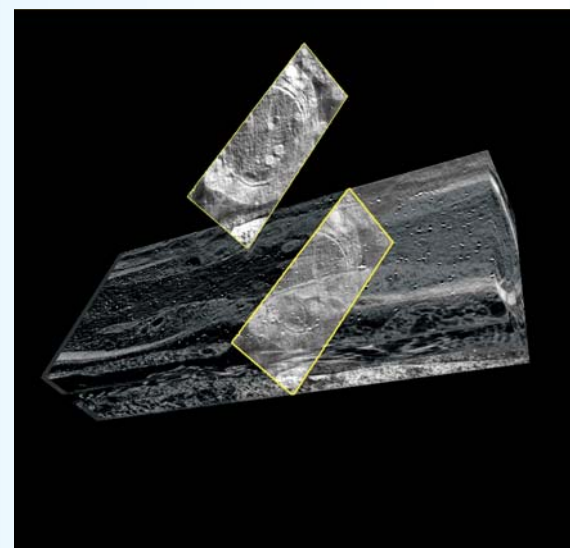
Analyze Slice Extractor (Anslex) Returns Volume Slice

An electron tomographic volume of the node of Ranvier of myelinated nerve viewed with the new BIRN tool Anslex, one of the BIRN 2.0 applications now available through the BIRN Portal.

This particular image relates to work on mouse models of neurodegenerative diseases and demonstrates one of the types of large volumetric data that will be obtained as the Mouse BIRN testbed continues to collaboratively study animal models of demyelinating disorders such as Multiple Sclerosis using multi-scale imaging methods and correlated genetic/genomic analyses.

The node of Ranvier is a small specialized site found at intervals along the myelinated nerve processes of vertebrate animals in both the central and peripheral nervous systems. It is where nerve impulses are re-amplified, enabling transmission of information to such distant targets as nerve terminals on muscles or other neurons. Nodes of Ranvier are sites where neuron-glia associations are disrupted early in the course of inflammatory neuropathies and demyelinating disease.

Image prepared by Stephan Lamont. Volume courtesy of Gina Sosinsky.



Mouse BIRN Highlights

Grant renewal efforts were a priority for Mouse BIRN researchers this summer as they continued to advance projects using the BIRN infrastructure.

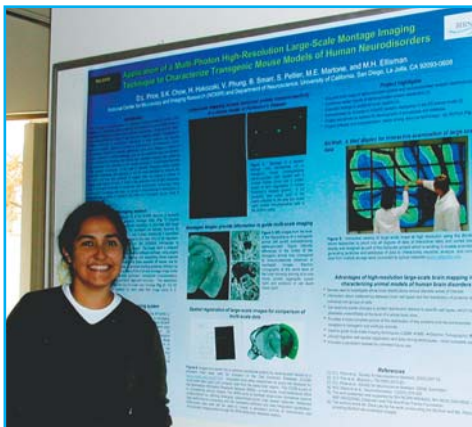
BIRN Scientist Wins M&M Award

Mouse BIRN researcher Diana L. Price, Ph.D. won the Traveling Poster Award at this year's Microscopy and Microanalysis Meeting for her study revealing neuropathology in the hippocampus and cerebellum of the Parkinsonian mouse brain, two areas often overlooked in Parkinson's disease research.

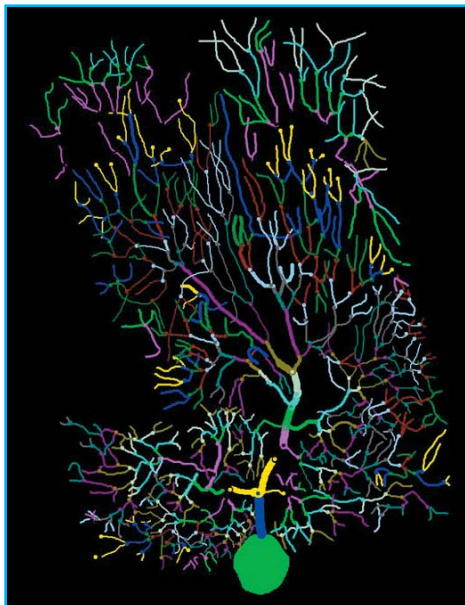
Price delivered her poster presentation, titled "Application of a Multi-Photon High-Resolution Scale Montage Imaging Technique to Characterize Transgenic Mouse Models of Human Neurodisorders," at the Aug. 2 meeting in Savannah, GA.

The labor-intensive nature of traditional imaging methods often restricts research to regions of the brain expected to exhibit pathology, such as the substantia nigra and striatum. But Price's method, which produced high-resolution images using a montaging technique in conjunction with multi-photon microscopy, allowed examination across multiple brain regions.

Price and co-authors Sunny K. Chow, Hiroyuki Hakozaki, Van Phung, Benjamin Smarr, Steven Peltier, Maryann E. Martone, and Mark H. Ellisman collaborated with Mouse BIRN Principal Investigator G. Allan Johnson of Duke University on this study.



Dr. Diana L. Price's poster won Microscopy and Microimaging's Traveling Poster award.



Mouse BIRN researchers are collaborating to study a possible connection between dendritic spines and a genetic disorder. A dendrite is the portion of a neuron cell that branches out from the neuron and detects electrical signals emitted by other neurons. It transmits those signals to the cell.

BIRN Infrastructure Enhances Test Bed Interactions

Mouse BIRN is adapting tools created for whole brain anatomy to examine subcellular changes in animal models of human disease. Morph BIRN researchers Lisa Fong and Tilak Ratnanather of the Johns Hopkins University Center for Imaging Science are partnering with Maryann Martone and Diana L. Price of the Mouse BIRN to investigate a possible connection between shape differences in dendritic spines and a genetic disorder. The shape differences will be analyzed using Large Deformation Diffeomorphic Metric Mapping (LDDMM), an application available through the BIRN Portal that allows for comparison and quantization of morphometric changes in shapes.

The BIRN data grid and the Cell Centered Database (CCDB) have been used to share data, including multiple images of dendritic spines developed through light and electron microscopy.

A dendritic spine is the cup-like shape at the ends of the dendrite that receives the bulk of synaptic input in the brain. Key in mediating synaptic plasticity, spiny dendrites are the major site of excitatory synapses in the central nervous system.

New CCDB Released

Version 2.0 of the newly redesigned CCDB, one of the independent databases linked through the Mouse BIRN data federation, was launched this summer, providing users with an improved navigational structure and new query capabilities. The Mouse BIRN data federation is linking stand-alone databases like the CCDB, which can be queried either independently or through the mediator.

The site, redesigned by NCMIR's Julia Sun, Ruth West, Christine Reilley, and Maryann Martone, was released August 20.

The CCDB debuted in 2002 as one of the first Internet databases for cellular imaging data. The database makes 3D microscopic imaging data available to the structural biology and neuroscience communities and houses structural and protein distribution information derived from confocal, multiphoton, and electron microscopy, including correlated microscopy.



The Cell Centered Database (CCDB) re-design provides improved navigation and query abilities.

Morphometry BIRN Prepares Tools to Disseminate to Research Community

by Jorge Jovicich, MGH

The Morphometry BIRN team has continued to make progress on several fronts, including the development of tools and methods that support the BIRN infrastructure, the definition of our work plans for the coming years, and the dissemination of our tools to the clinical research community. These activities are outlined below.

Morphometry BIRN Tools

The progress of our group in the development of tools and methods can be summarized in the list of most recent publications [1-10]. This work includes the development of web-based informatics tools [1-4], methods for de-identifying structural MRI data as required for data sharing [5], and morphometry and calibration methods suited for multi-site studies [6-10]. These advances emphasize progress using the BIRN infrastructure coupled with the local expertise of the various participating sites. For more details on these projects, refer to <http://nbirn.net/Publications/Presentations/index.htm>.

Expansion of Morphometry BIRN Goals

The Morphometry BIRN team has also spent considerable time planning and preparing the grant proposal for the work to be done in the next years. The following broad areas of work refine and expand upon our initial developments:

- Optimization and validation of multi-site structural MRI acquisition and calibration methods, with extension to include more vendors, more field strengths and additional imaging contrasts (T2 and diffusion for lesion detection white matter characterization)
- Continued development of morphometric analysis, visualization and interpretation tools, with the addition of Massachusetts Institute of Technology (MIT) as a new site that will support machine learning techniques to incorporate statistical modeling methods.
- Continued development of a neuroinformatics infrastructure that will deliver

efficient data management, dynamic access, and application-based querying to neuroimaging data and the associated neuropsychiatric, behavioral, and neuro-genetic data.

Disseminating Morphometry BIRN Infrastructure to the General Clinical Research Community

The Morphometry BIRN team, together with the BIRN-CC, have been planning demonstrations at several meetings to both disseminate tools and infrastructure to the neuroscience community and to receive feedback about desired developments. These demonstrations are extensions of those presented at the NIH Building on the BIRN Workshop (see *BIRNING Issues*, July 2004).

One of these demonstrations is a presentation of the Multi-site Imaging Research in the Analysis of Depression

(MIRIAD) project (see *BIRNING Issues*, 2.3). In this project, imaging acquired at a single site, Duke, is processed by integrated morphometry tools of various sites, BWH and UCLA.

The project illustrates the advances that BIRN infrastructure is bringing to the research community. For example, the image below shows that MIRIAD's full automation has significantly decreased image processing time, thereby increasing researchers' data supply.

Work on this project continues on two main fronts: a) validation of the accuracy of the results and b) integration the MIRIAD raw and derived data with the Human Imaging Database, the Query Interface, and the statistical tools.

Upcoming meetings where these demon-
(Continued on page 11)

MIRIAD Project: Accomplishments

Improved computational capabilities

Segmentation Item	Duke (semi-automated)	BIRN-MIRIAD (fully-automated)
# of tissue classes	3 (Fig1)	23 (Fig2)
Time for 200 brains	400 hours	1 hour
Time for 200 lobe & regional analysis	250 hours	all lobes (Fig3) and 27 regions included above



The BIRN Multi-Institution Research in the Analysis of Depression (MIRIAD) project, undertaken during the first phase of the Morphometry BIRN Project, utilizes the BIRN infrastructure to pool algorithms from different sites for analysis of retrospective morphometry data.

Morphometry BIRN Prepares Tools to Disseminate to Research Community...

(Continued from page 10)

strations have been planned include:

- **BIRN-GCRC Workshop**

(Oct. 14–15, Boston, MA): This meeting immediately follows the BIRN 2004 All Hands Meeting. Representatives from BIRN and General Clinical Research Centers (GCRC) will meet to plan integration efforts for clinical research.

- **Society for Neuroscience**

(Oct. 23–27, San Diego, CA): A BIRN booth will present the highlights of the BIRN infrastructure for all test beds and its benefits in collaborative science, with free sessions designed for impromptu meetings.

- **Radiological Society of North America**

(Nov. 28–Dec. 3, Chicago, IL): Internet2 has invited us to present Morphometry BIRN projects as part of the targeted demonstrations of Internet technology developed to enhance and improve the range of diagnosis and treatments of diseases through new modalities in image storage, sharing, remote review and diagnosis.

- **Winter Conference on Brain Research**

(Jan. 22–28, Breckenridge CO): A panel discussion "Multiple Problems with Multi-Site Brain Imaging Studies – Partial Solutions," will be held by Morphometry BIRN team members.

Morphometry BIRN Conference Abstracts and Presentations

1. Marcus DM, Olsen TR, Ramaratnam M, Buckner R (2004) XNAT: A software framework for managing neuroimaging laboratory data, to be presented at the Society for Neuroscience, San Diego, Oct.
2. Ozyurt BI, Wei D, Keator DB, Potkin SG, Brown GG, Grethe JS, Morphometry BIRN, Function BIRN, and BIRN Coordinating Center (2004) A user-friendly, web-accessible system for the management, discovery, retrieval, and analysis of clinical and brain imaging data. Poster presented at the Human Brain Project Annual Conference, NIH, Bethesda, MD, Apr 2004.
3. Marcus DM, Olsen T, Ramaratnam M, Snyder A, Buckner R; XNAT—The extensible neuroimaging archive toolkit: informatics tools for managing and exploring neuroimaging data. Poster presented at the Human Brain Project Annual Conference, NIH, Bethesda, MD, Apr 2004.
4. Ozyurt IB, Brown GG, Grethe JS, Morphometry BIRN, FIRST BIRN; A general, extensible system for human brain imaging data retrieval and maintenance; Human Brain Mapping, Budapest, Jun 2004.
5. Bischoff-Grethe A, Fischl B, Ozyurt IB, Morris S, Brown GG, Fennema-Notestine C, Clark CP, Bondi MW, Jernigan TL, Brain Morphometry BIRN; A technique for the deidentification of structural brain MR images; Human Brain Mapping, Budapest, Jun 2004.
6. Fischl B, Salat DH, van der Kouwe AJW, Makris N, Ségnne F, Dale AM (2004) Sequence-independent segmentation of magnetic resonance images, *Neuroimage*. Jul;22(3):1060-75.
7. Beg MF, Ceritoglu C, Kolasny AE, Priebe CE, Ratnanather JT, Yashinski R, Younes L, Yu P, Jovicich J, Buckner RL, Pieper S, Fischl B, Miller MI (2004) Biomedical Informatics Research Network: Multi-site processing pipeline for shape analysis of brain structures; Human Brain Mapping, Budapest, Jun.
8. Jovicich J, Greve D, Haley E, Kennedy D, Tosa Y, Gollub RL, Fischl B, Dale A, Brain Morphometry BIRN (2004) Multi-site structural MRI studies: an evaluation of image distortions and image intensity reproducibility; International Society of Magnetic Resonance in Medicine, Kyoto, May.
9. Jovicich J, Haley E, Greve D, Gollub R, Kennedy D, Fischl B, Dale A, Brain Morphology BIRN (2004) Reliability in multi-site structural MRI studies: effects of gradient nonlinearity correction on volume and displacement of brain subcortical structures; Human Brain Mapping, Budapest, Jun.
10. Horne NR, Bondi MW, Fennema-Notestine C, Houston WS, Brown GG, Jernigan TL, Salmon DP, Mickes LB, Fischl B, The Human Brain Morphometry BIRN (2004) Hippocampal and amygdala brain changes in young-old and very-old with Alzheimer's disease: associations with neuropsychological functioning, The 9th International Conference on Alzheimer's Disease and Related Disorders, Jul.

The Biomedical Informatics Research Network

Growing Collaborative Biomedical Research Through Technological Advances

The Biomedical Informatics Research Network (BIRN), a National Institutes of Health (NIH), National Centers for Research Resources (NCRR), and U.S. Department of Health and Human Services (DHHS) supported initiative, is establishing a distributed information technology infrastructure to enable fundamentally new capabilities in large-scale studies of human disorders, such as Parkinson's, Alzheimer's, and mental retardation.

The BIRN involves a national consortium of 15 universities and 22 research groups, comprising three

neuroimaging test bed projects that are conducting structural and functional studies of neurological disease.

The BIRN Coordinating Center was established in 2001 to create, support, and distribute essential cyberinfrastructure and to pioneer the model for a persistent, scalable architecture with application beyond neuroimaging.

This integrated cyberinfrastructure is being created upon technologies supported by the next generation Internet and the National Science Foundation (NSF)



Middleware Initiative, including high bandwidth, inter-institutional connectivity via Internet2, grid-based file management and computational services, software and techniques to federate databases, and shared processing, visualization, and analysis environments.

BIRN, Smart Atlas Cited at ESRI User Conference

by Christine Reilley

BIRN's Smart Atlas was highlighted as a novel application of geographic information system (GIS) technology at this year's ESRI International User Conference in San Diego.

From hundreds of entries, the Smart Atlas was selected by Environmental Systems Research Institute (ESRI) President Jack Dangermond as a unique illustration of how GIS technology is entering "new frontiers." In the Aug. 9 opening remarks delivered before an audience of 13,000, Dangermond referred to the brain mapping techniques achieved through Smart Atlas technology as "a new kind of geography – geography of the brain." He added that Smart Atlas employs such applications as ModelBuilder and ArcGIS to study the brain's "topology." (See Mouse BIRN Uses Geography to Map the Brain, *BIRNing Issues* 2.3).

The Smart Atlas was noted alongside technologies studying the landscape of Mars, crime rates in Chicago, and agriculture in Germany as an inventive way of

The Smart Atlas, unveiled by the Mouse BIRN at the NIH Building on the BIRN conference, allows BIRN users to retrieve and integrate multi-scale data on mouse models of human disease registered to a particular location in the brain.

using GIS tools to help solve "the world's problems."

Released this spring, the Smart Atlas provides investigators with a query interface and data management tool for manipulating spatial brain data. BIRN users can retrieve, query, and integrate multi-scale data on mouse models of human disease registered to a particular location in the brain. GIS systems and

spatial data manipulation allow the Smart Atlas to integrate brain data.

ESRI developed GIS technology during the 1980s as a method of managing, analyzing, and displaying geographic knowledge through maps and globes, geographic datasets, processing and work flow models, data models, and metadata. ESRI's Annual International User Conference is now in its 24th year.

