NIfTI Background Information

Background

A variety of neuroimaging technologies allow the structure and function of the intact human brain to be studied with minimal invasion, presenting a tremendous opportunity to better understand the human brain, both in healthy and disordered states. Neuroimaging provides a crucial perspective for basic and clinical human neuroscience.

Informatics tools are key at all stages of neuroimaging, allowing scientists to control highly sophisticated imaging instruments and to make sense of the vast amounts of complex data generated by them. For example, in functional magnetic resonance imaging (fMRI), informatics is used to: design and implement the manner in which the imaging instruments capture signals from the brain, guide the behavioral tasks used to probe particular brain systems, reconstruct the resulting signals into a three-dimensional representation of the brain, correct for and suppress noise, statistically analyze the data, and visualize the results. This list is not comprehensive, and, of course, informatics is also used in storing, querying, retrieving, sharing and comparing data once they are collected.

While informatics tools are paramount to taking full advantage of the promise of neuroimaging, seizing this opportunity is, paradoxically, impeded by the informatics tools currently used by the neuroimaging research community. In the use of functional magnetic resonance imaging (fMRI), for example, many existing tools have been developed piecemeal, by scientists who are interested in answering particular neuroscience questions rather than in producing software products that are optimized for meeting the many and varied needs of the broader research community. It is, therefore, not surprising that many of these informatics tools are not as robust, generally useful, or easy to use as they might be. And, while a handful of neuroimaging informatics tools are suitable for general use, many important tools are not widely available. Furthermore, even those that are in general use make varying assumptions, use different algorithms, or implement similar algorithms in different ways.

This Tower of Babel problem raises important concerns about compatibility between different tools; it also limits the ability of scientists to rigorously compare their findings, which is the foundation upon which progress in science is built.

Over the course of the past several years, through a variety of large and small venues, sponsored and initiated by the National Institutes of Health and others, members of the neuroimaging research community have made clear the need for informatics tools that are reliable, accurate, easy to use, and clearly documented. Members of that research community have also repeatedly expressed interest in being able to rigorously compare different tools and algorithms and improving compatibility and interoperability across tools and data. This community also wants training opportunities in neuroimaging informatics that are not currently available. Clearly, there is a need for leadership and resources to advance neuroimaging informatics tools used by researchers.

***N*euroimaging *In*formatics *T*echnology *I*nitiative (*NIfTI*)**

The Neuroimaging Informatics Technology Initiative (NIfTI) is meant to work with the tool-user and tool-developer communities to address these needs. Thus, the primary goal of NIfTI is to provide coordinated and targeted service, training, and research to speed the development and

enhance the utility of informatics tools related to neuroimaging. The National Institute of Mental Health and the National Institute of Neurological Disorders and Stroke are joint sponsors of this initiative.

The initial focus of NIfTI will be on tools that are used in fMRI. There are several reasons to focus on this area. First, a circumscribed substantive area like fMRI offers a constrained test bed for NIfTI, which represents a novel approach to addressing a community-wide problem. Second, fMRI is rapidly growing, and improvement in informatics tools will likely have broad benefits for neuroscience. Third, there are a small number of widely used informatics tools used by many in the fMRI research community, so there are greater tool-related commonalities in this area compared to other neuroimaging modalities, thusly increasing the cost/benefit ratio. If NIfTI proves useful in addressing informatics issues in the fMRI research community, it may be expanded to address similar issues in other areas of neuroimaging.

Major objectives now envisioned for NIfTI are described below, as are the principals that will guide this effort and the significance it is hoped to have for neuroimaging research.

Objectives of NIfTI

- Enhancement of existing informatics tools used widely in neuroimaging research
- Dissemination of neuroimaging informatics tools and information about them
- Community-based approaches to solving common problems, such as lack of interoperability of tools and data
- Unique training activities and research career development opportunities to those in the tool-user and tool-developer communities
- Research and development of the next generation of neuroimaging informatics tools

Operating Principles of NIfTI

- Guidance through close and ongoing communication with the tool-user and tool-developer communities
- Intellectual property rights and credit for tools to remain with original authors
- Coordination within NIfTI and across other, related, programs and activities
- Optimal mechanism to be used for each activity, drawing from both intramural and extramural resources
- Involvement of multiple Institutes at NIH

Significance of NIfTI

- More useful and useable neuroimaging informatics tools
- One-stop resource for neuroimaging informatics tools and information about them

- Environment to facilitate convergence on common solutions to widespread problems
- Maximize scientific opportunities from neuroimaging research

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
NATIONAL INSTITUTES OF HEALTH • NATIONAL INSTITUTE OF MENTAL HEALTH
NIMH National Institute of Mental Health