



Unlocking the Mysteries of the Human Brain to Improve the Diagnosis and Treatment of Neurological Diseases

The brain is one of the most intricate and powerful phenomena in the human body, enabling us to sense and experience the world around us, process immense amounts of information, make decisions and initiate action every day. Although scientists have significantly advanced our understanding of the human brain, including the discovery of its 100 billion nerve cells that form a million new connections every second, there are still many questions about how this organ develops and functions.

Brain mapping is the complicated and time-consuming process of surveying the smallest sectors of the brain. These investigations generate thousands of unique images and data files, often exceeding hundreds of megabytes in size. Despite significant research investments in leading-edge endeavors in this field, the scientific community has struggled to fully exploit the massive volumes of brain-related information. Creating an innovative data management system is the focus of a pan-Canadian team of researchers from McGill University, the University of Toronto, the University of Western Ontario, the University of British Columbia and Université de Montreal, together with collaborators such as CANARIE.

The CBRAIN (Canadian Brain Imaging Research Network) team is developing a new research platform that will provide scientists with unprecedented and immediate access to vast volumes of 3- and 4-dimensional brain imaging data that is stored or being created across the country. It promises to accelerate the mapping of the human brain, and related research discoveries in many scientific fields including psychiatry, neurology, cognitive neuroscience and human development and aging.

Leveraging the advanced networking capabilities provided by CANARIE and its regional partner RISQ (or *Réseau d'informations scientifiques du Québec*, Quebec's Scientific Information Network), the platform allows researchers to access brain related information from almost any host institution, lab or hospital. It enables the user to visualize, manipulate and exchange images of the human brain throughout the various stages of development, and during the progression of neurological disorders such as autism, Parkinson's, and Alzheimer's disease. As the platform also draws on the powerful compute capability delivered by Compute Canada, scientists can also process this data from any location.

"Each brain is unique—and we have something to learn from each one," says Dr. Alan Evans, the Principal Investigator of CBRAIN and lead researcher at the Montreal Neurological Institute. "It is essential to provide scientists with the most comprehensive collection of brain data possible to accelerate our understanding of this organ and how to combat neurological diseases." In support of this objective, the team is establishing 'BIG BRAIN', a massive 1 terabyte data set that contains more than 7,400 images (or slices) of an entire brain. Working with the CBRAIN platform, users will be able to browse and visualize 3D images at a distance to support their investigations.

The CBRAIN platform is opening up many new opportunities for research collaboration. "We are currently bringing together five labs that conduct leading-edge research on Alzheimer's disease," says Dr. Evans. "The advanced networking capability provided by CANARIE is enabling us to pool this knowledge, and seamlessly share information and expertise for clinical trials. This could help us to discover a cure for this debilitating disease."

Building on \$2.4 million from CANARIE's Network-Enabled Platforms (NEP) program in 2008, the team secured an additional \$1.8 million in NEP funding in 2009 to develop GBRAIN (Global Brain Imaging Research Network), a network that will connect brain researchers around the world.