# 'Virtual' mouse brains now available online

July 9 2007

A multi-institutional consortium including Duke University has created startlingly crisp 3-D microscopic views of tiny mouse brains -- unveiled layer by layer -- by extending the capabilities of conventional magnetic resonance imaging.

"These images can be more than 100,000 times higher resolution than a clinical MRI scan," said G. Allan Johnson, Duke's Charles E. Putman Distinguished Professor of radiology and professor of biomedical engineering and physics. He is first author of a report describing the innovations set for publication in the research journal NeuroImage. View it online at tinyurl.com/2upj7n .

Images on the website for Duke's Center for In Vivo Microscopy www.civm.duhs.duke.edu/, which Johnson directs, reveal examples of these innovations in action. In one video two different mouse brains -- one from a normal animal and the other from a rodent missing a gene linked to mental abnormalities -- seem to assemble themselves before the viewer's eyes, structure by structure.

Watch the video with Johnson at realmedia.oit.duke.edu/ramgen/ …ews/brain_imaging.rm (RealMedia) or quicktime.oit.duke.edu/news/brain_imaging.mov (Quicktime).

After building up like time-lapse photos of opening flowers, the side-by-side brain images begin revolving as overlying tissues dissolve into computer-rendered transparency. What remains visible, seemingly floating over the bases of the animals' skulls, are two color-coded brain

structures -- the ventricles and hippocampus -- showing different volumes resulting from specific genetic differences.

Under funding from the National Center for Research Resources, the new imaging technologies are being developed and shared by six institutions that form the Mouse Bioinformatics Research Network (MBIRN).

Those six schools -- Duke, the California Institute of Technology, the University of Tennessee at Memphis, the University of California at Los Angeles, Drexel College of Medicine and the University of California at San Diego -- are connected via a very high speed network with each other as well as with the San Diego Supercomputing Center.

The consortium has developed the computer infrastructure to collect a rapidly growing library of 3-D mouse brain data, and make all the data available on the web tinyurl.com/3cgj6z. The goal is to use mouse brains as surrogates for human brains to study the connections between genes and brain structure. Investigators from all over the world are sending their models to Duke where the 3-D images are acquired in a standardized fashion and made available via high speed web connections.

High resolution magnetic resonance imaging -- which the researchers call "MRI histology" provides distortion-free 3-D images with superb ability to distinguish subtle tissue differences in the brain, according to Johnson.

"The specimen is still actually in the skull," he said. "It hasn't been cut by a knife. It has not been dehydrated and distorted as it would be in conventional histological techniques."

Using computer-guided statistical methods, the data can be segmented into more than 30 anatomical structures with quantitative volume

measurements. These structures can then be computer-enhanced to produce color-coded and labeled volume renderings of selected anatomical details in 3-D, seen at any angle.

MRI scanning is also quicker and costs less than conventional histology, he said. MRI histology permits study of an entire brain, which would be prohibitively expensive using conventional methods.

The Duke center has pioneered the development of MRI microscopy to image the micro-anatomies of small biological specimens. The NeuroImage study describes the ways his group have devised to manipulate the signals to achieve varieties of contrasts and resolutions.

For instance, the technology can discriminate grey matter from the white matter within mouse brains. "We have the ability to highlight soft tissue differences with extraordinary clarity," Johnson said.

Source: Duke University