Medical Xpress

A better look at the brain

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The challenge of Dr. Mark Ellisman's life is understanding how the brain works. He wants to know how the interplay of structural, chemical, and electrical signals in and between cells of nervous tissue gives rise to behavior. To meet this challenge, he and his colleagues at the University of California, San Diego, develop methods to understand the entire brain, studying it from the whole atoms up to the whole structure. An innovative tool they've built is the Whole Brain Catalog, which is similar to Google Earth, allowing scientists to see the details and the bigger view.

"The Whole Brain Catalog is an open source, downloadable, virtual catalog of the mouse brain—from the whole brain to the molecular level," said Ellisman, a Professor of Neurosciences at UCSD.

A self-described "recovering molecular biophysicist," Ellisman gave a polished presentation about the latest tools for studying the brain at the Frontiers in Chemical Imaging Seminar Series July 26 at Pacific Northwest National Laboratory. This PNNL-hosted seminar series features academic, government, and industrial leaders discussing novel advances in imaging.

In addition to the Whole Brain Catalog, Ellisman described the use of instruments and methods including synchrotrons and microscopes, nuclear magnetic resonance, magnetic resonance imaging, and positron emission tomography. Many of these are being developed at the National Center for Microscopy and Imaging Research, which Ellisman established in 1988 at UCSD.

Having all these different instrument types is essential for examining the brain at a wide range of scales, but there's a catch. The instruments have different databases, with little or no integration or connection across the scales. The NCMIR is designed to bridge the different data sources and to make these technologies and data broadly available to researchers.

High-resolution large-scale brain imaging requires ultra-wide-field light microscopy developed by Ellisman and colleague Roger Tsien. This method can image a whole brain in the centimeter to micron range.

"We can take a 1-mm whole brain slice and zoom in on it," Ellisman said, "and keep zooming up to the diffraction limit, to the intranuclei, to the neurons in the cerebellum."

The data from the microscope are large, so they have built big projection systems on walls to see them. The data are 3D, which can be a problem, as the projection walls are generally 2D. But technology is leading to the ability to project data in 3D on personal tablets such as the iPad. Such images show how exercise and health create neurons.

Ellisman wants to go to "visual proteomics," where scientists use maps of brain cells as frameworks for organizing biological knowledge and integrate these with atlases. This could possibly lead to building a brain of visible cells, Ellisman hopes.

Provided by Pacific Northwest National Laboratory

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