

Major step taken towards an open and shared digital brain atlasing framework

Easier data sharing and integration has the potential to transform collaborative research.

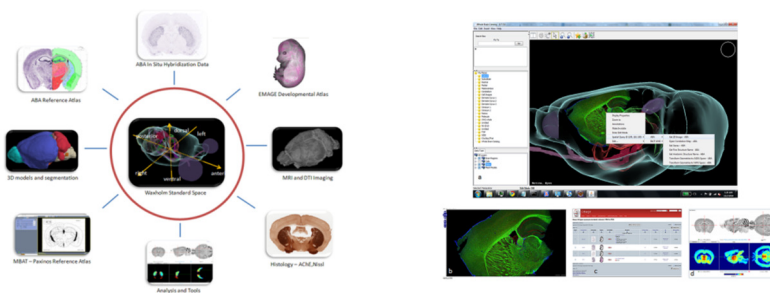
Modern brain research generates immense quantities of data across different levels of detail, from gene activity to large-scale structure, using a wide array of methods. Each method has its own type of data and is stored in different databases. Integrating findings across levels of detail and from different databases, for example to find a link between gene expression and disease, is therefore challenging and time consuming. In addition, combining data from multiple types of brain studies provides a basis for new insights and is crucial for the progress of neuroscience research. Far too often, scientific progress is hindered by technical barriers to integrating data from different experiments and laboratories.

A major step in addressing these problems, a standard toolset that allows different types of neuroscience data to be combined and compared, is now available for one of the most important subjects in experimental neuroscience: the mouse, *Mus musculus*. A paper describing the vision and key steps that led to the creation of a digital mouse brain atlasing framework for sharing data has just been published in the Public Library of Science (PLOS) Computational Biology journal. In this landmark publication, the INCF Digital Atlasing Task Force announces a digital atlasing framework which consists of Waxholm Space (WHS; named in honor of the group's first meeting location) and a supporting web-based Digital Atlasing Infrastructure (DAI). Together they enable the integration of data from genetic, anatomical and functional imaging studies.

"By enabling researchers to link genetic studies with large-scale brain structure and behavior, we will catalyze both basic and medical neuroscience research – precisely the reason INCF was founded in the first place." – Dr. Sean Hill, Executive Director, INCF.

Three major online mouse brain resources - the Allen Mouse Brain Atlas, the Edinburgh Mouse Atlas Project, and an effort from UCSD (primarily the Cell Centered Database) - are now integrated with the INCF Digital Atlasing Infrastructure and therefore working together. This interoperability will facilitate future research as well as increase the value of previously acquired data.

Images



High-resolution images can be downloaded from the [article web page](#) and are distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

WHS and DAI were developed with coordination, organization and funding from the International Neuroinformatics Coordinating Facility (INCF). They are a collaborative project, spanning more than two years, of the now retired INCF Standards in Digital Atlasing Task Force. Since then, new Task Forces have been formed to continue and expand on this work. A more detailed publication of this group's recommendations can be found in their report, published in September 2009 (see link below).

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Brief facts

- The Waxholm Space (WHS) is a virtual coordinate system that unifies 3D mouse brain data
- The Digital Atlasing Infrastructure includes web services that allow researchers to
 - Transform brain images to a standardized brain atlas
 - Relate different types of experimental data within a common reference brain
- All WHS tools and data are provided freely to the international research community
- Work to add WHS capability for the rat is actively underway in the scientific community
- Waxholm Space is named after Waxholm, Sweden, the site of the first INCF Digital Atlasing Working Group meeting, September 2008

Information resources

The Waxholm Space was developed by the INCF Standards in Digital Atlasing Task Force. A more detailed publication of this group's recommendations can be found in their report, published in September 2009. Available via the INCF Collection at Nature Precedings:

<http://precedings.nature.com/documents/4000/version/1>

The Waxholm Space framework is being built on and expanded by the current INCF Digital Atlasing Task Forces. To find more details about these groups, standards and projects, or other recent activities see:

<http://waxholm.incf.org/>

Scientific publications using WHS:

- *Digital Atlasing and Standardization in the Mouse Brain*. Hawrylycz M, Baldock RA, Burger A, Hashikawa T, Johnson GA, Martone M, Ng L, Lau C, Larsen SD, Nissanov J, Puelles L, Ruffins S, Verbeek F, Zaslavsky I, Bolin J. PLoS Comput Biol 7(2): e1001065.
<http://dx.doi.org/10.1371/journal.pcbi.1001065>
- *A symmetrical Waxholm canonical mouse brain for NeuroMaps*. Bowden DM, Johnson GA, Zaborsky L, Green WD, Moore E, Badea A, Dubach MF, Bookstein FL. J Neurosci Methods. 2011 vol. 195(2):170-5.
<http://dx.doi.org/10.1016/j.jneumeth.2010.11.028>
- *Waxholm space: an image-based reference for coordinating mouse brain research*. Johnson GA, Badea A, Brandenburg J, Cofer G, Fubara B, Liu S, Nissanov J. Neuroimage. 2010 vol. 53(2):365-72.
<http://dx.doi.org/10.1016/j.neuroimage.2010.06.067>

More information on the community resources currently integrated by WHS can be found via these web pages:

- Allen Brain Atlas: <http://mouse.brain-map.org/>
- Edinburgh Mouse Atlas Project: <http://genex.hgu.mrc.ac.uk/>
- Whole Brain Catalog: <http://wholebraincatalog.org/>

About INCF

The INCF was established in 2005 through the Global Science Forum of the OECD, to foster the sharing of data and computing resources to the international research community. INCF is leading the development of an international neuroinformatics infrastructure for clinical and neuroscientific data sharing, archiving, publishing, analysis, visualization, modeling and simulation - using grid, cloud and supercomputing infrastructures. See www.incf.org for more information.