Toward globally collaborative science: the International Neuroinformatics Coordinating Facility

Linda Lanyon
Executive Director
International Neuroinformatics Coordinating Facility
Multiomic Neuroscience Data

subcellular resolution:
- Microarrays
- Electron Microscopy
- Confocal Microscopy
- Single Cell PCR
- Protein quantification
- Magnetic bead
- Gene sequencing
- Gene silencing
- Gene over-expression
- Genetic vectors
- Two-hybrid system
- Protein separation
- Wholecell & Inside-Out Patch
- Laser micro-dissection
- Cell culture
- Fluorescence microscopy
- Cellular tracing
- Cell sorting
- In situ hybridization
- Rhodopsin vectors
- Immuno-detection amplified by T7
- Mass-spectroscopy
- Organelle transfection
- Spatial Proteomics
- Immuno-staining
- Multi Electrode Array Extracellular Recording
- Dye Imaging
- 2DE proteomics
- Tissue transfection
- Enzymatic-activity measurement

cellular resolution:
- Behavioral Studies
- Ultramicroscopy
- Magnet Resonance Diffusion Imaging
- fMRI
- EEG
- Transgenic lines

whole brain scale:
- Behavioral Studies
- Ultramicroscopy
- Magnet Resonance Diffusion Imaging
- fMRI
- EEG
- Transgenic lines

behaviors:
- Ultramicroscopy
- Magnet Resonance Diffusion Imaging
- fMRI
- EEG
- Transgenic lines
Upon this gifted age, in its dark hour,
Rains from the sky a meteoric shower
Of facts . . . they lie unquestioned, uncombined.
Wisdom enough to leech us of our ill
Is daily spun; but there exists no loom
To weave it into fabric;

Edna St. Vincent Millay, 1939
How do we bring all this data together?
A tsunami of data

February 11, 2011. Science special on issues surrounding the increasingly huge influx of research data in many fields, including neuroscience.

Science asked peer reviewers about the top three barriers to data access/sharing in their fields, and about their treatment of data:

“Even within a single institution there are no standards for storing data, so each lab, or often each fellow, uses ad hoc approaches.”

Majority of scientific research is not reproducible

All images & data from the Science data special:
http://www.sciencemag.org/site/special/data/
“Just so are these preachers and scholars holding various views blind and unseeing... In their ignorance they are by nature quarrelsome, wrangling, and disputatious, each maintaining reality is thus and thus”

- The Blind Men and the Elephant

13th century Buddhist writings
Transform Neuroscience into an eScience

- Databases
- Genomics
- Translational
- Systems Biology
- Integrative Biology
- Informatics
- Neuroscience
- Mathematical Modeling
- Supercomputer Simulation
- Visualization
- Analysis
The Global Science Forum of OECD realized the need for a concerted action for developing Neuroinformatics on the international level.

2005 INCF plans endorsed by the ministers of research of OECD.

August 1st 2005 INCF formed with 7 members including Japan and the US.
17 INCF Member Countries

Belgium  
Czech Republic  
Finland  
France  
Germany  
Italy  
India  
Japan  
The Netherlands  
Norway  
Poland  
Republic of Korea  
Sweden  
Switzerland  
United Kingdom  
United States  
Victoria (Australia)
INCF Secretariat: Stockholm, Sweden

- Founded in 2006, Hosted at the Karolinska Institute
- Coordinates all Program & Node activities
- Organizes annual Neuroinformatics congress
- Advocate, work with various sectors to promote data sharing, open access, collaboration
Current Strategic Plan 2011-15

2014 INCF 5 Year Review

Independent Review
Formation of new 5 year Strategic Plan
INCF Programs

Currently over 180 contributing Scientists!

Digital Brain Atlasing (DBA)
Coordinates and improves the impact of brain atlasing projects

Multiscale Modeling (MSM)
Improves interoperability and reproducibility of neural simulations

Ontologies of Neural Structures (PONS)
Establishes consistent naming and classification for all neural structures

Standards for Data Sharing (DASH)
Develops metadata and data standards for reproducible research

Mathew Abrams
Program Officer
Mission: to coordinate and improve the impact of brain atlasing projects, with a focus on the rodent brain

Rembrandt Bakker

Scalable Brain Atlas (SBA)
- Web-based display engine for brain atlases, imaging data, and topologies:
  - Allows client websites to show brain region-related data in 3D interactive contexts
  - Provides services to look-up brain regions, generate thumbnails, download nomenclature, and delineate data

Waxholm Space (WHS)
- Coordinate-based reference space:
  - Developed from high resolution MR and Nissl stain image stacks
  - Allows mapping and registration of neuroanatomical data in the mouse brain
  - Provides translations among other mouse brain atlases

Digital Atlasing Infrastructure (DAI)
- Web service architecture for atlas interoperability:
  - Developed to support the WHS
  - Transforms images from their own data format to that of a collaborator
  - Allows the simultaneous integration of different types of data

www.incf.org/about/programs/atlasing
Oversight Chair: Rob Williams, U Tennessee

Ilya Zaslavsky
Mission: To establish consistent naming and classification for all neural structures

Key products

- Neuron Registry
- Neurolex Wiki
- Pan Mammalian reference structures
- Waxholm Space (WHS) delineations and definitions
- Common Upper Mammalian Brain Ontology (CUMBO)

www.incf.org/about/programs/pons
Chair: Maryann Martone, UCSD, USA
Community-Based Neuroscience Encyclopedia

- semantic annotation
- multimedia environment
- encourage maintenance of ontologies and vocabulary
- integrates data, models and literature
- assisted curation
- community definition
- assisted data mining
- common web API to ontology queries
DataSpace
- Serves as a “Drop Box” for data and models
- Contents may be Public or Private

“LabSpace”
- Serves as a Private “QC” space for labs
- Data is curated and Semantically annotated

KnowledgeSpace
- Public space that contains a lexicon, as well as data and models from DataSpace and LabSpace
- Allows community contributions
- Content exportable as RDF
Mission: to develop metadata and data standards for reproducible research; to develop standards for archiving, storing, sharing, and re-using neuroscience data and databases.
TF leads: Thomas Wachtler, Fritz Sommers

Electrophysiology Task Force
Focuses on electrophysiological data and databases

- Use cases for handling and converting electrophysiology metadata
- Web page on tools for converting between data formats
- Further development of Neuroshare API
- Continued engagement of industry vendors

TF leads: David Kennedy, JB Poline

Neuroimaging Task Force
Focuses on neuroimaging data and databases of neurological/psychiatric disorders and cognitive function

- One-Click share tool
- Standard description of neuroimaging data, metadata & common API
- Standard data formats
- Standard workflows and provenance tracking

www.incf.org/about/programs/datasharing
(INCF gratefully acknowledges the work of Colin Ingram as chair 2010-13)
Mission: to improve interoperability and reproducibility of neural simulations

Descriptions of Neural Models: Network Interchange format for NEuroscience (NineML), NeuroML

Connection Set Algebra (CSA)  Multi-Simulation Coordinator (MUSIC)  Computational Neuroscience Ontology (CNO)

Lead: Yann Le Franc, Paris

Lead: Mikael Djurfeldt, INCF & KTH, Sweden

Oversight Chair to 2014: Erik De Schutter, Okinawa Institute

Oversight Chair from 2014: Andrew Davison, CRNS, France
Mission: to improve interoperability and reproducibility of neural simulations

Oversight Chair: Andrew Davison, CRNS, France

2014:

- INCF 5 Year Review; new strategic plan for INCF in formation
- Engagement of communities
- Consultation on new directions
Clinical Neuroinformatics
International collaboration on traumatic brain injury

- Better characterise TBI
- Identify the most effective clinical interventions

CENTER-TBI

- Large-scale international study
- 7 year study
- > 5,000 patients
- €30 million FP7 funding
- Integration with existing databases and biobanks
- Open-source database
- International standardization of CDEs
- NIH, FDA, CDISC

Compatibility with FITBIR

US
CANADA
AUSTRALIA
RUSSIA
CHINA

Andrew Maas, David Menon
• 60 centers, 20 EU countries
• 5400 patients
• INCF role:
  – Data collection standards (CDEs)
  – Open standards-based informatics platform
  – Facilitate development of novel big data analytics techniques for clinical data
• Data repositories:
INCF Infrastructural Vision
Keynote speakers: Margarita Behrens
Dmitri (Mitya) Chklovskii
Daniel Choquet
Ila Fiete
Michael Milham
Felix Schürmann
INCF Video