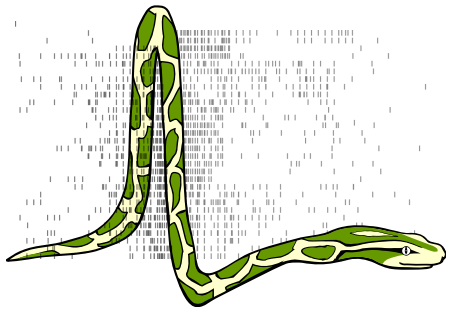
Python in Electrophysiology



Find the community @ http://neuralensemble.org

Data I/O

Neuroshare Tools

neuroshare

http://g-node.org/neuroshare-tools

Neuroshare is a standardized API for accessing neurophysiology data stored in vendor-specific binary formats in a vendor-neutral way.

- High-level Python library to access Neuroshare compatible data-files
- Automatically detects file types and loads the corresponding vendor library
- Support for GNU/Linux, MacOS X, and Windows
- Neuroshare-WineProxy enables the use of vendor libraries for Windows under GNU/Linux and MacOS X
- Comes with a tool to convert any data file supported by Neuroshare to the HDF5 format

Neo

http://packages.python.org/neo

Neo provides a common model for representing electrophysiology data in Python. It provides I/O for reading a wide range of neurophysiology file formats (Spike2, NeuroExplorer, AlphaOmega, Axon, Blackrock, Plexon, Tdt) and for writing to a subset of these formats plus non-proprietary formats including HDF5.
Neo implements a hierarchical data model well-adapted to intracellular and extracellular electrophysiology and EEG data with support for multi-electrodes (e.g., tetrodes). Neo's data objects build on the quantities package, which in turn builds on NumPy by adding support for physical dimensions. Thus Neo objects behave like normal NumPy arrays but with additional metadata, checks for dimensional consistency and automatic unit conversion.

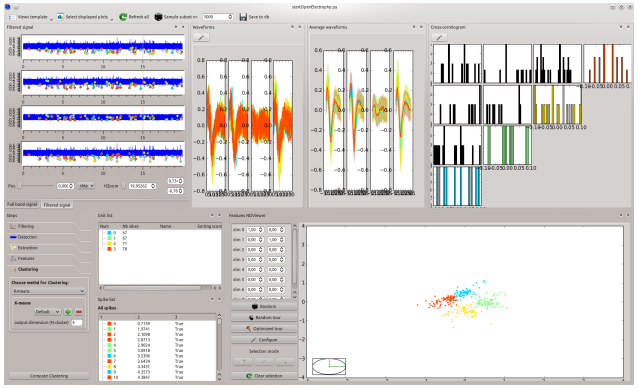
A project with similar aims but for neuroimaging file formats is NiBabel.

OpenElectrophy

http://packages.python.org/OpenElectrophy

OpenElectrophy is build on top of neo. It provides

- Powerful GUI
- Collection of methods for spike sorting
- Wavelet method for LFP transient oscillations analysis
- Customisable database to organize datasets



Data Management

G-Node Data API Python Client

http://g-node.github.com

G-Node provides a free cloud-based service neuroscientists can use for storage, management and sharing of data (https://portal.g-node.org/data/). An API for data access is provided (http://g-node.github.com/g-node-portal/), allowing developers to code their own clients. A client for Python is currently under development:

- Compatibility with NEO
- Smart lazy loading and caching for frugal bandwidth and memory usage
- Possibility to work in a mixed workflow: work on the same data in Python and MATLAB®

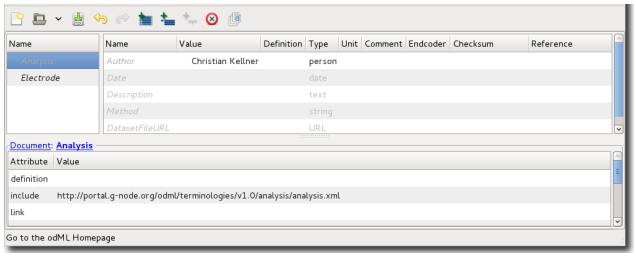
Metadata Management

odML libraries & Editor

http://www.g-node.org/odml/

Use the open metadata Markup Language to annotate data with information about the stimulus, data acquisition, and experimental conditions.

- Developer friendly libraries for Python and Java
- Fully functional graphical editor for Linux, Windows, and MacOS X



Grewe J, Wachtler T, Benda J (2011) A bottom-up approach to data annotation in neurophysiology. Front. Neuroinform. 5:16. doi: 10.3389/fninf.2011.00016

Simulation Tools

LFPy

http://compneuro.umb.no/LFPy

LFPy is a Python module for simulation of extracellular electrical potentials evoked by activity of multi-compartment model neurons.
LFPy provides:

- A forward modeling scheme for calculating extracellular potentials from compartmental membrane currents in an infinite homogeneous linear extracellular medium
- Scripting capabilities thanks to NEURON and the Python programming environment
- Simultaneous simulation of the model cell responses and extracellular potentials based on a biophysically detailed neuronal model
- Support for common formats for reconstructed neuronal morphologies, allowing use of publicly available 3D-reconstructions (*e.g.*, http://www.neuromorpho.org).

Analysis

MNE-Python

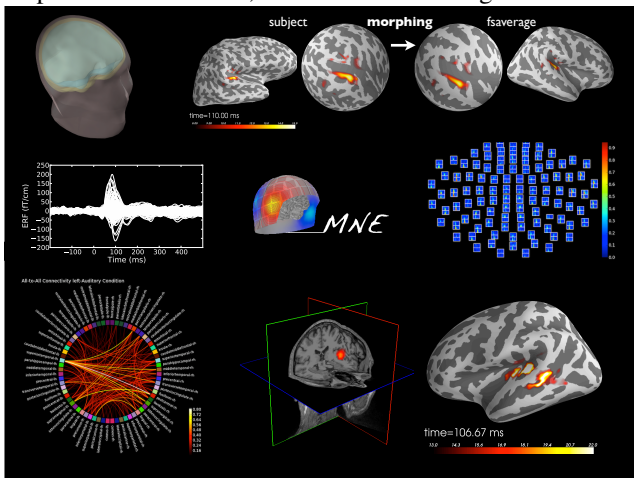
http://www.martinos.org/mne

MNE is a software package for processing magnetoencephalography (MEG) and electroencephalography (EEG) data. (http://www.martinos.org/mne)

- Data conditioning and data conversion utilities
- Interactive and batch-mode modules for the forward and inverse calculations
- Cortically-constrained source estimates
- Associated dynamic statistical parametric maps, option-

ally constrained by fMRI

- Frequency-domain and time-frequency analyses, non-parametric statistics, multivariate decoding



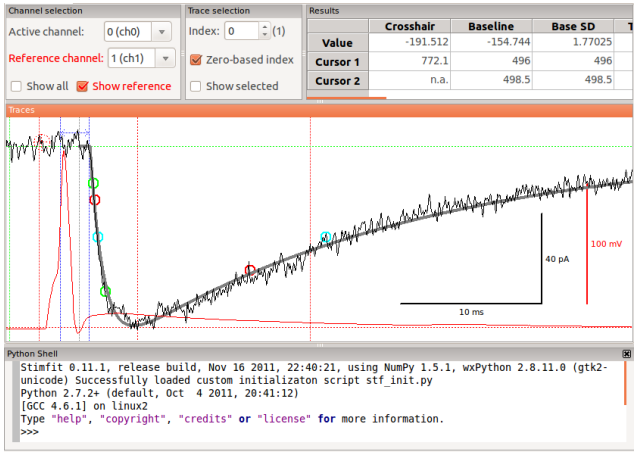
A. Gramfort, *et. al.* MNE software for processing MEG and EEG data, NeuroImage, Volume 86, 1 February 2014, Pages 446-460, ISSN 1053-8119, http://dx.doi.org/10.1016/j.neuroimage.2013.10.027

Stimfit

http://www.stimfit.org

Visualize and quantify electrophysiological data.

- With a focus on patch-clamp recordings
- Supports most standard patch-clamp file types
- Embedded Python shell
- Measures action potential, EPSC and EPSP kinetics
- Extracts spontaneous and evoked events
- Successfully used in many publications for >5 years

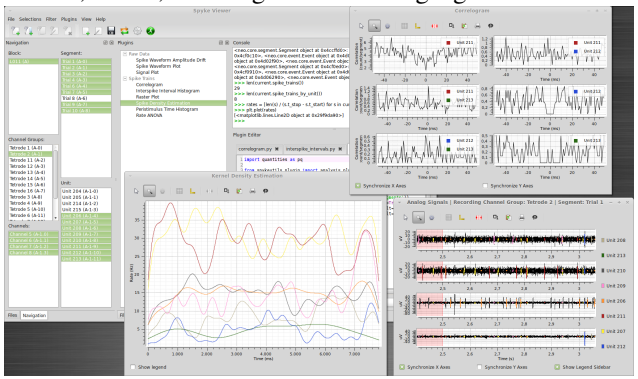


Spyke Viewer

http://spyke-viewer.readthedocs.org

Navigate, visualize and analyze electrophysiological data. Designed to be flexible and extensible.

- Based on Neo for easy data and algorithm sharing
- Flexible: Work with selected data using the embedded Python console
- Easily extensible: Create useful plugins in minutes
- Use supplied plugins for common plots such as Raster Plot, PSTH, Correlogram and analog signals

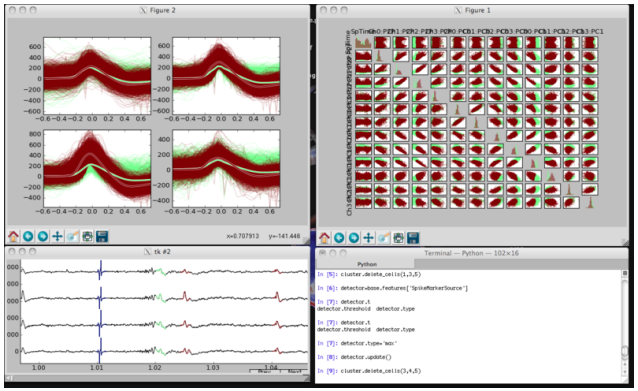


SpikeSort

http://spikesort.org

SpikeSort is a flexible spike sorting framework implemented completely in Python. It features manual and automatic clustering, many data formats and it is memory-efficient. Truely Open Source, BSD-licensed.

- Interactive command-line interface in Python
- GUI and visualization widgets
- Support for multi-channel data



Data Acquisition

ACQ4

http://acq4.org

ACQ4 is a complete software system for data acquisition and analysis in neurophysiology research. It is currently used for patch clamp electrophysiology, multiphoton imaging, photostimulation mapping, calcium imaging, and intrinsic imaging.

- Easy to design protocols synchronizing multiple devices
- Live camera viewing for patching and online analysis of calcium imaging
- Modular and scalable design – easy to expand support for new hardware and experiments
- Integrated data manager for hierarchical data storage with annotations and other metadata