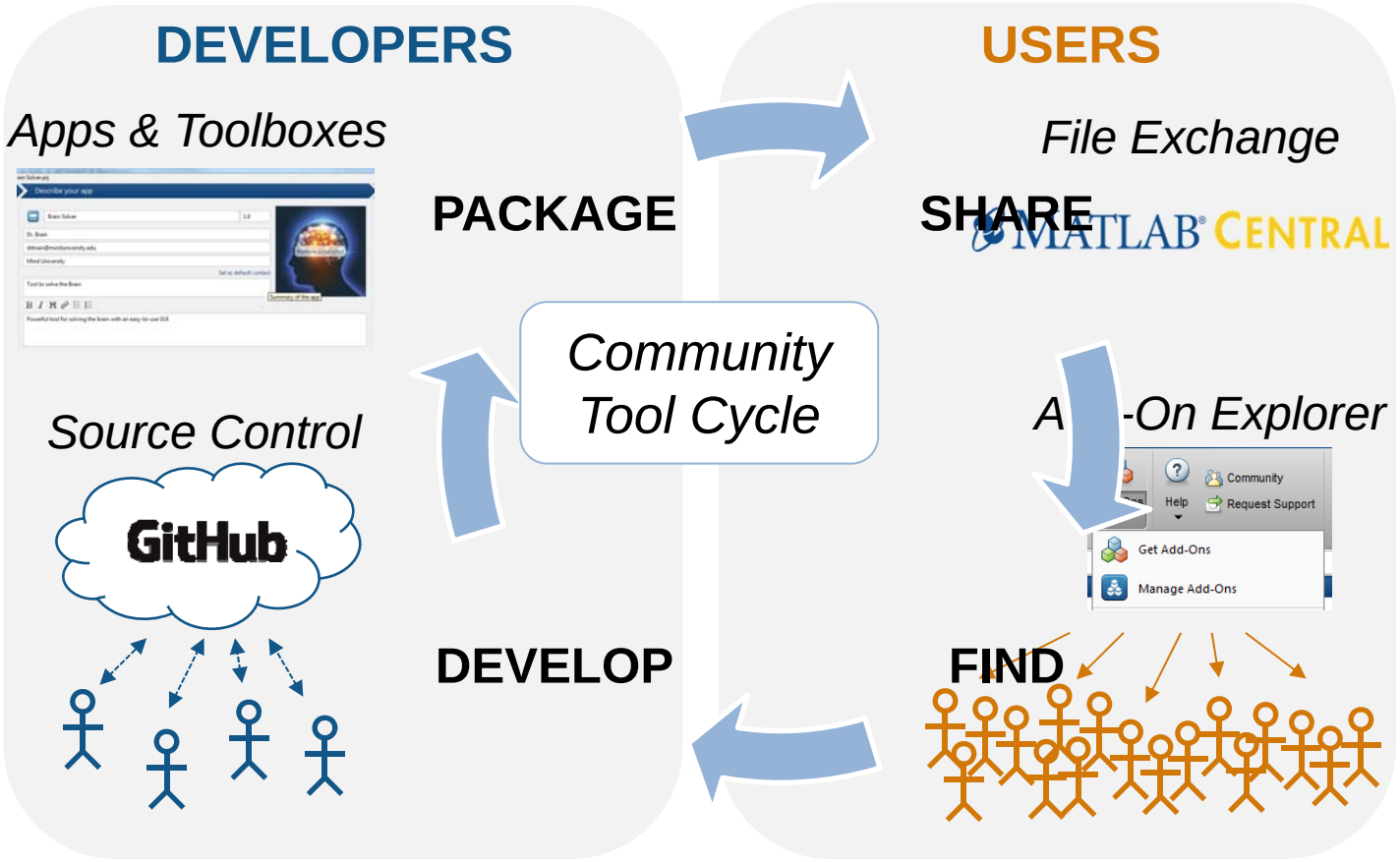
MathWorks

Community Tools for Neuroscience

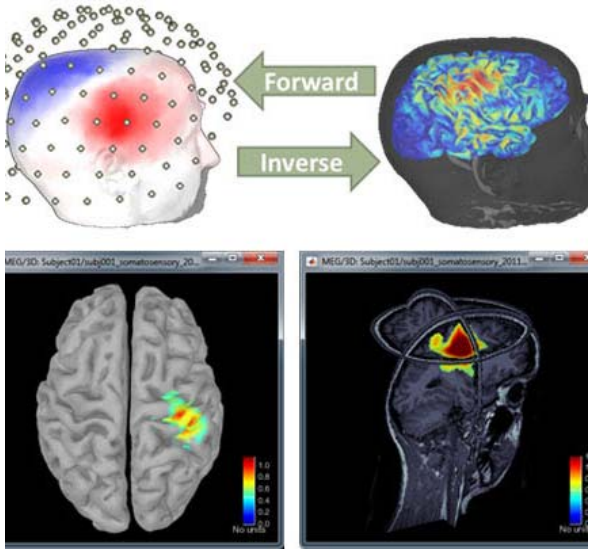
Developers and users collaborate with MATLAB



MathWorks

BrainStorm

Analysis and visualization of high-speed EEG/MEG data



Uses MATLAB:

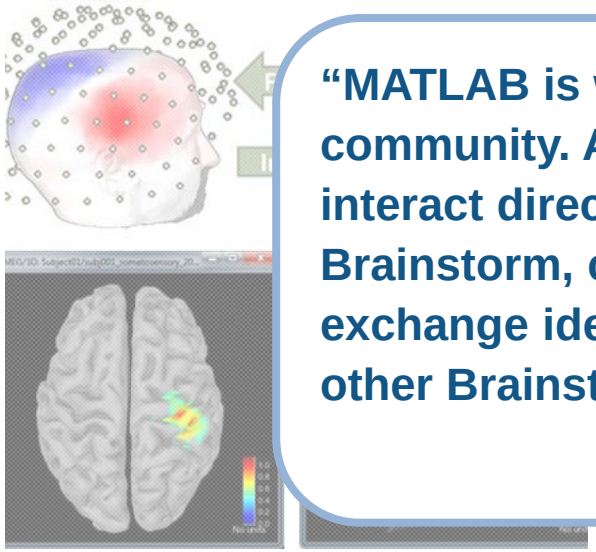
- To coregister EEG/MEG data with MRI head volume data
- To filter and interactively preprocess physiology data
- To reconstruct brain activity from measured data using boundary element & inverse modeling approaches

http://neuroimage.usc.edu/brainstorm/

MathWorks

BrainStorm

Analysis and visualization of high-speed EEG/MEG data



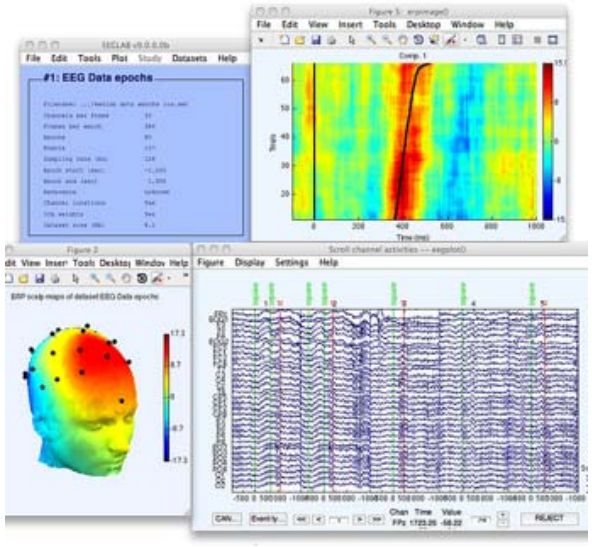
"MATLAB is widely used in the scientific community. As a result, researchers can interact directly with their data using Brainstorm, contribute new plug-ins, and exchange ideas and code prototypes with other Brainstorm users."

-the BrainStorm team

http://neuroimage.usc.edu/brainstorm/

EEGLAB

Signal processing high-density electrophys data (EEG/MEG)



Uses MATLAB:

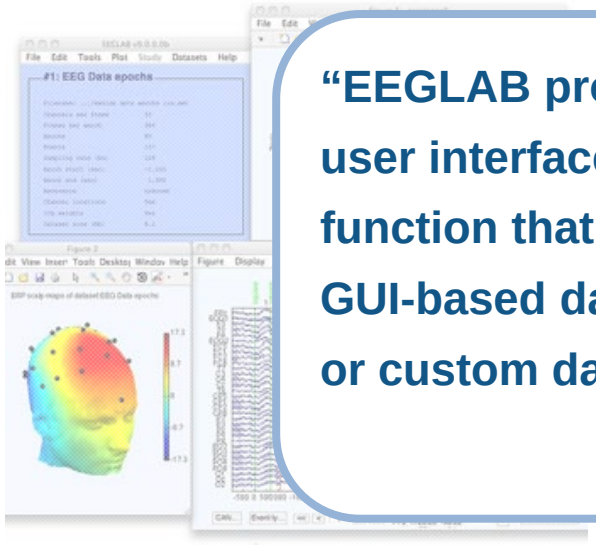
- To apply independent component analysis (ICA) and time-frequency analysis (TFA)
- To develop batch workflows for whole study analysis
- To support its worldwide community of users and wide range of plug-ins

http://sccn.ucsd.edu/eeglab/

MathWorks

EEGLAB

Signal processing high-density electrophys data (EEG/MEG)



"EEGLAB provides an interactive graphic user interface (GUI)…plus a command history function that eases users' transition from GUI-based data exploration to…running batch or custom data analysis scripts."

-the EEGLAB team

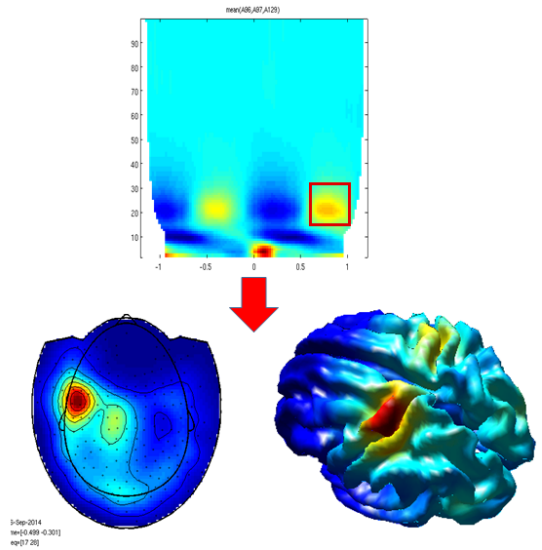
http://sccn.ucsd.edu/eeglab/

MathWorks

MathWorks

FieldTrip

Spatiotemporal analysis for electrophysiology data



Uses MATLAB:

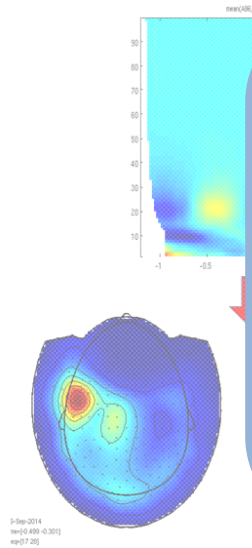
- To support most common EEG, MEG, and intracranial data formats
- To provide a large set of algorithms for user analysis
- To implement tools for source reconstruction and connectivity analysis

http://www.fieldtriptoolbox.org

MathWorks

FieldTrip

Spatiotemporal analysis for electrophysiology data



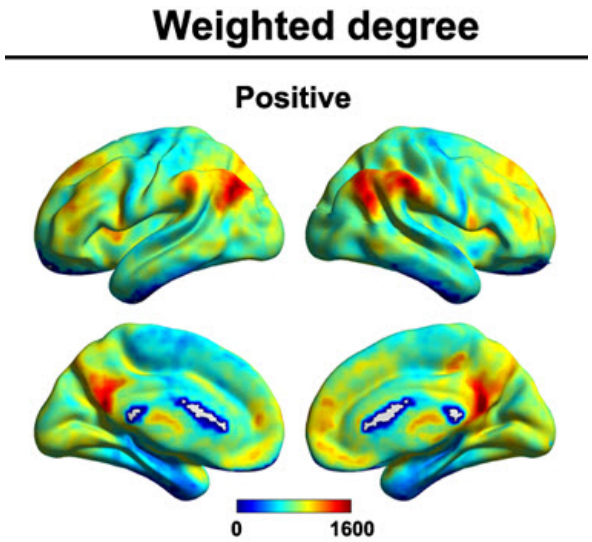
“When you are using the FieldTrip toolbox, your analysis protocol is the MATLAB script…The set of scripts you make in analyzing your data defines all the steps that you are taking during the analysis.”

-the FieldTrip team

http://www.fieldtriptoolbox.org

GRETNA

Graph network analysis for imaging connectomics



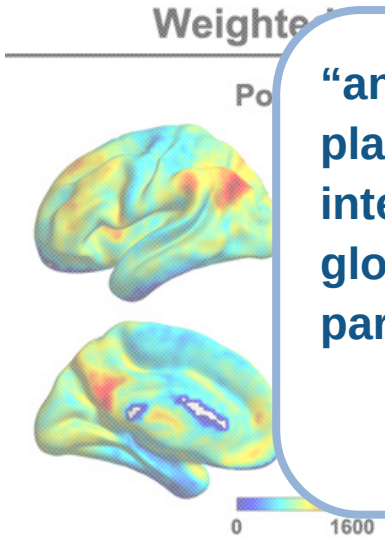
Uses MATLAB:

- For imaging connectomics, including from human resting-state fMRI (R-fMRI) data
- To flexibly manipulate network construction and analysis
- For statistical comparison of global, nodal, & connectional network metrics

http://www.nitrc.org/projects/gretna/

GRETNA

Graph network analysis for imaging connectomics



"an open-source, Matlab-based, cross-platform package with a graphical user interface…allowing topological analysis of global and local network properties with parallel computing ability"

-publication about GRETNA

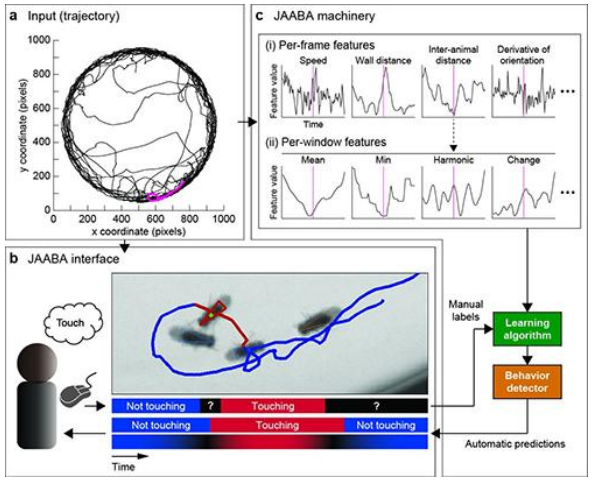
Wang, J, *et al*; *Front Human Neurosci.* 2015

http://www.nitrc.org/projects/gretna/

MathWorks

JAABA

Automated animal behavior analysis via machine-learning



Uses MATLAB:

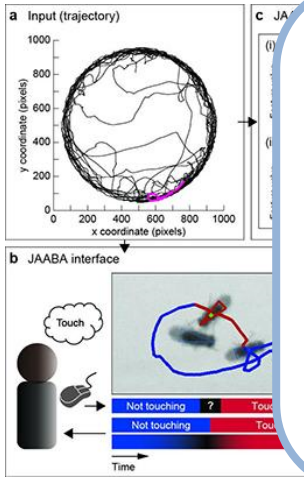
- To quantify individual and social animal behaviors
- To interactively annotate specific behaviors on small training data sets
- To automatically classify behaviors on large screen-scale data sets

https://www.janelia.org/open-science/jaaba

MathWorks

JAABA

Automated animal behavior analysis via machine-learning



"Through our interactive system, users encode their intuition about behavior by annotating a small set of video frames. These manual labels are converted into classifiers…"

-publication about JAABA

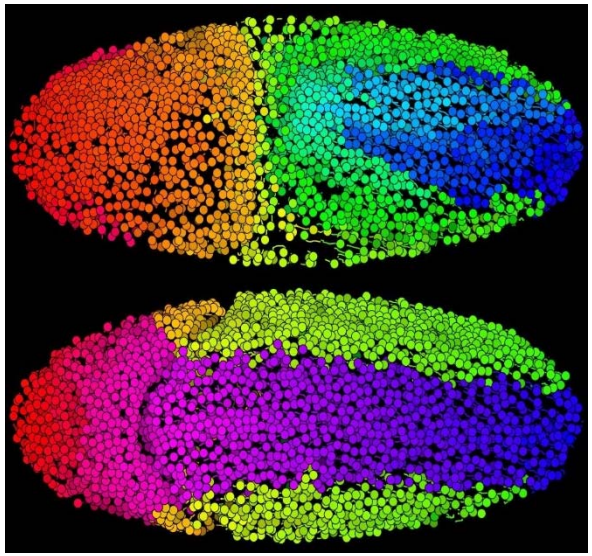
Kabra, M *et al*; *Nature Methods 2013*

https://www.janelia.org/open-science/jaaba

MathWorks

Light Sheet Microscopy Workflow

Manage, process, and analyze large scale image data



Amat *et al; Nature Methods* 2014

Uses MATLAB:

- To process tens of terabytes of multi-dimensional data
- For high-speed multicore CPU image compression
- To register and fuse time-lapse, multi-view data

https://www.janelia.org/lab/keller-lab/software

MathWorks

Light Sheet Microscopy Workflow

Manage, process, and analyze large scale image data

Amat *et al; Nature Methods* 2014

“Efficient processing and analysis of large-scale light-sheet microscopy data”

-publication describing tool

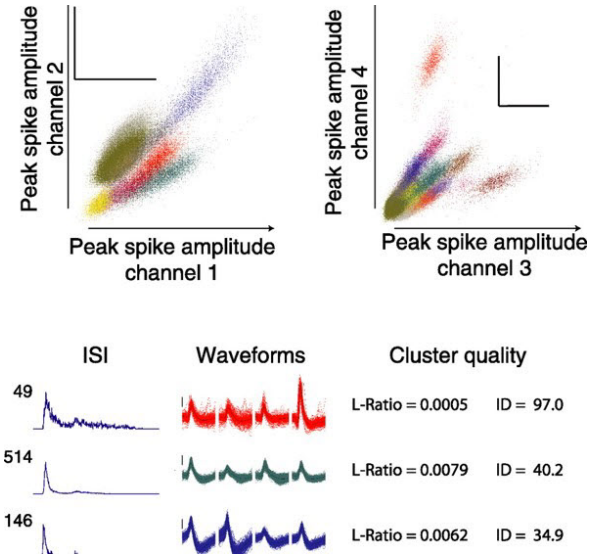
Amat, F *et al*; *Nature Protocols* 2015

https://www.janelia.org/lab/keller-lab/software

MathWorks

MClust

Clustering spikes from tetrode recordings



Jadin C. Jackson *et al*; *J. Neurosci.* 2006

Uses MATLAB:

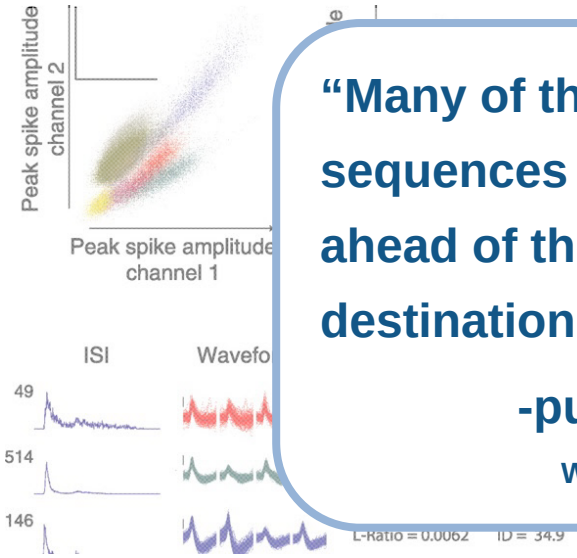
- For semi-automated or manual clustering of single-electrode, stereotrode, and tetrode recordings
- To separate out single neuron spike trains from multiple cells

http://redishlab.neuroscience.umn.edu/MClust/MClust.html

MathWorks

MClust

Clustering spikes from tetrode recordings



"Many of these [hippocampal theta] sequences contained spikes from cells ahead of the rat's location, near its goal destination."

-publication using MClust software

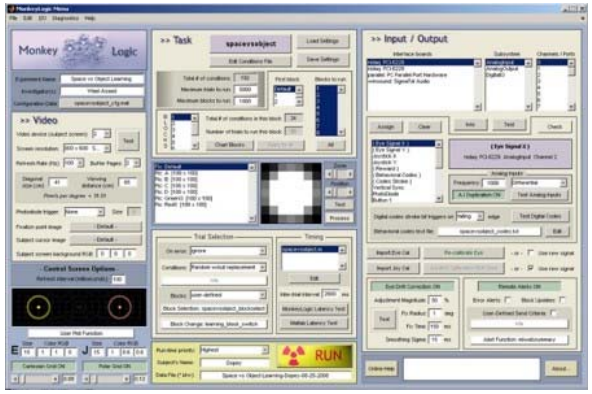
Wikenheiser, AM & Redish, AD; *Nature Neurosci.* 2015

http://redishlab.neuroscience.umn.edu/MClust/MClust.html

MathWorks

MonkeyLogic

Psychophysical task execution at high temporal precision



Uses MATLAB:

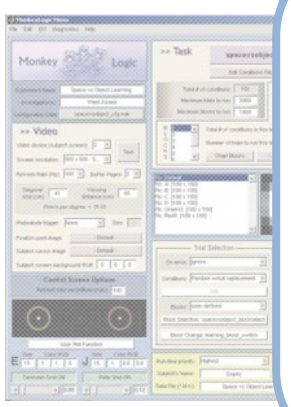
- To simultaneously track behavior and present movie stimuli
- Storing and viewing event-based behavioral data
- To control behavioral task flows based on subject performance

http://www.monkeylogic.net

MathWorks

MonkeyLogic

Psychophysical task execution at high temporal precision



“running in a non-real-time operating system, high performance can nevertheless be achieved…on modern, multi-core machines”

-authors of MonkeyLogic

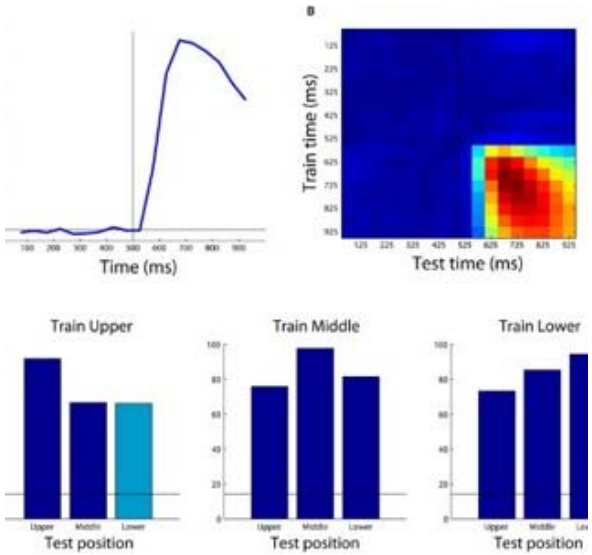
http://www.monkeylogic.net

MathWorks

MathWorks

Neural Decoding Toolbox

Population decoding analysis of neural activity



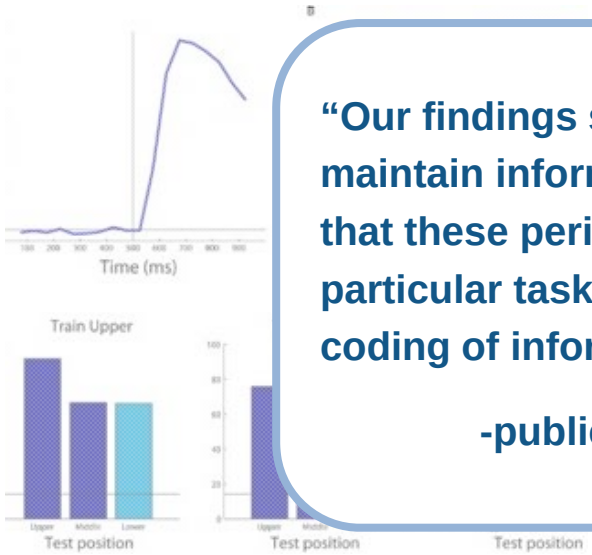
Uses MATLAB:

- To predict experimental conditions from neural data using machine learning
- To examine neural representations of abstract information
- To compare neural representations across time

http://www.readout.info

Neural Decoding Toolbox

Population decoding analysis of neural activity



“Our findings suggest that neurons in ITC and PFC maintain information in their mean firing rates…and that these periods of selectivity are time-locked to particular task events … giving rise to a dynamic coding of information at the population level.”

-publication using Neural Decoding Toolbox

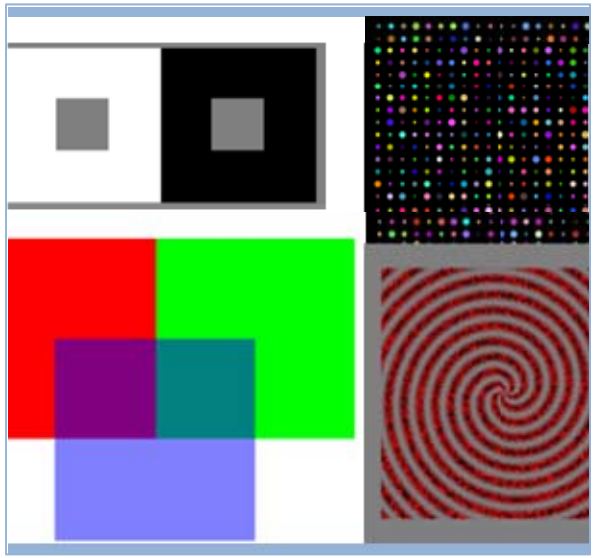
http://www.readout.info

MathWorks

MathWorks

Psychophysics Toolbox

Visual and auditory stimuli for human or animal observers



Uses MATLAB:

- To synthesize precise stimuli
- To present stimuli on computer display and audio hardware
- To achieve low latency and sub-millisecond timing

http://psychtoolbox.org/

Psychophysics Toolbox

Visual and auditory stimuli for human or animal observers

"Even for experienced programmers, three features of MATLAB greatly speed the development cycle over other languages...a rich library of high level functions…operates on arrays and images…and it is interactive"

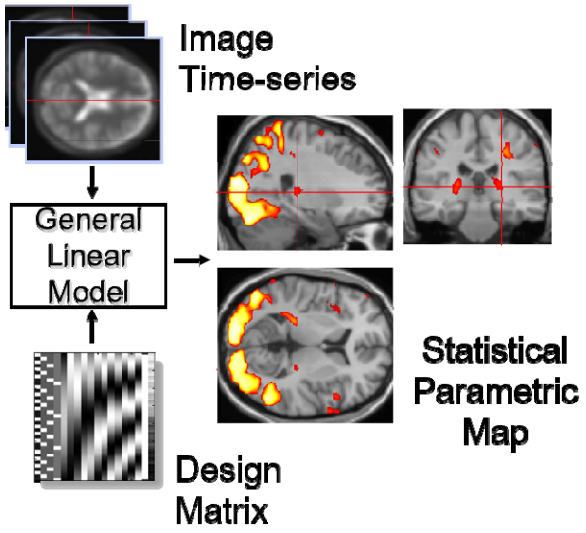
-the PTB team

http://psychtoolbox.org/

MathWorks

SPM (Statistical Parametric Modeling)

Analysis of functional brain imaging data sequences



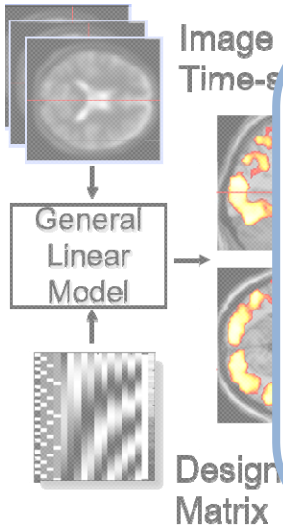
Uses MATLAB:

- To analyze fMRI/PET/MEG/ EEG/SPECT image data sets
- To study single-subject time series or cohort image series
- To test functional imaging hypotheses using statistical parametric approaches

http://www.fil.ion.ucl.ac.uk/spm

SPM (Statistical Parametric Modeling)

Analysis of functional brain imaging data sequences



"Only with the first neuroimaging evidence for things like colour and motion specific processing did the notion of functional specialization become fact…Neuroimaging has fundamentally re-framed most aspects of neuroscience and in particular cognitive neuroscience."

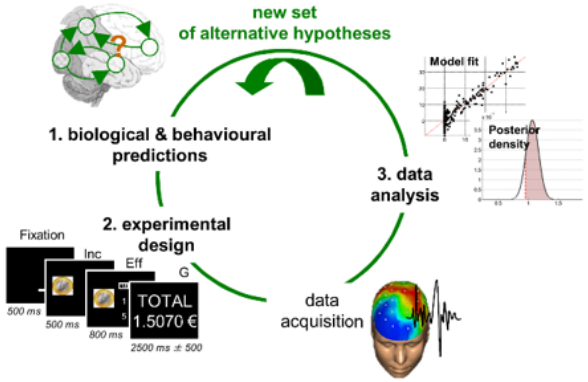
-from "A Short History of SPM"

http://www.fil.ion.ucl.ac.uk/spm

MathWorks

VBA Toolbox

Bayesian model-based analysis of neural & behavioral data



Uses MATLAB:

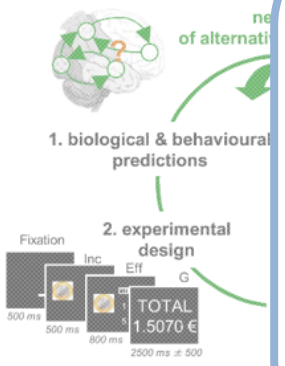
- For efficient and robust parameter estimation on nonlinear models
- For quantitative diagnostics of model fitting
- To optimize experimental designs for model-based analysis

http://mbb-team.github.io/VBA-toolbox/wiki/

MathWorks

VBA Toolbox

Bayesian model-based analysis of neural & behavioral data



"sophisticated statistical approaches…[that] act as a 'mathematical microscope' that is capable of unravelling mechanisms...hidden deep within experimental data."

-authors of VBA Toolbox

Daunizeau, J., Adam, V., & Rigoux, L.; *PLOS Comp. Bio.* 2014

http://mbb-team.github.io/VBA-toolbox/wiki/

MathWorks