



دانشگاه تهران
دانشکده روانشناسی و علوم تربیتی



MATLAB for Brain and Cognitive Psychology (Signal processing)

Presented by:

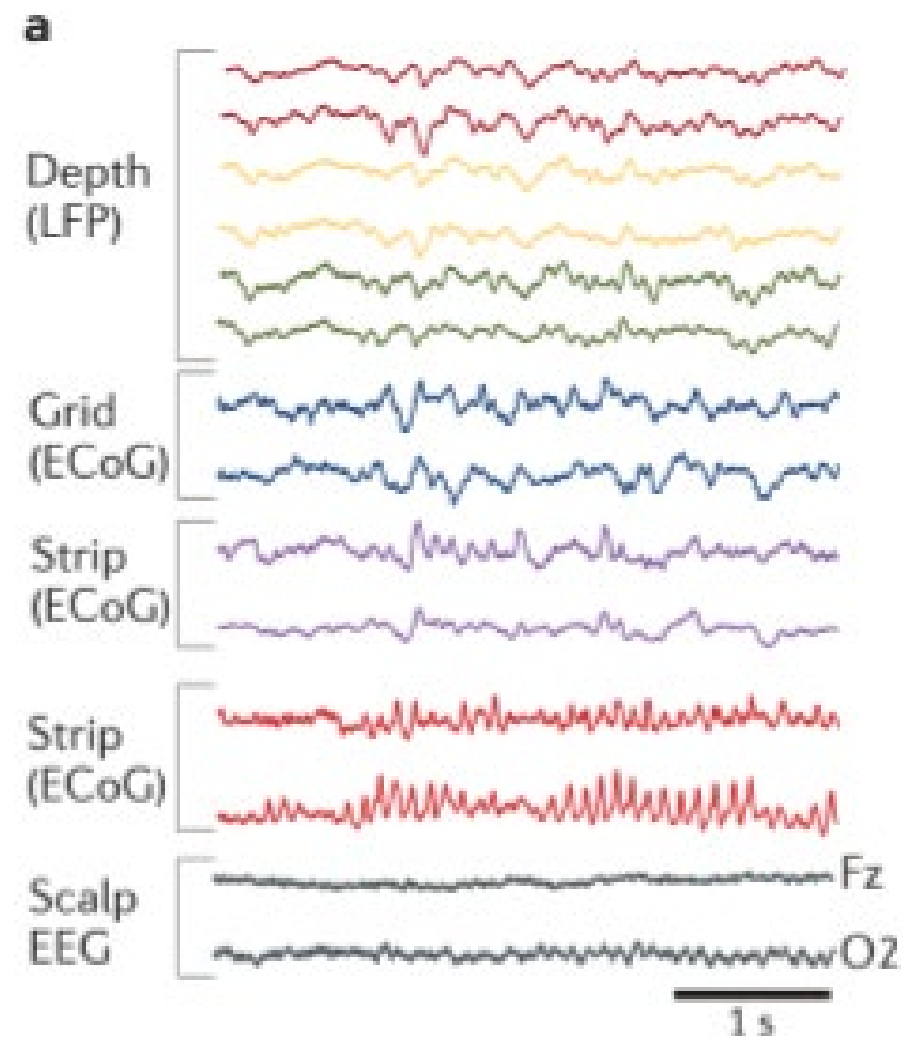
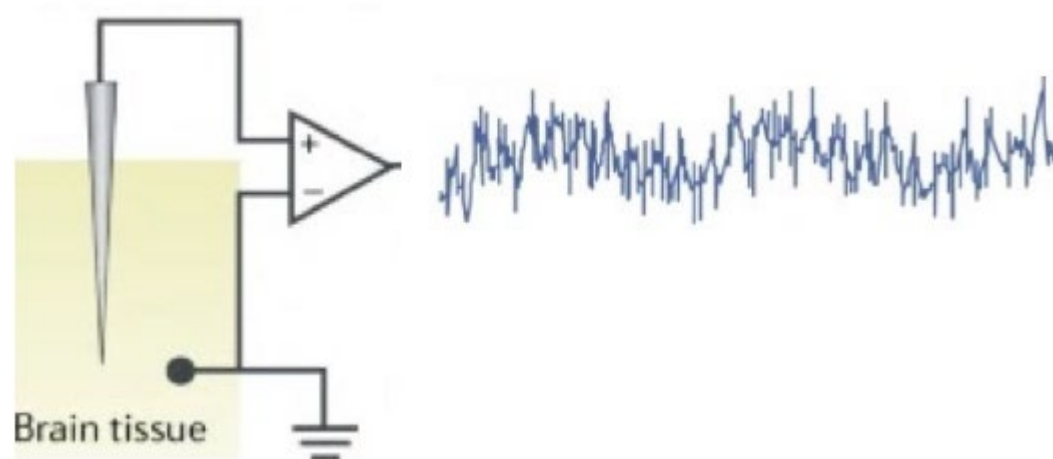
Ehsan Rezayat, Ph.D.

Faculty of Psychology and Education, University of Tehran.

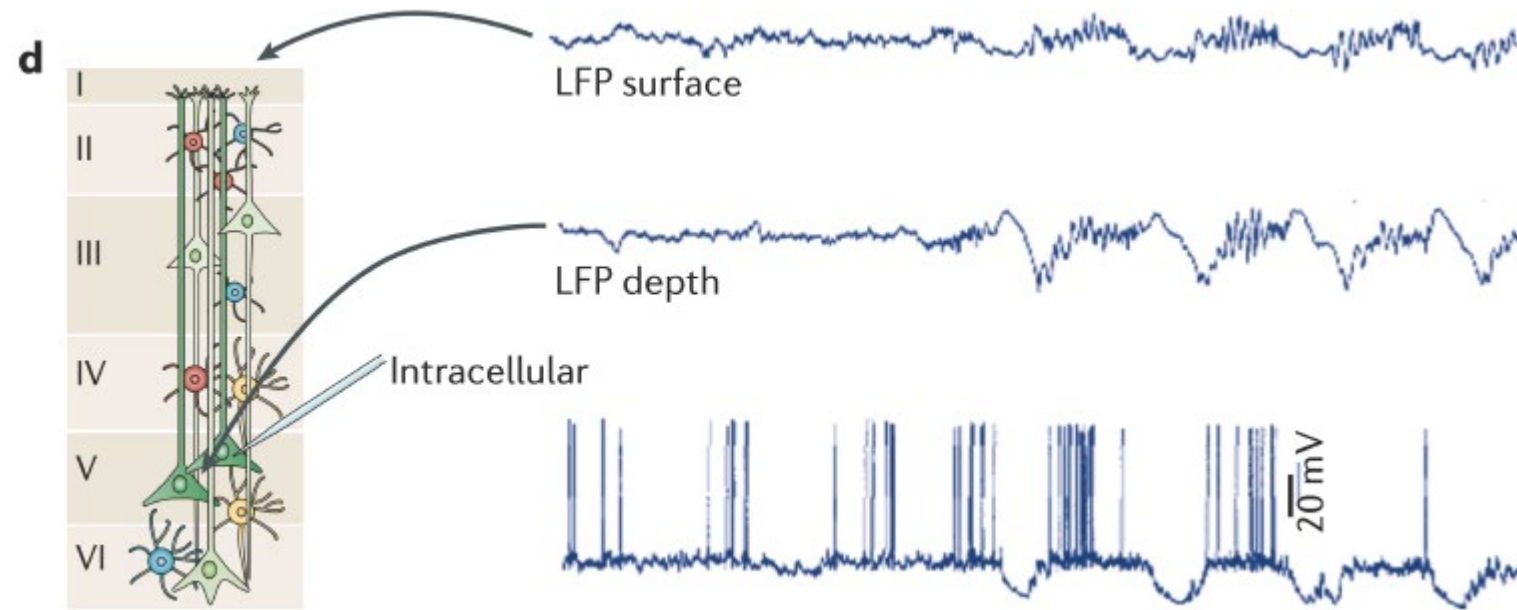
Institute for Research in Fundamental Sciences (IPM), School of Cognitive Sciences,

emails: rezayat@ut.ac.ir, rezayat@ipm.ir, erezayat.er@gmail.com

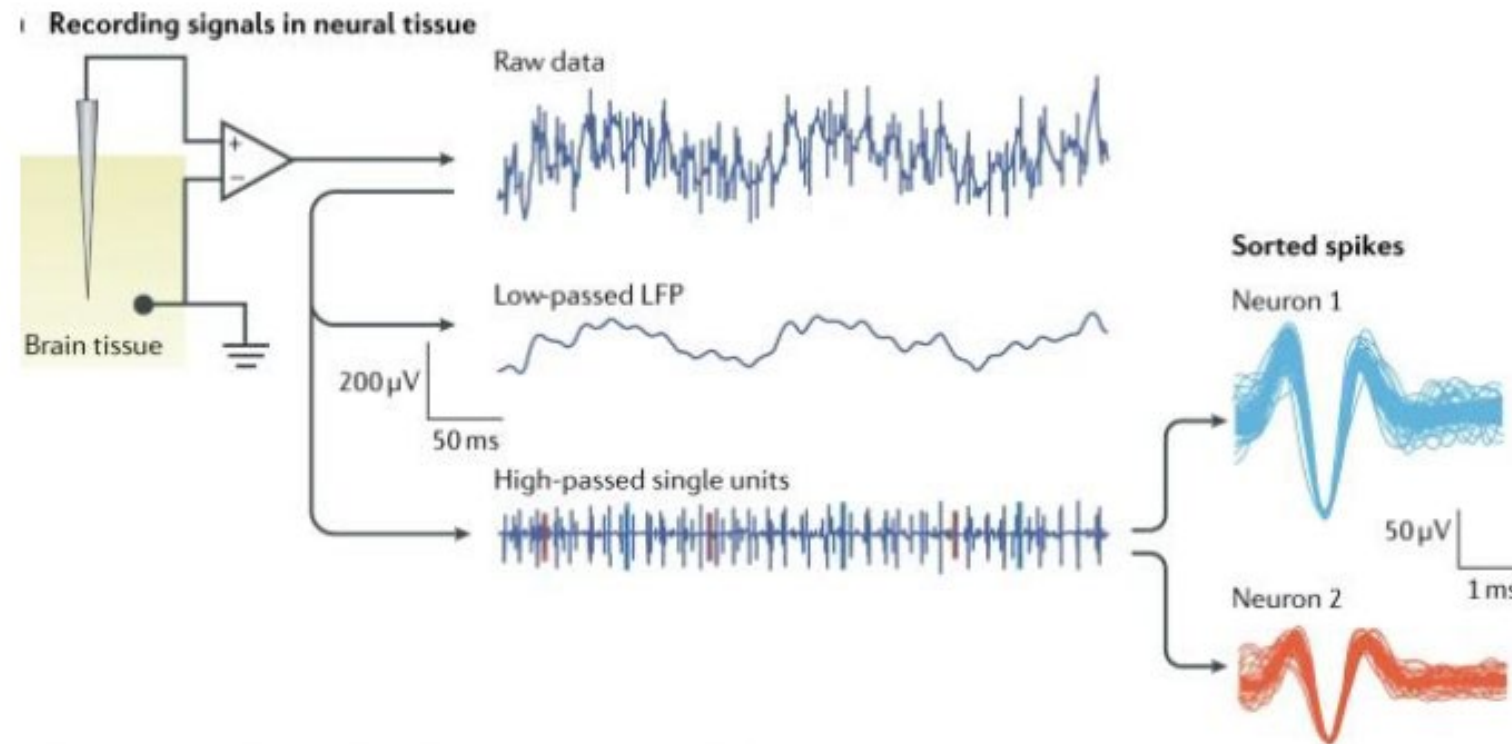
The neural data

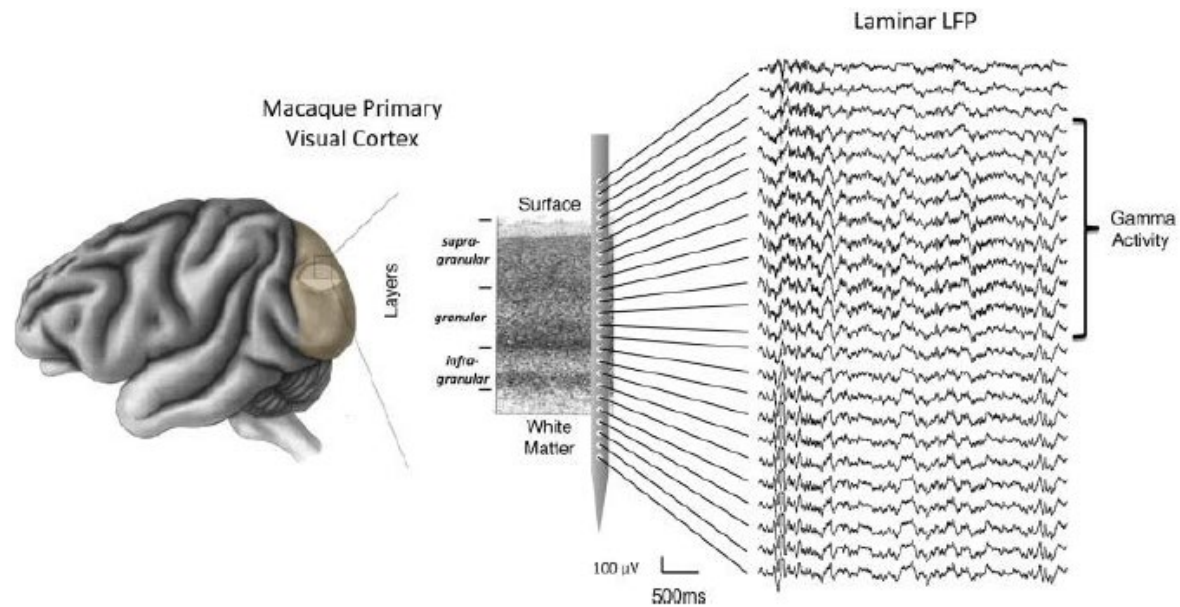
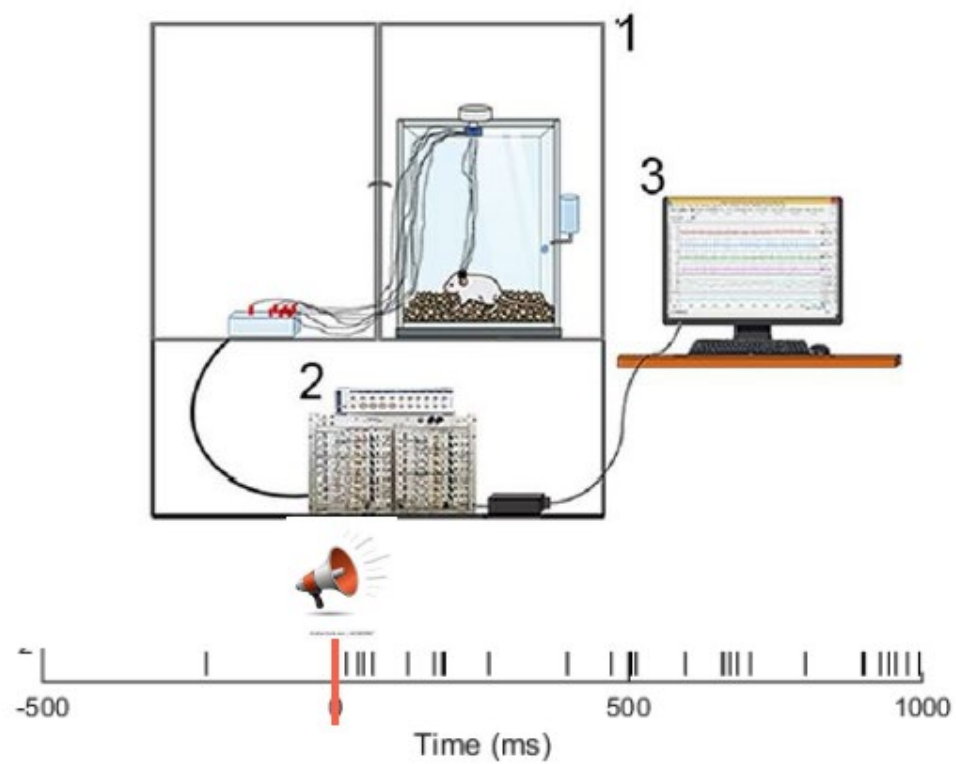


Neural data components

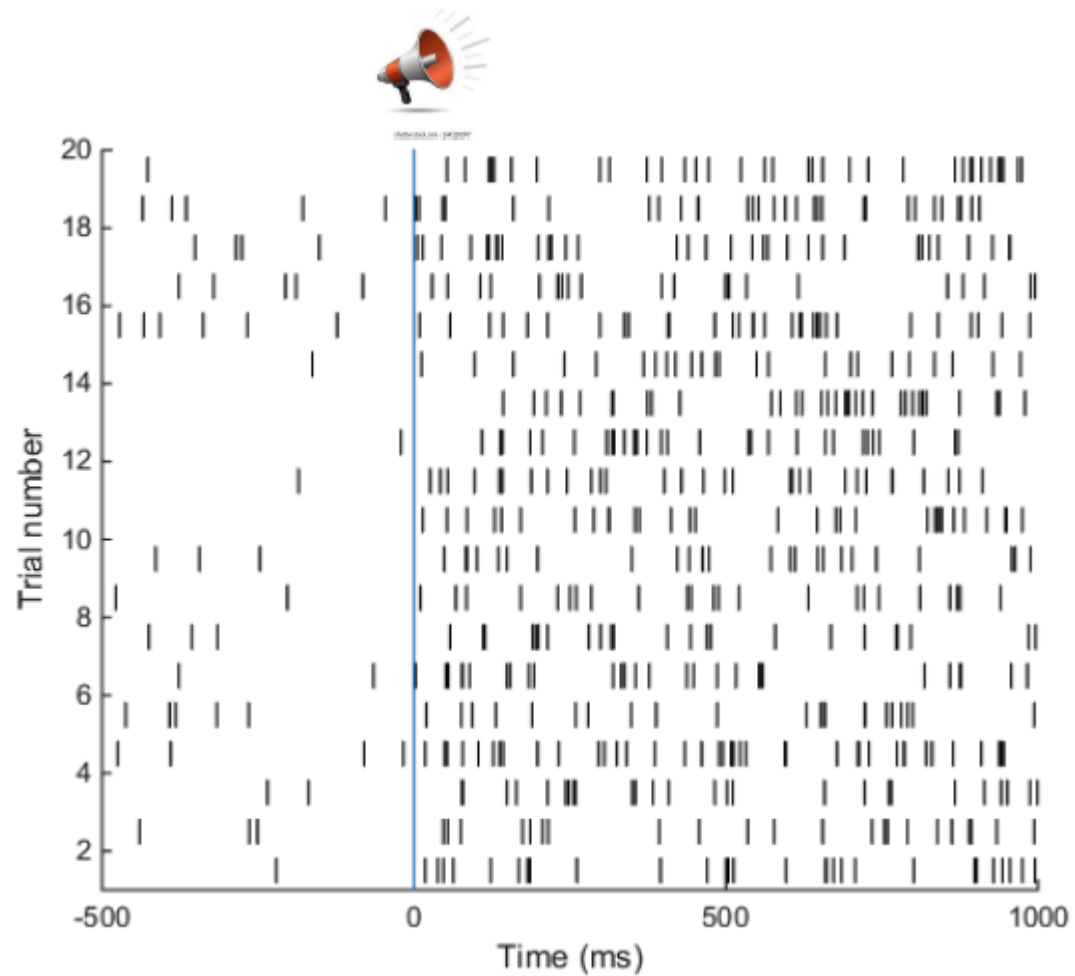


Neural data components

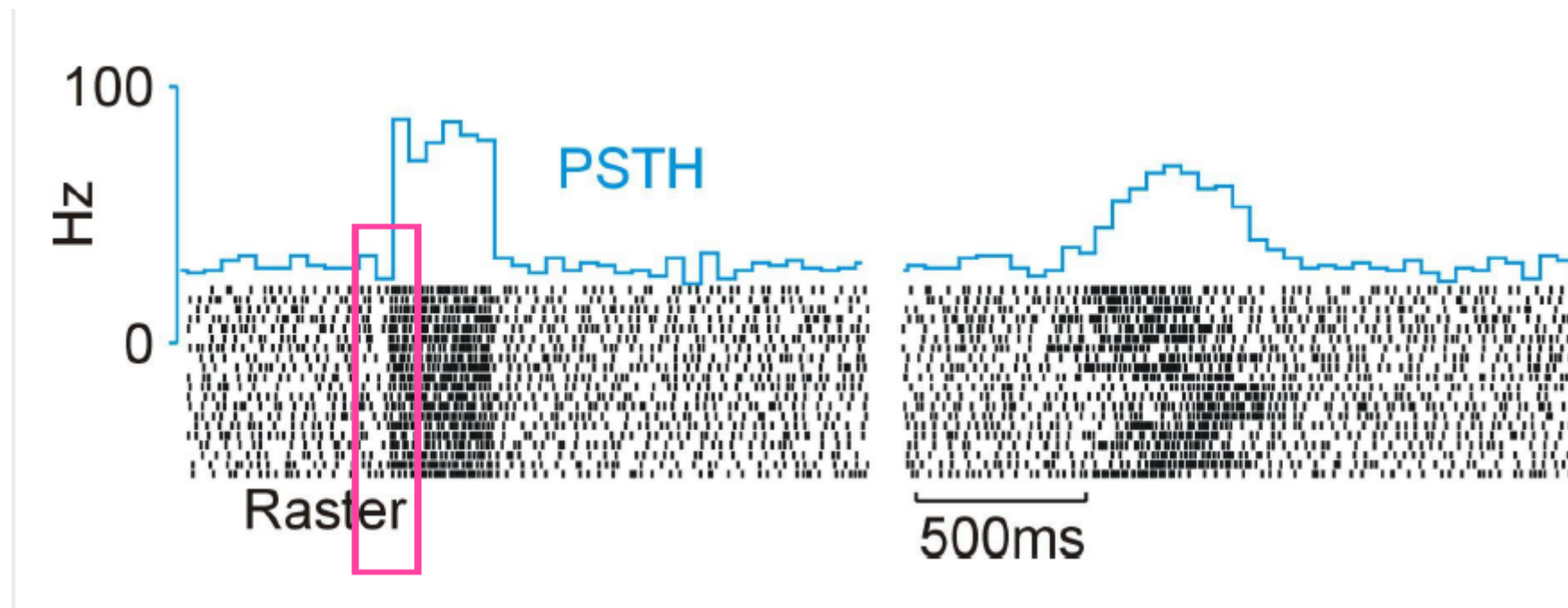




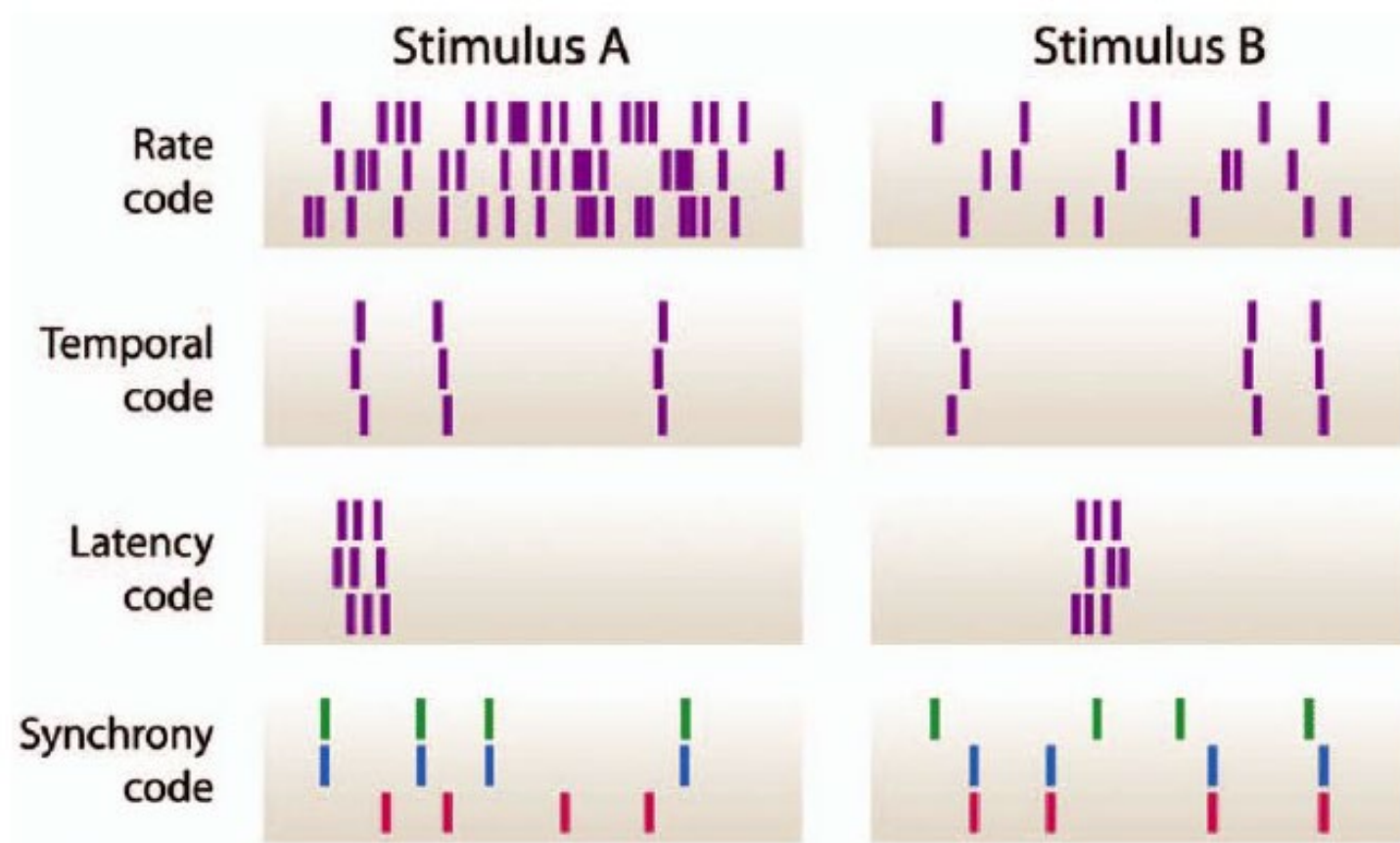
Spiking activity



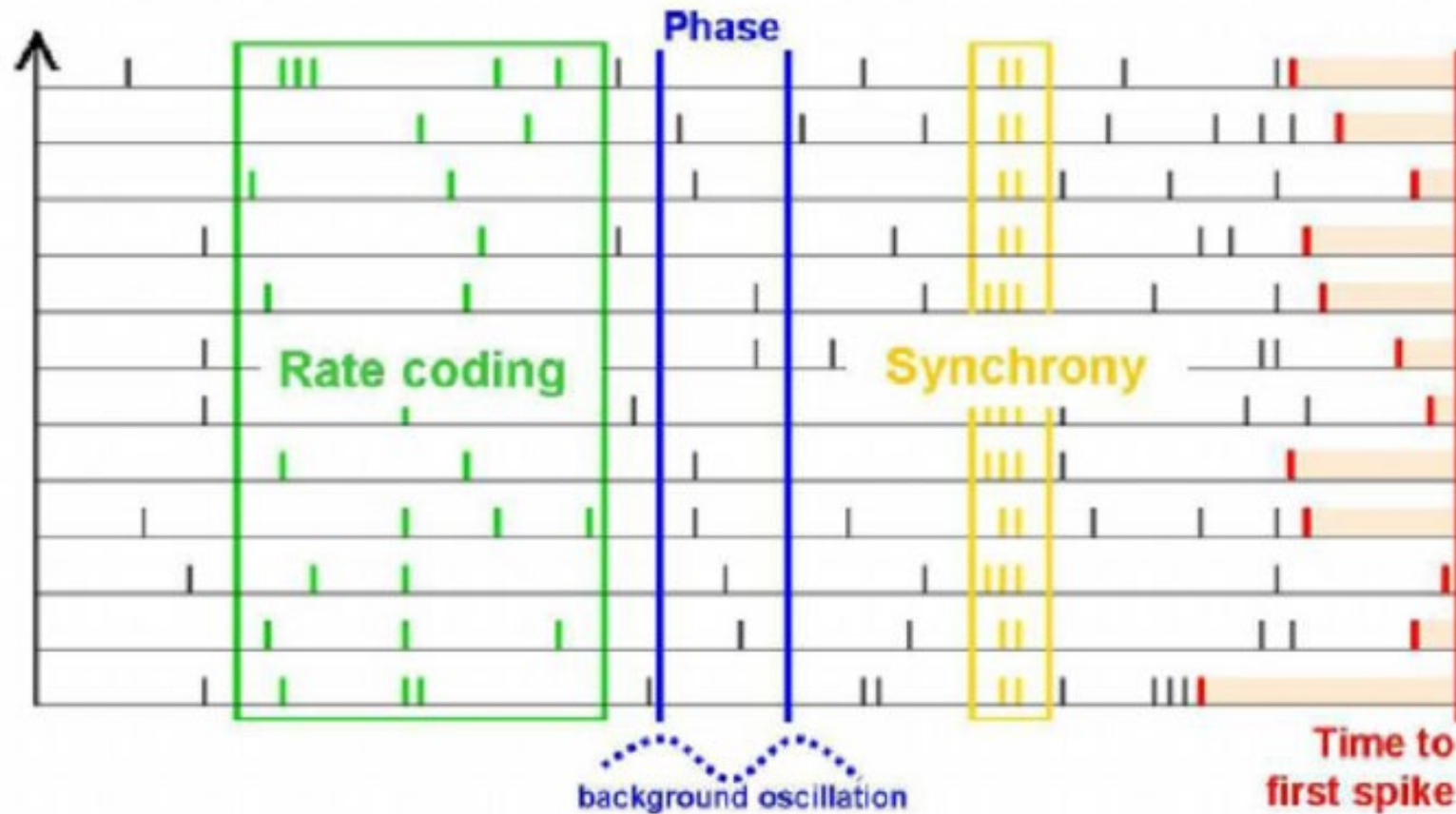
Rate coding



Different coding based on spiking activity

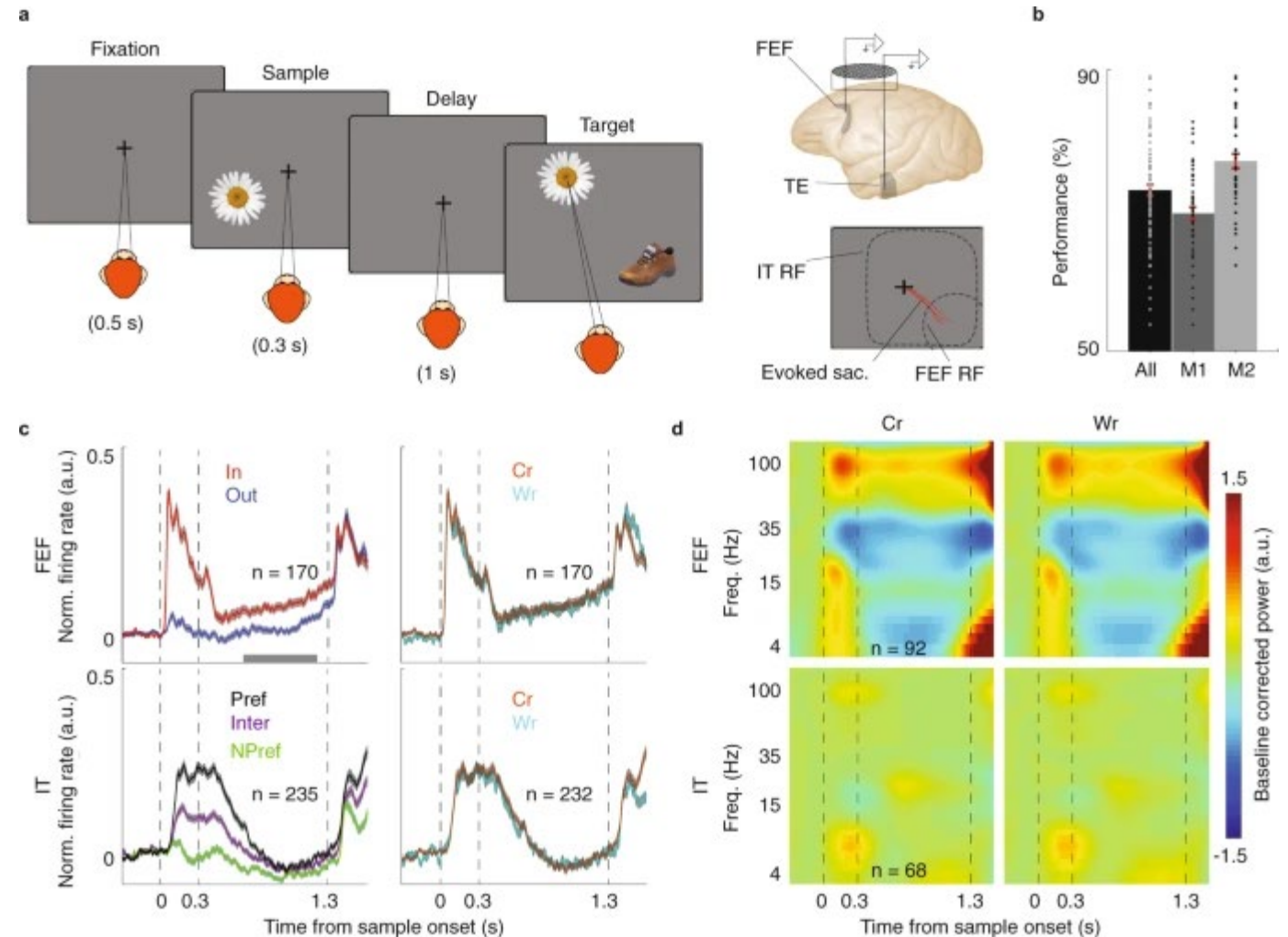


Different coding based on spiking activity



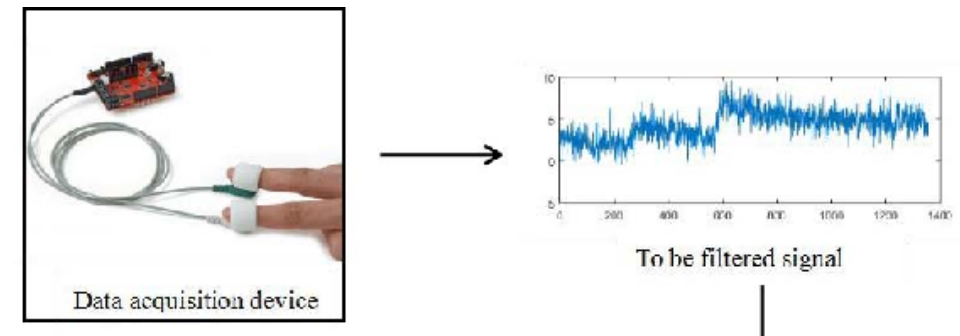
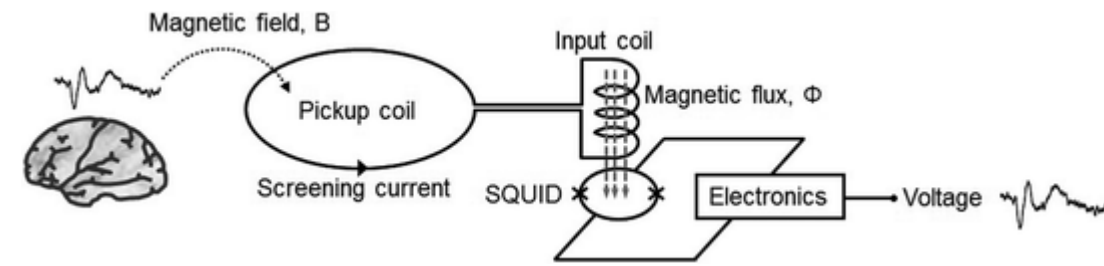
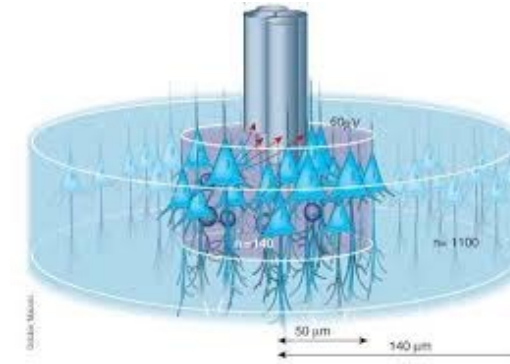
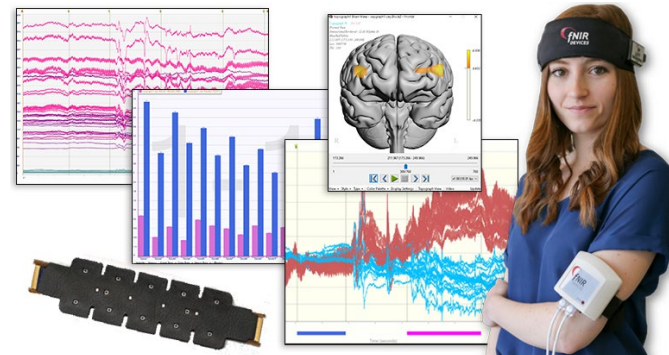
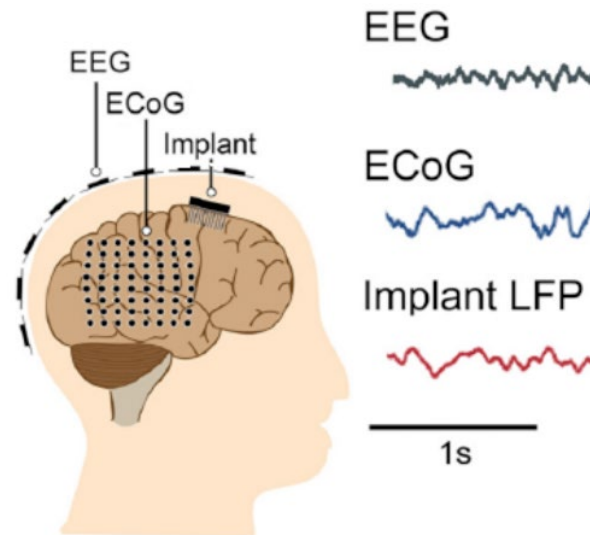
Example of rate coding

- Frontal eye field sample

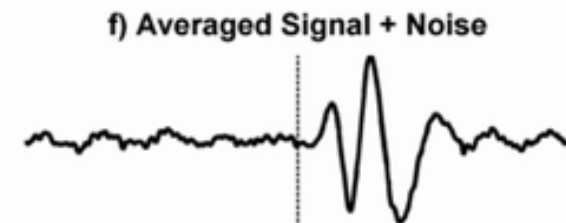
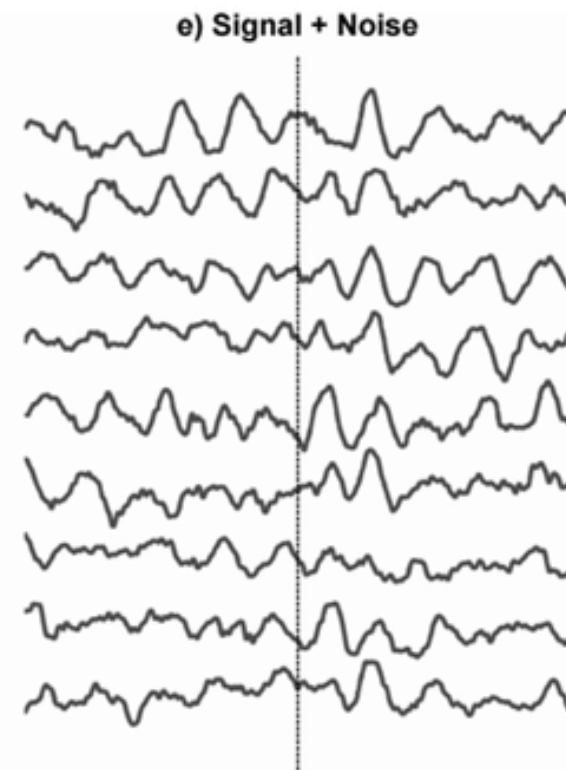
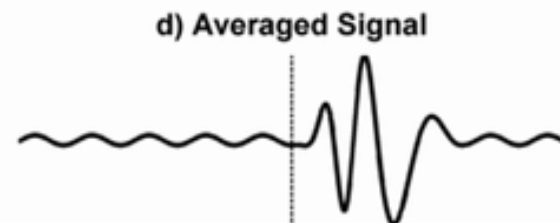
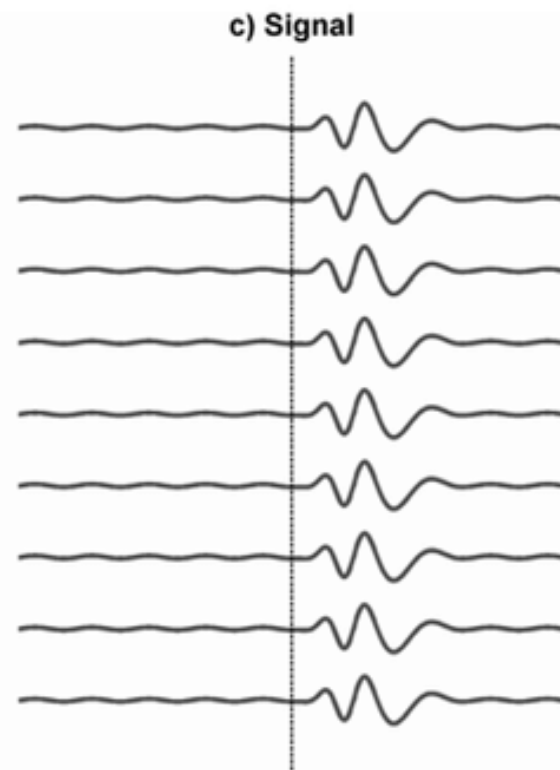
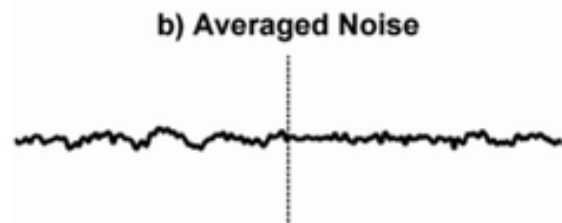
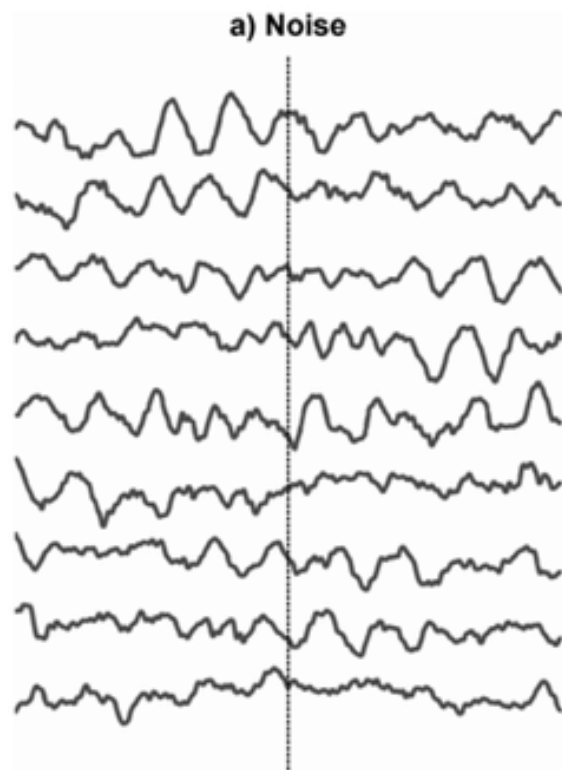


Continues signals

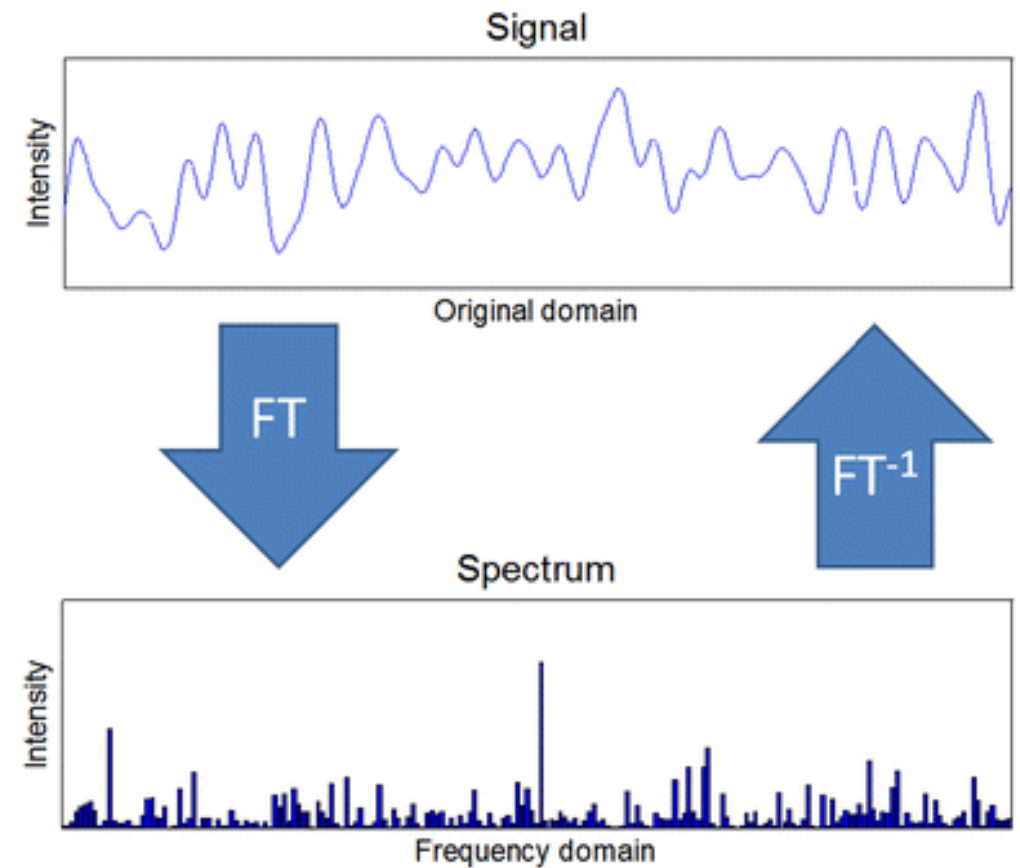
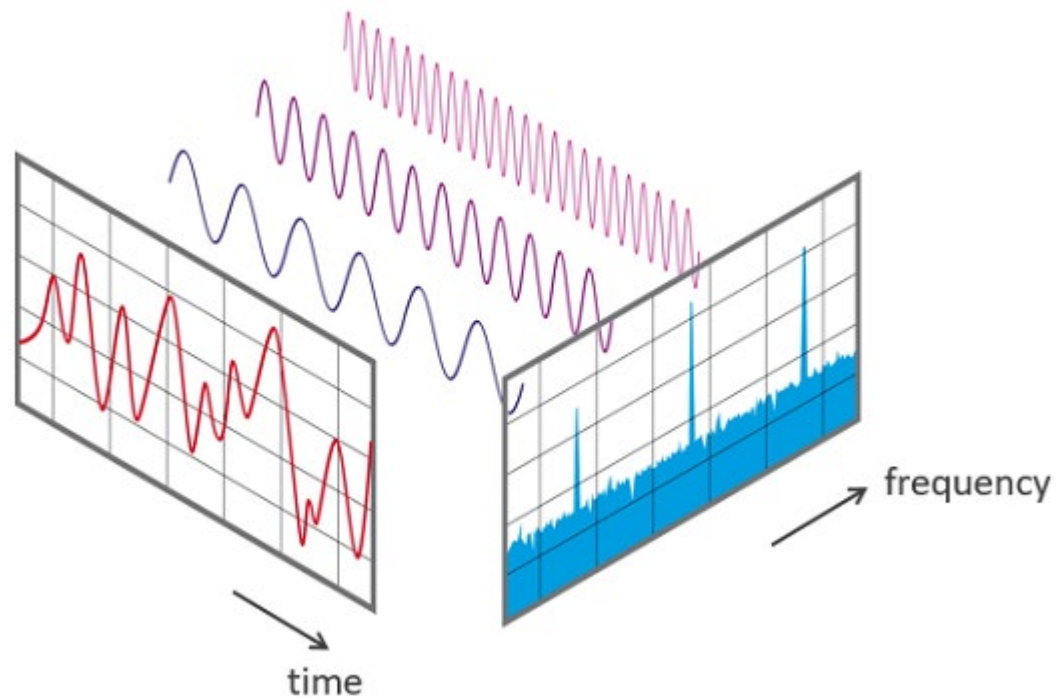
- Local field potential (LFP)
- ECOG
- EEG
- MEG
- FNIR
- GSR
- EMG
- ECG



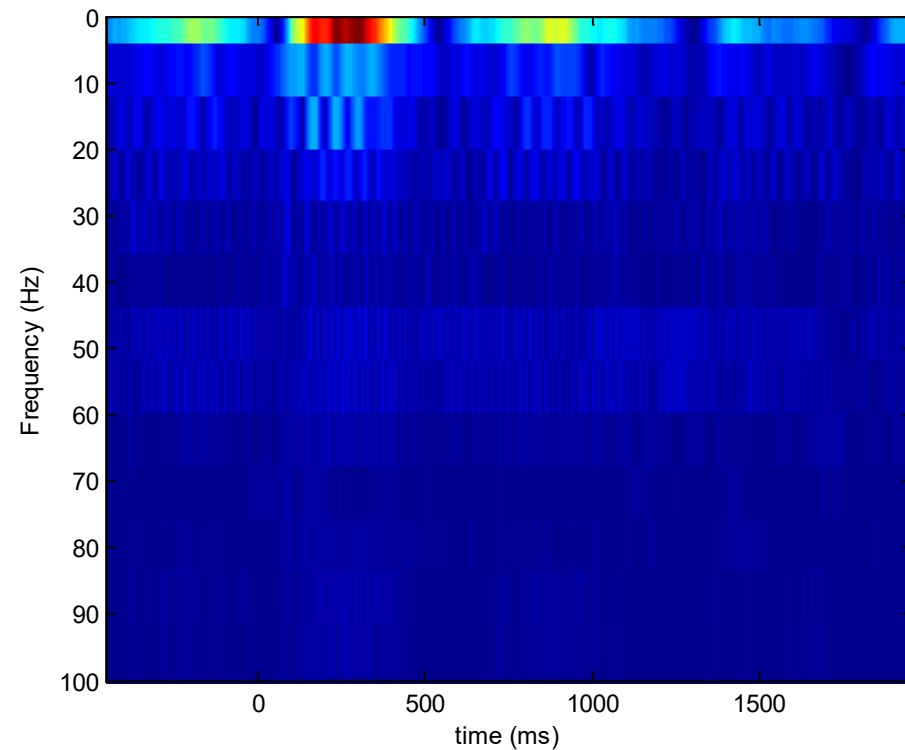
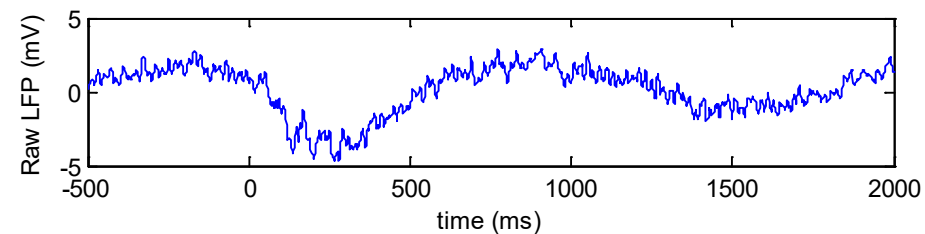
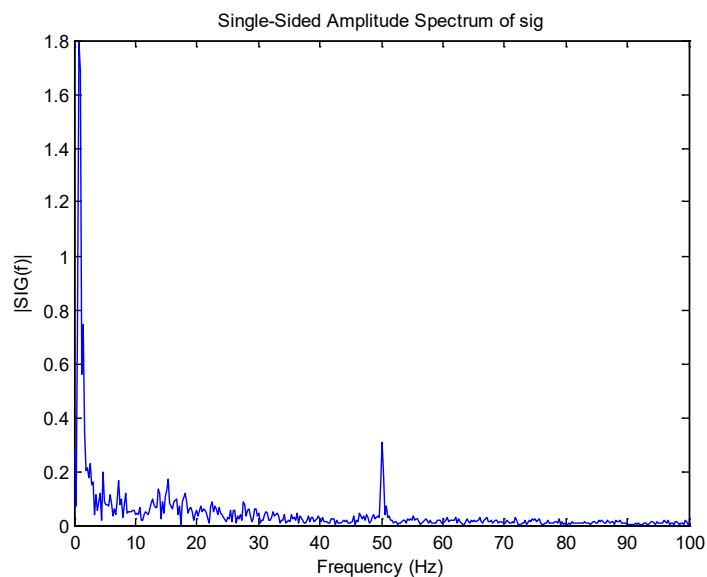
ERP signals



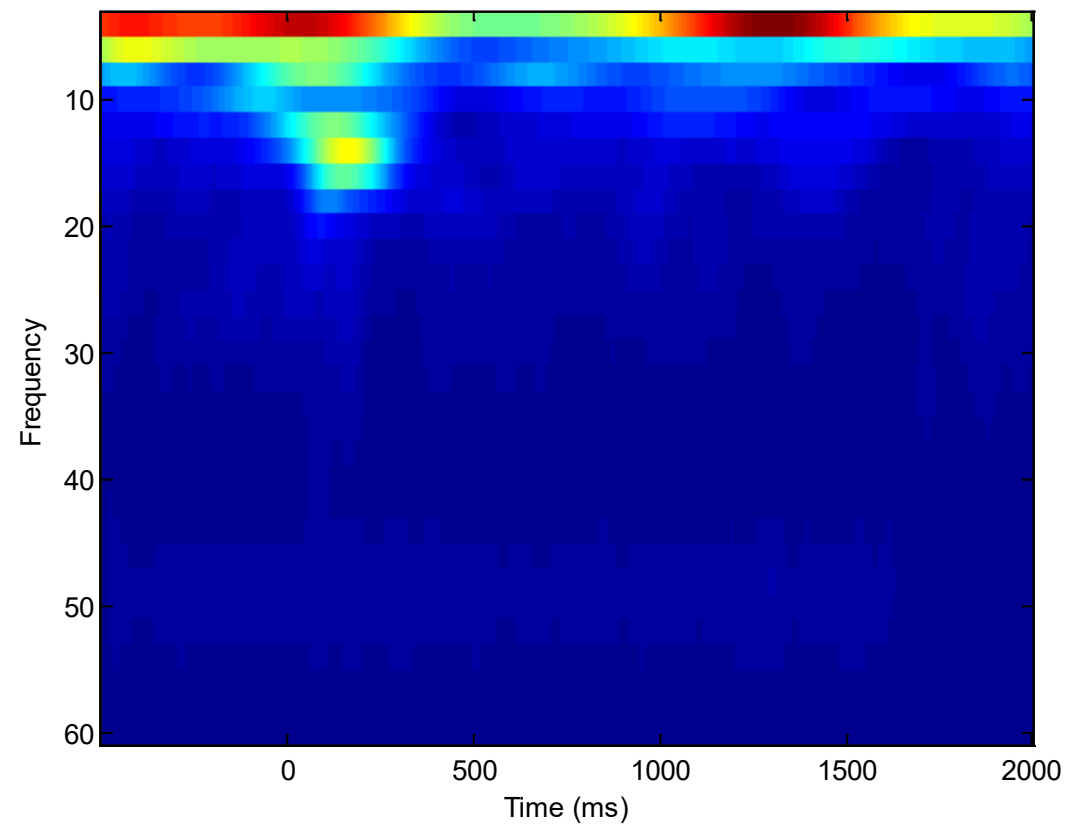
Fourier transform frequency domain



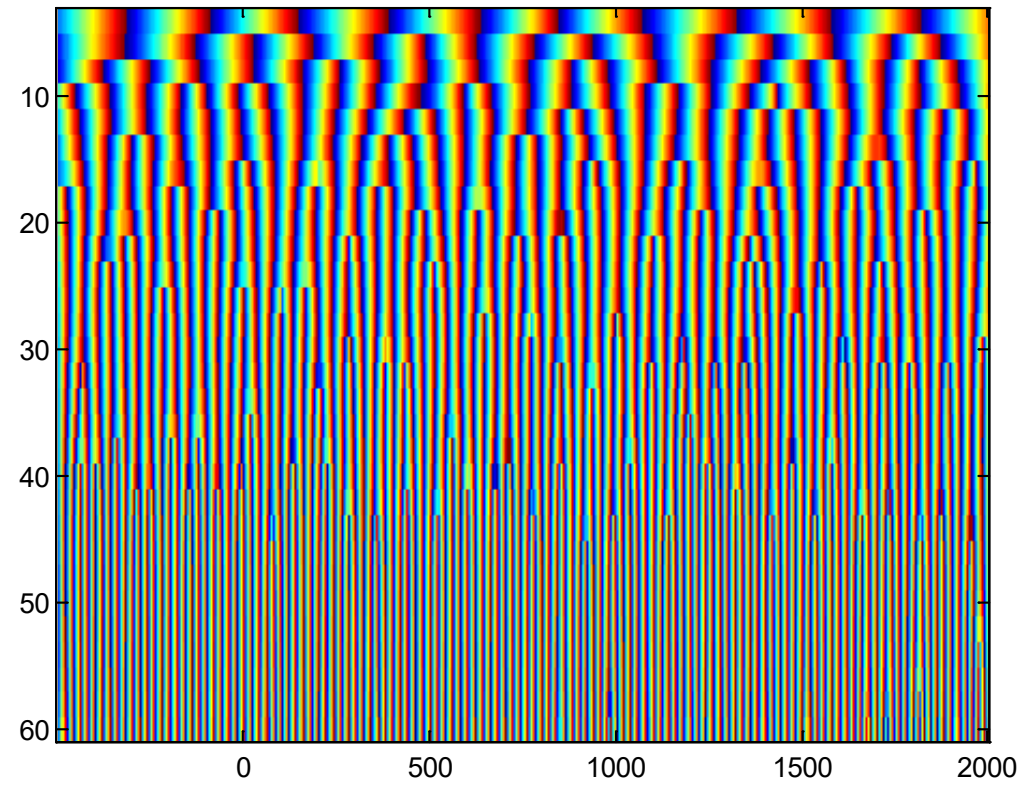
Time frequency map of signal



Power

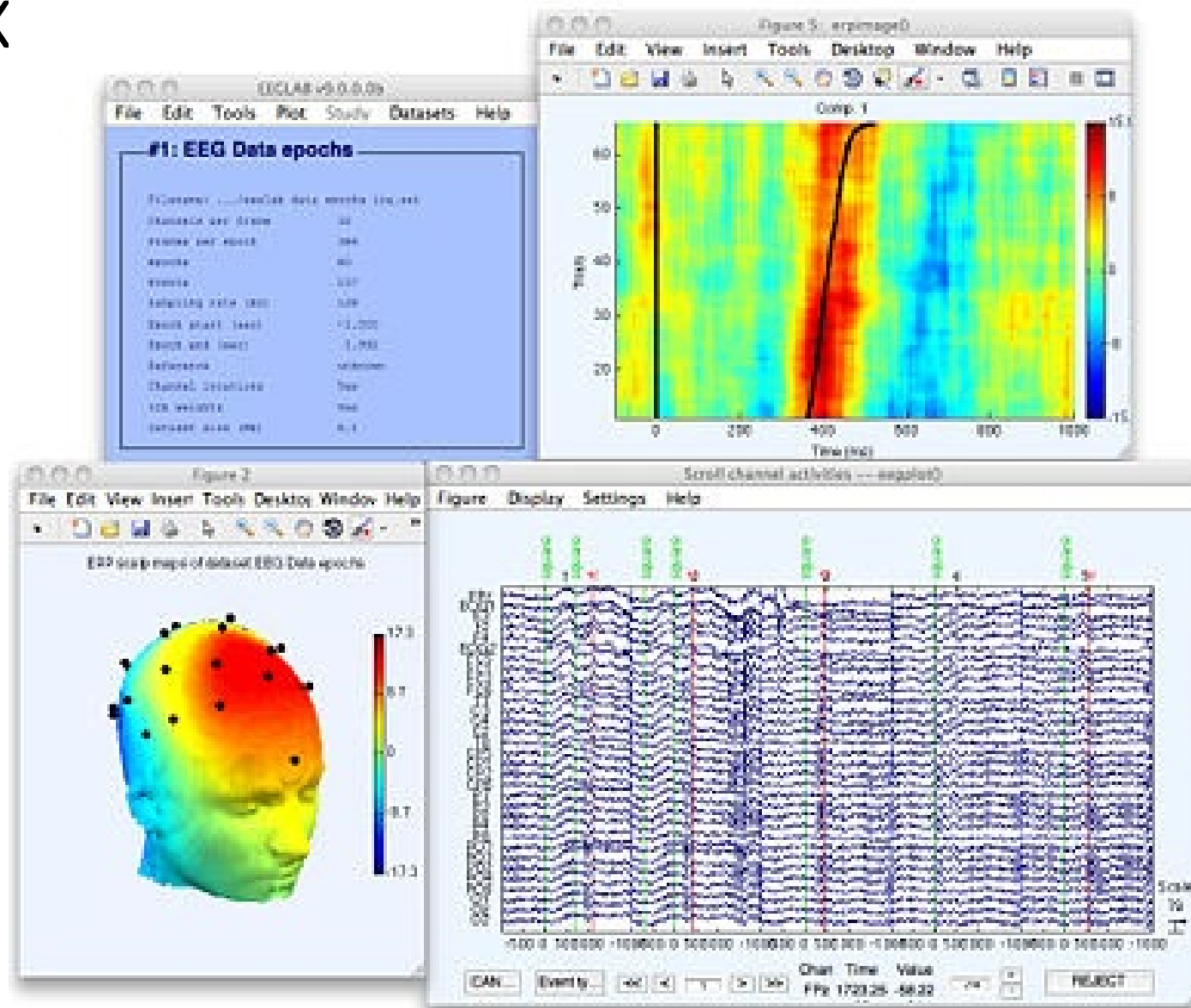


Phase Map



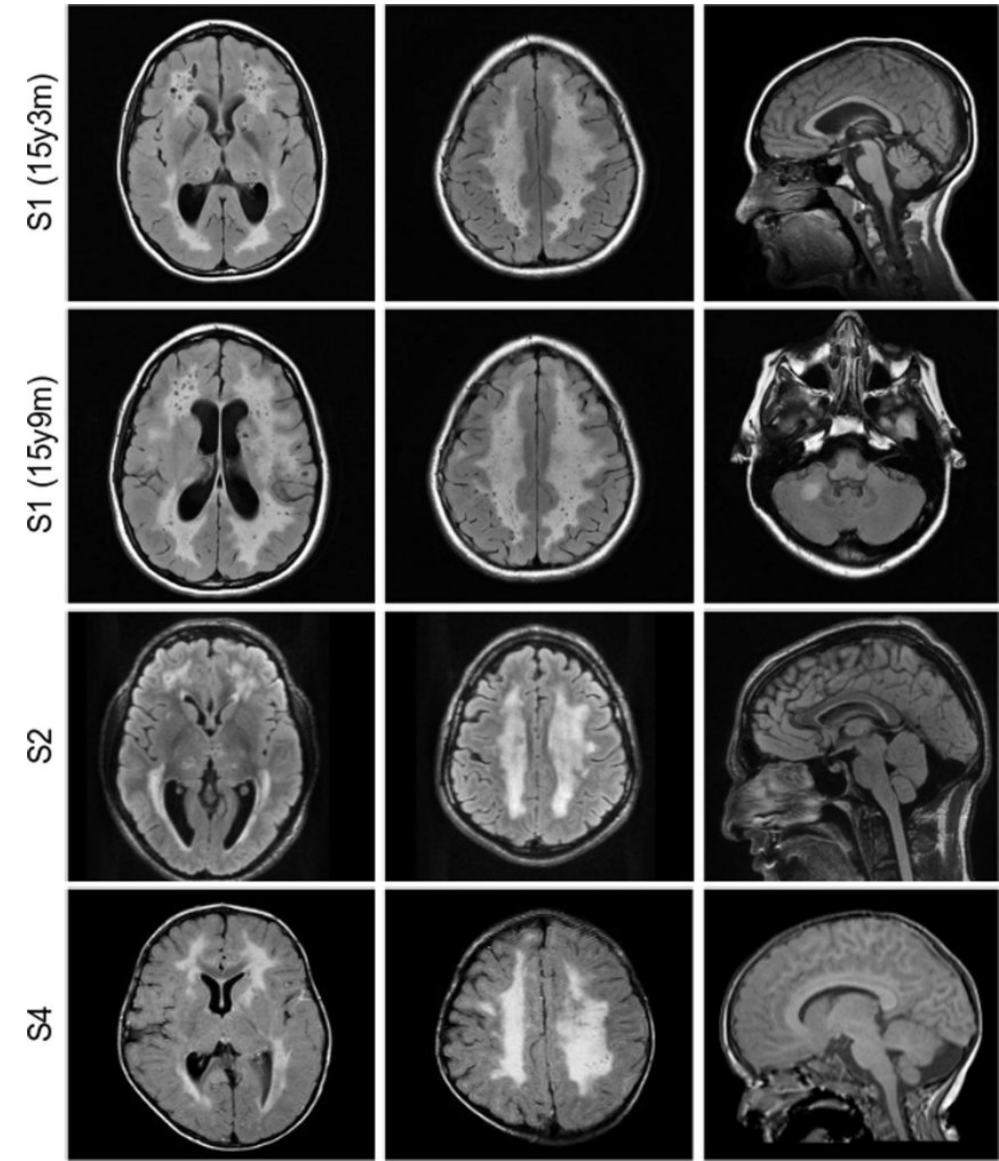
EEG Lab toolbox

<https://sccn.ucsd.edu/eeglab/index.php>



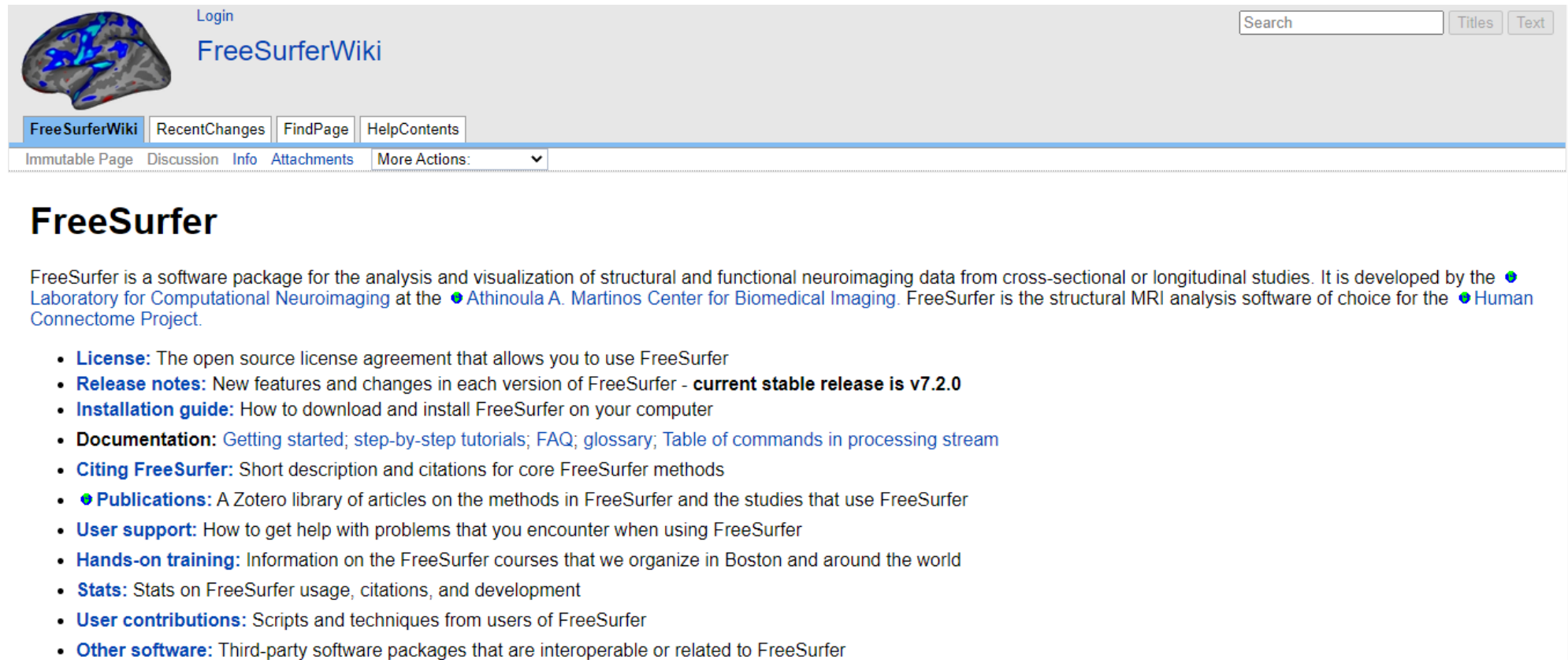
Imaging techniques

- MRI
- fMRI
- DTI
- CT scan
- PET scan



FreeSurfer

- <https://surfer.nmr.mgh.harvard.edu/fswiki>



The screenshot shows the FreeSurferWiki homepage. At the top left is a brain image with blue and red regions. To its right is a 'Login' link and the 'FreeSurferWiki' title. On the far right is a search bar with 'Search', 'Titles', and 'Text' buttons. Below the header is a navigation bar with links: 'FreeSurferWiki', 'RecentChanges', 'FindPage', and 'HelpContents'. A secondary bar contains 'Immutable Page', 'Discussion', 'Info', 'Attachments', and a 'More Actions' dropdown. The main content area has a large 'FreeSurfer' heading, followed by a paragraph describing the software as a package for neuroimaging data analysis, developed by the Laboratory for Computational Neuroimaging at the Athinoula A. Martinos Center for Biomedical Imaging. Below this is a list of links and resources:

- **License:** The open source license agreement that allows you to use FreeSurfer
- **Release notes:** New features and changes in each version of FreeSurfer - **current stable release is v7.2.0**
- **Installation guide:** How to download and install FreeSurfer on your computer
- **Documentation:** [Getting started](#); [step-by-step tutorials](#); [FAQ](#); [glossary](#); [Table of commands in processing stream](#)
- **Citing FreeSurfer:** Short description and citations for core FreeSurfer methods
- **Publications:** A Zotero library of articles on the methods in FreeSurfer and the studies that use FreeSurfer
- **User support:** How to get help with problems that you encounter when using FreeSurfer
- **Hands-on training:** Information on the FreeSurfer courses that we organize in Boston and around the world
- **Stats:** Stats on FreeSurfer usage, citations, and development
- **User contributions:** Scripts and techniques from users of FreeSurfer
- **Other software:** Third-party software packages that are interoperable or related to FreeSurfer



FSL

- <https://fsl.fmrib.ox.ac.uk/fsl/fslwiki>



Help Login

FSL

Search

FMRI Software Library v6.0

Created by the [Analysis Group](#), FMRI, Oxford, UK.

News: Latest version of the [FSL Course](#) is now online, including all the material from the 2020 online course, such as full lecture recordings and practical overviews.

FSL is a comprehensive library of analysis tools for FMRI, MRI and DTI brain imaging data. It runs on Apple and PCs (both Linux, and Windows via a Virtual Machine), and is very easy to install. Most of the tools can be run both from the command line and as GUIs ("point-and-click" graphical user interfaces). To quote the relevant references for FSL tools you should look in the individual tools' manual pages, and also please reference one or more of the FSL overview papers:

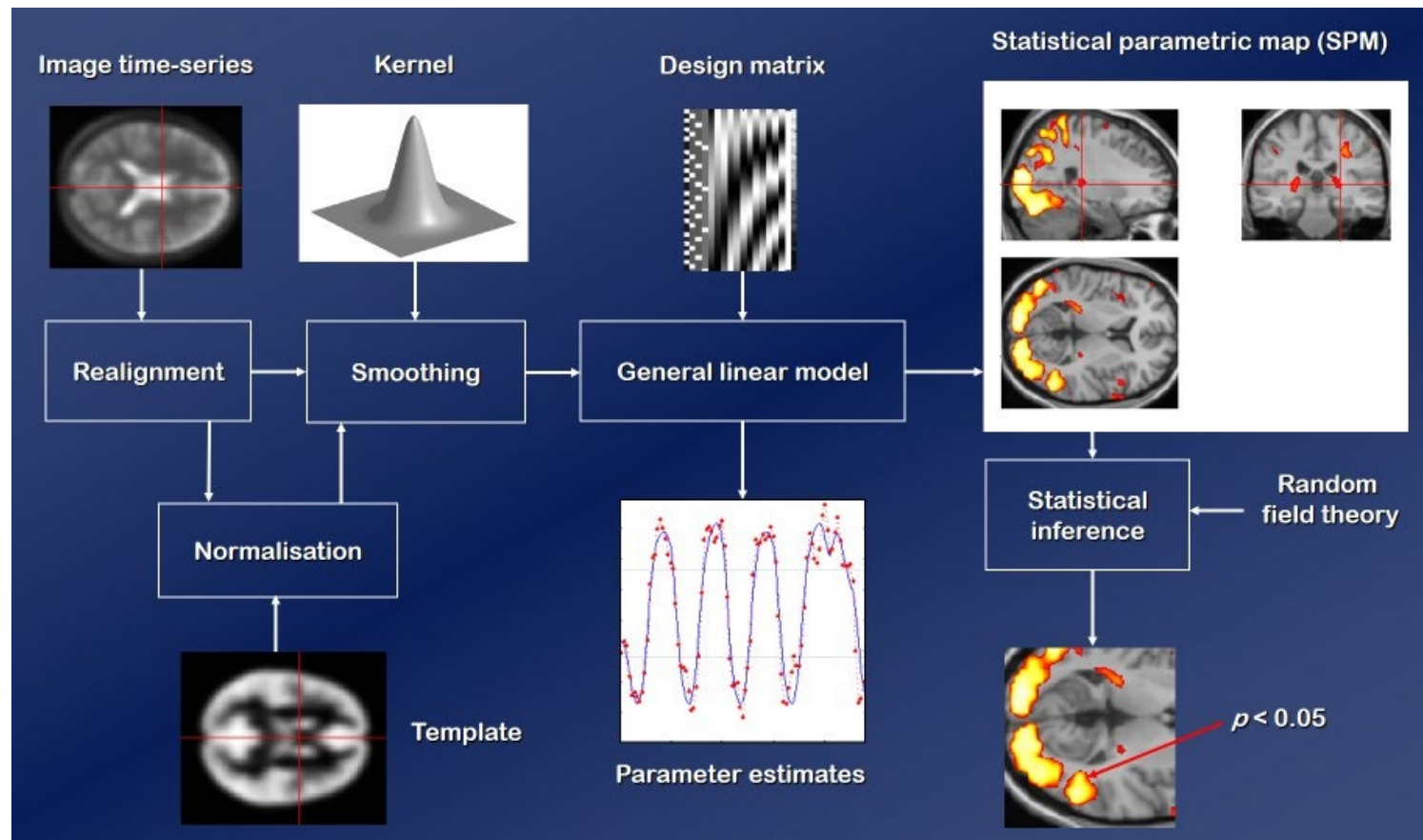
1. M.W. Woolrich, S. Jbabdi, B. Patenaude, M. Chappell, S. Makni, T. Behrens, C. Beckmann, M. Jenkinson, S.M. Smith. Bayesian analysis of neuroimaging data in FSL. *NeuroImage*, 45:S173-86, 2009
2. S.M. Smith, M. Jenkinson, M.W. Woolrich, C.F. Beckmann, T.E.J. Behrens, H. Johansen-Berg, P.R. Bannister, M. De Luca, I. Drobnjak, D.E. Flitney, R. Niazy, J. Saunders, J. Vickers, Y. Zhang, N. De Stefano, J.M. Brady, and P.M. Matthews. Advances in functional and structural MR image analysis and implementation as FSL. *NeuroImage*, 23(S1):208-19, 2004
3. M. Jenkinson, C.F. Beckmann, T.E. Behrens, M.W. Woolrich, S.M. Smith. FSL. *NeuroImage*, 62:782-90, 2012

- [Download/Install and licence](#)
- [Overview of FSL tools](#)
 - Functional MRI: [FEAT](#), [MELODIC](#), [FABBER](#), [BASIL](#), [VERBENA](#)
 - Structural MRI: [BET](#), [FAST](#), [FIRST](#), [FLIRT](#) & [FNIRT](#), [FSLVBM](#), [SIENA](#) & [SIENAX](#), [MIST](#), [BIANCA](#), [MSM](#), [fsl_anat](#)
 - Diffusion MRI: [FDT](#), [TBSS](#), [XTRACT](#), [eddy](#), [topup](#), [eddyqc](#)



SPM

- <https://www.fil.ion.ucl.ac.uk/spm/>

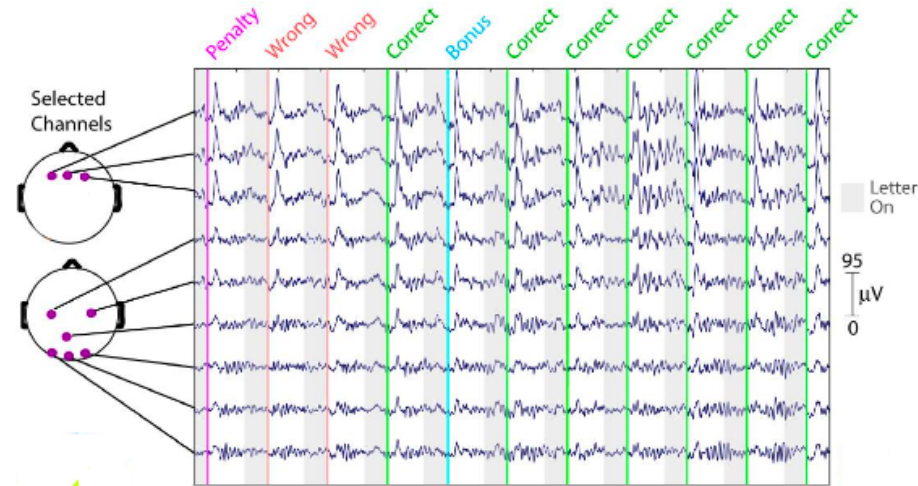


Assignment#15

https://sccn.ucsd.edu/~arno/fam2data/publicly_available_EEG_data.html

- Load s
- chann
- Calcul
- Load y

ne



**EEG / ERP data available for free public download
(updated 2020)**

History of this page

Since there was no public database for EEG data to our knowledge (as of 2002), we had decided to release some of our data on the Internet. We have kept the page as it seems to still be usefull (if you know any database or if you want us to add a link to data you are distributing on the Internet, send us an email at arno@sccn.ucsd.edu).

