The MNE package for M/EEG data processing

MGH/HST Athinoula A. Martinos Center for Biomedical Imaging

A. Gramfort[1], M. Luessi[2], E. Larson[3], D.A. Engemann[4], D. Strohmeier[5], C. Brodbeck[6], M. Hämäläinen[2]

[1]Telecom ParisTech, CNRS LTCI - CEA/Neurospin [2]MGH, Harvard Med. School, USA [3]U. of Washington, USA [4]CNS (INM-3), Juelich Research Center, Germany [5]Ilmenau U., Germany [6]New York U., USA

The MNE Software Vision

- State-of-the-art methods, many examples, documented and tested
- Open development: collaboration between several centers
- Share the best practices, promote reproducible research

Software Features

Preprocessing

- Review raw data, filter, correct ECG / EOG with SSPs, ICA

Forward & inverse modeling

- FreeSurfer structural data: Automatic forward modeling
- MNE – dSPM – sLORETA – (TF-)MxNE – LCMV

Statistics (sensor and source spaces)

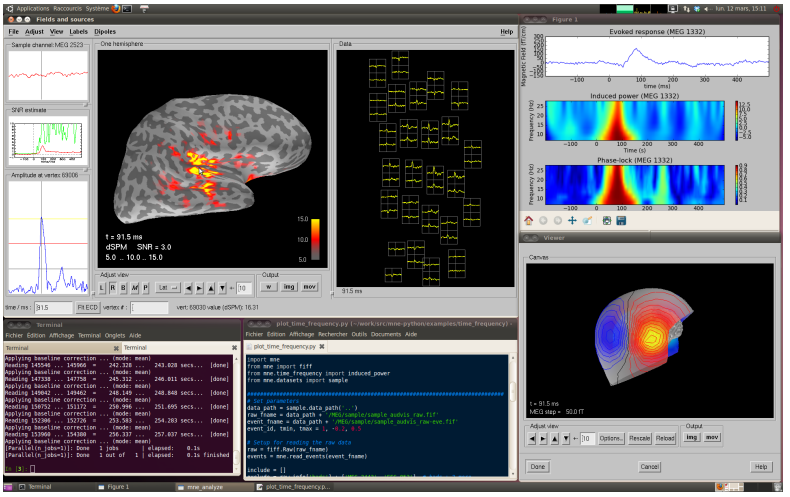
- Time-Frequency (Phase-Locking, Induced Power)
- Parametric and non-parametric stats, with clustering

Connectivity (sensor and source spaces)

- Functional and effective connectivity measures

The MNE Software Family

MNE-C – MNE-Matlab – MNE-Python

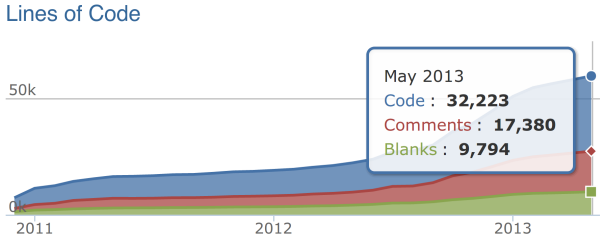


http://martinos.org/mne **http://github.com/mne-tools**

A. Gramfort, M. Luessi, E. Larson, D. Engemann, D. Strohmeier, C. Brodbeck, L. Parkkonen, M. Hämäläinen
MNE software for processing MEG and EEG data, Submitted.

MNE-Python

- Python: general-purpose, high-level language
- Free: can run on a cluster without license problems
- Permissive BSD license: allows use in commercial products
- Many third-party packages easily integrated, e.g., ML
- Open, 29 contributors so far: ≈ 8 person years of effort

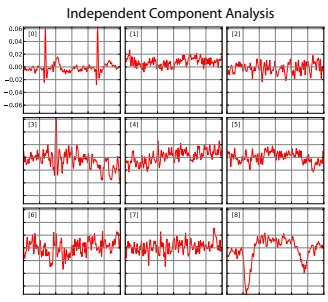


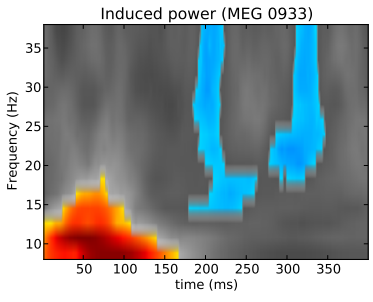
From raw to dSPM in < 30 lines of code

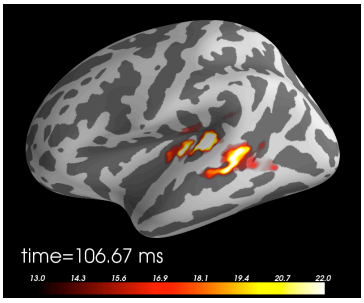
```
import mne

# load data
fname = 'raw.fif'
raw = mne.fiff.Raw(fname)
raw.info['bads'] = ['MEG 2443', 'EEG 053']  # mark bad channels

# band-pass filter data in beta band, and save it
raw.filter(13.0, 30.0, filter_length=4096, n_jobs='cuda')
raw.save(fname[:-4] + '_beta.fif')

# extract epochs
picks = mne.fiff.pick_types(raw.info, meg=True, eeg=True, eog=True,
                            exclude='bads')
events = mne.find_events(raw)
epochs = mne.Epochs(raw, events, event_id=1, tmin=-0.2, tmax=0.5, proj=True,
                    picks=picks, baseline=(None, 0), preload=True,
                    reject=dict(grad=4000e-13, mag=4e-12, eog=150e-6))

# compute evoked response and noise covariance, and plot evoked
evoked = epochs.average()
cov = mne.compute_covariance(epochs, tmax=0)
evoked.plot()

# compute inverse operator
fwd_fname = 'sample_audvis-meg-eeg-oct-6-fwd.fif'
fwd = mne.read_forward_solution(fwd_fname, surf_ori=True)
inv = mne.minimum_norm.make_inverse_operator(raw.info, fwd, cov, loose=0.2)

# compute inverse solution
stc = mne.minimum_norm.apply_inverse(evoked, inv, lambda2=1 / 3.0 ** 2,
                                     method='dSPM')

# morph it to average brain for group study
stc_avg = mne.morph_data('sample', 'fsaverage', stc, 5, smooth=5)
stc_avg.plot()
```

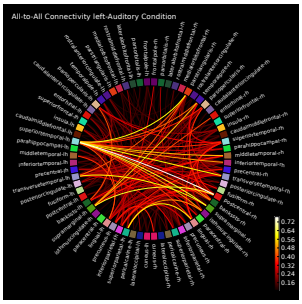
Learn more

- Mailing list: mne_analysis@nmr.mgh.harvard.edu
- http://martinos.org/mne/ (general doc)
- http://martinos.org/mne/python_tutorial.html
- http://martinos.org/mne/auto_examples/ (> 70 demos)
- http://mne-tools.github.com/mne-python-intro-slides









Funded by: NIH grants P41RR14075, R01EB009048, F32DC012456 and NSF awards 0958669, 1042134