MNE-BIDS and MNE-BIDS-Pipeline Tutorial

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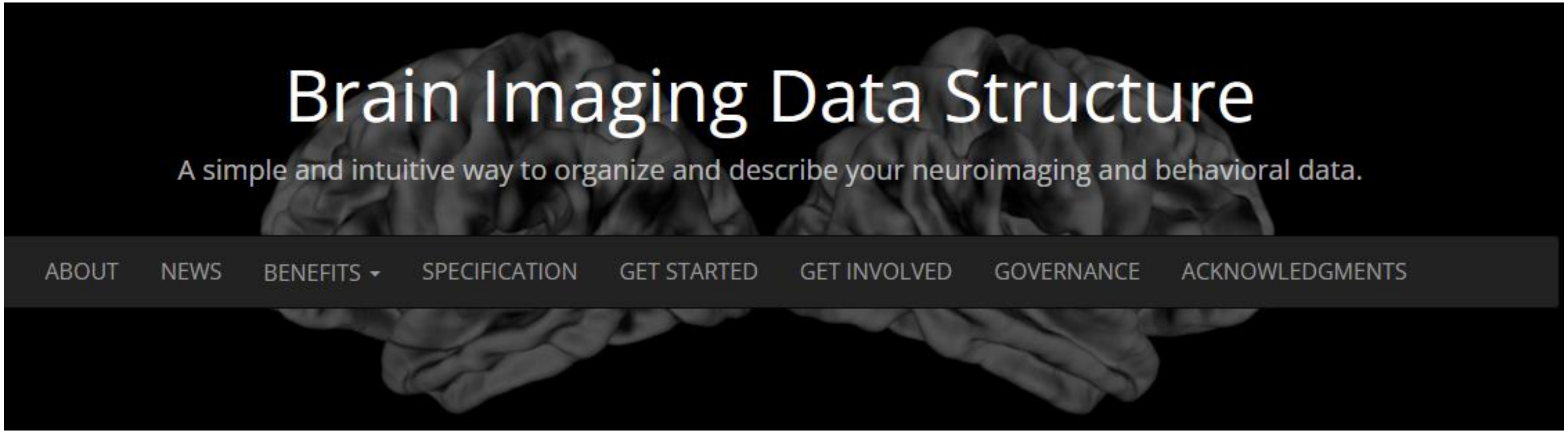
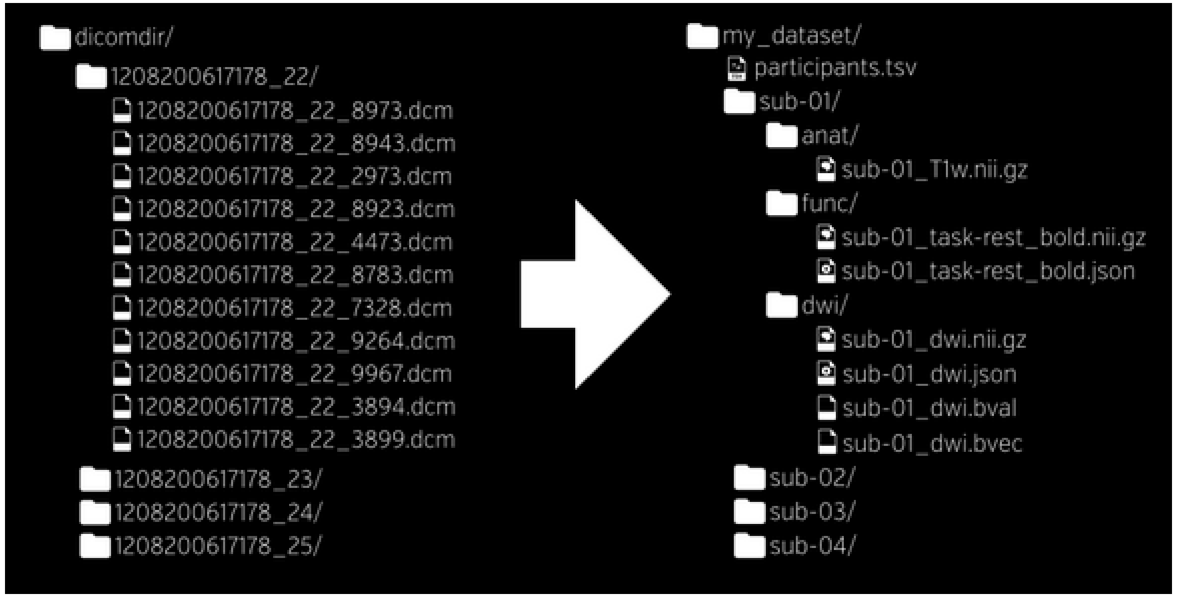
Outline

- Brain Imaging Data Structure (BIDS)
- MNE-BIDS
- MNE-BIDS-Pipeline
- Code demo throughout



Brain Imaging Data Structure

A simple and intuitive way to organize and describe your neuroimaging and behavioral data.



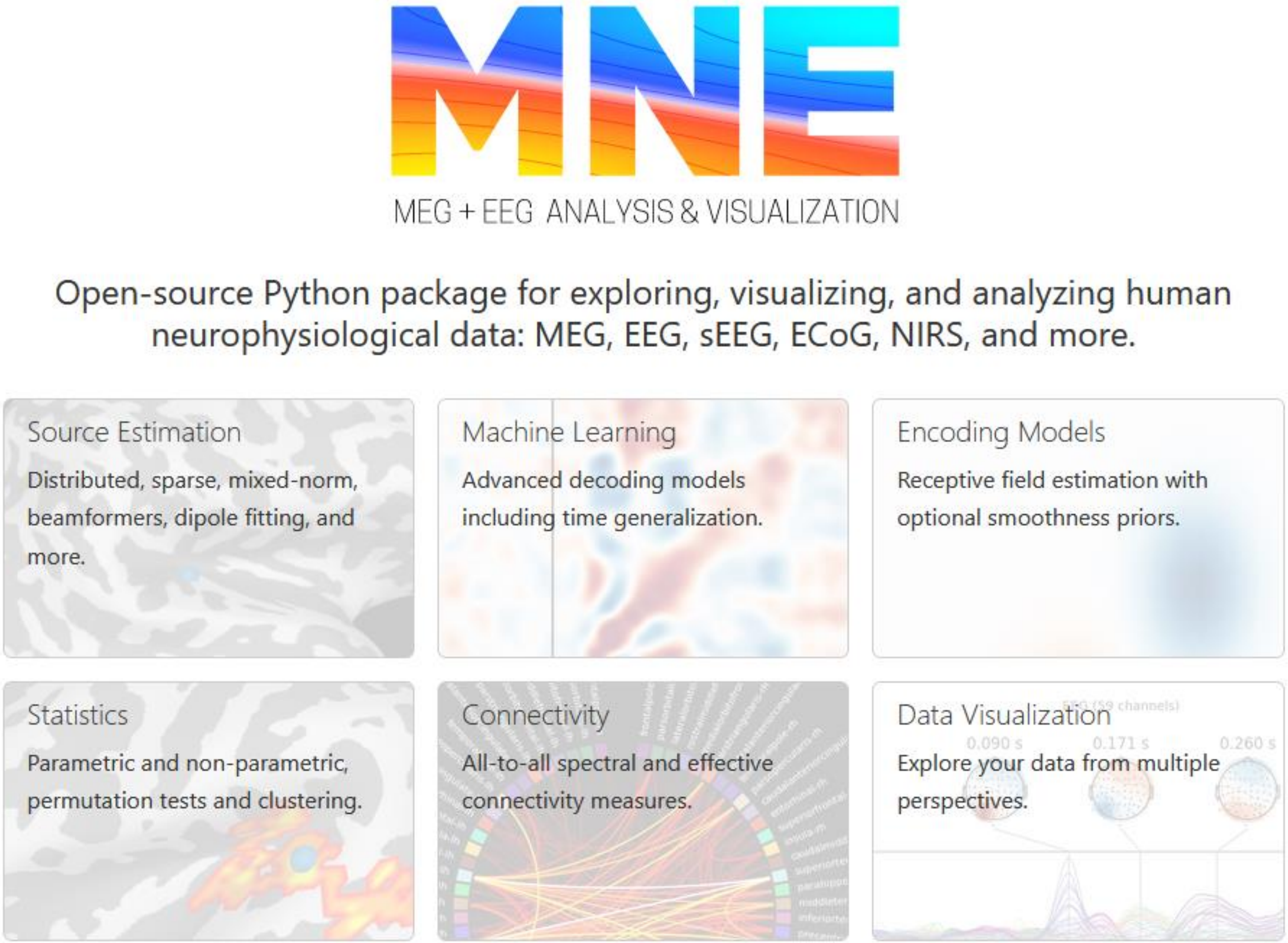
```
dicomdir/
    1208200617178_22/
        1208200617178_22_8973.dcm
        1208200617178_22_8943.dcm
        1208200617178_22_2973.dcm
        1208200617178_22_8923.dcm
        1208200617178_22_4473.dcm
        1208200617178_22_8783.dcm
        1208200617178_22_7328.dcm
        1208200617178_22_9264.dcm
        1208200617178_22_9967.dcm
        1208200617178_22_3894.dcm
        1208200617178_22_3899.dcm
    1208200617178_23/
    1208200617178_24/
    1208200617178_25/
```

```
my_dataset/
    participants.tsv
    sub-01/
        anat/
            sub-01_T1w.nii.gz
        func/
            sub-01_task-rest_bold.nii.gz
            sub-01_task-rest_bold.json
        dwi/
            sub-01_dwi.nii.gz
            sub-01_dwi.json
            sub-01_dwi.bval
            sub-01_dwi.bvec
    sub-02/
    sub-03/
    sub-04/
```

MEG, EEG, iEEG support included!

https://bids.neuroimaging.io/

https://bids-specification.readthedocs.io/en/stable/



MNE

MEG + EEG ANALYSIS & VISUALIZATION

Open-source Python package for exploring, visualizing, and analyzing human neurophysiological data: MEG, EEG, sEEG, ECoG, NIRS, and more.

Source Estimation

Distributed, sparse, mixed-norm, beamformers, dipole fitting, and more.

Machine Learning

Advanced decoding models including time generalization.

Encoding Models

Receptive field estimation with optional smoothness priors.

Statistics

Parametric and non-parametric, permutation tests and clustering.

Connectivity

All-to-all spectral and effective connectivity measures.

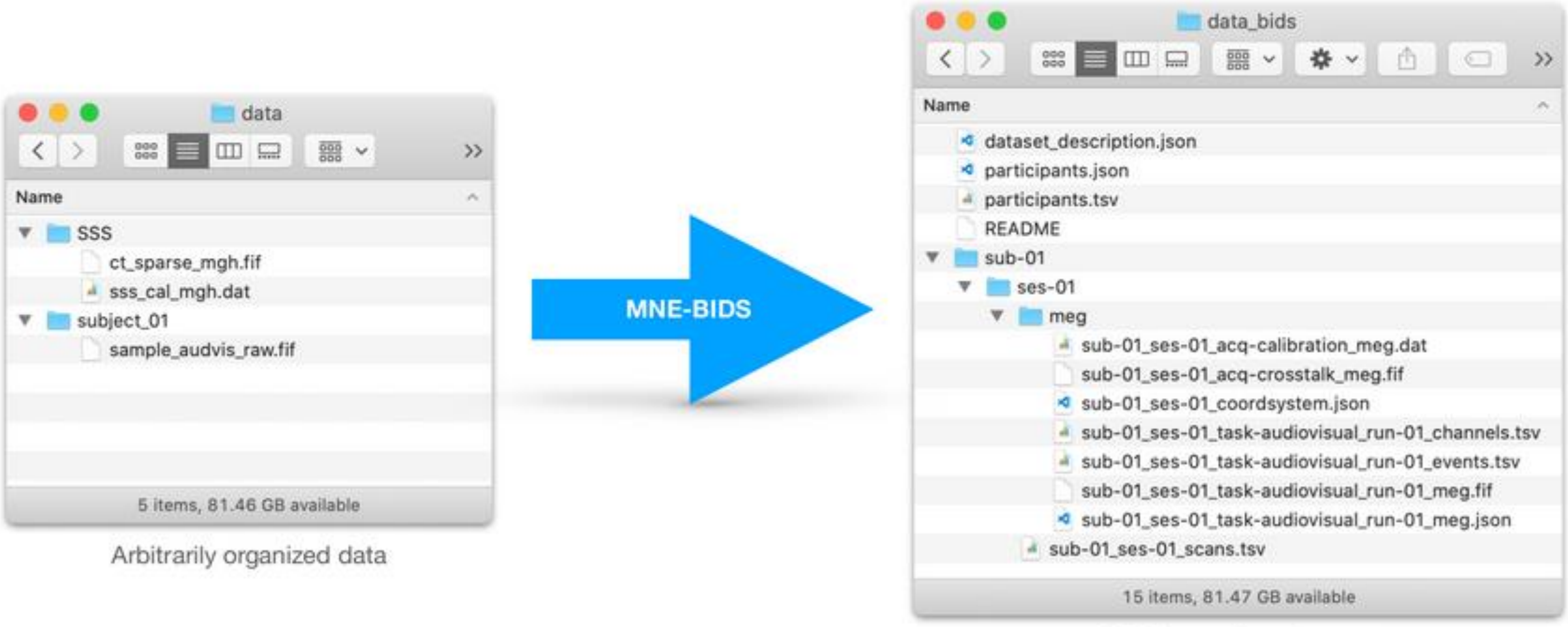
Data Visualization

Explore your data from multiple perspectives.

https://mne.tools/stable/index.html

MNE-BIDS

MNE-BIDS is a Python package that allows you to read and write BIDS-compatible datasets with the help of MNE-Python.



```
▼ SSS
    ct_sparse_mgh.fif
    sss_cal_mgh.dat
▼ subject_01
    sample_audvis_raw.fif
```

5 items, 81.46 GB available

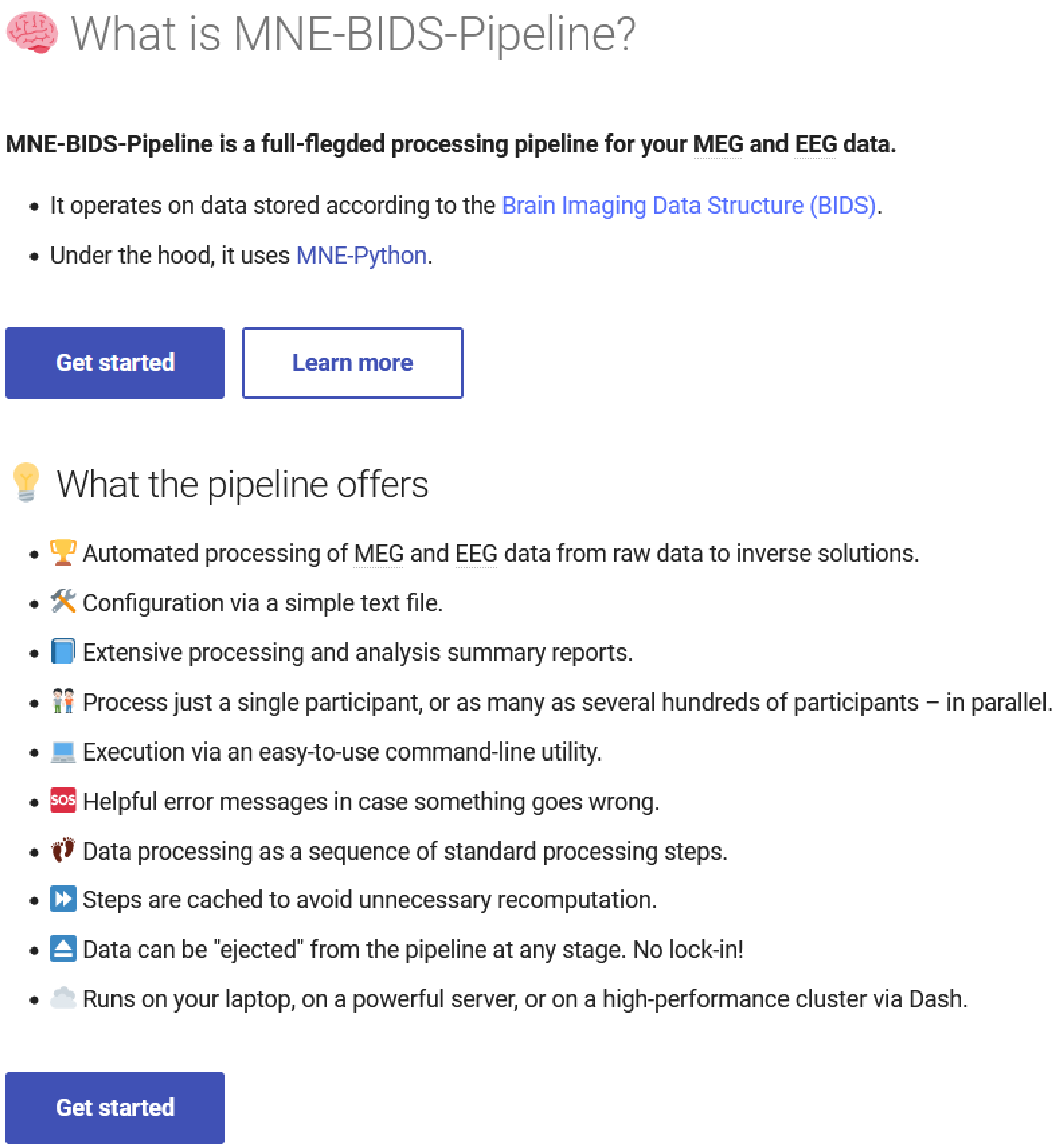
Arbitrarily organized data

```
dataset_description.json
participants.json
participants.tsv
README
▼ sub-01
    ▼ ses-01
        ▼ meg
            sub-01_ses-01_acq-calibration_meg.dat
            sub-01_ses-01_acq-crosstalk_meg.fif
            sub-01_ses-01_coordsystem.json
            sub-01_ses-01_task-audiovisual_run-01_channels.tsv
            sub-01_ses-01_task-audiovisual_run-01_events.tsv
            sub-01_ses-01_task-audiovisual_run-01_meg.fif
            sub-01_ses-01_task-audiovisual_run-01_meg.json
        sub-01_ses-01_scans.tsv
```

15 items, 81.47 GB available

BIDS-compliant dataset

https://mne.tools/mne-bids/stable/index.html



🧠 What is MNE-BIDS-Pipeline?

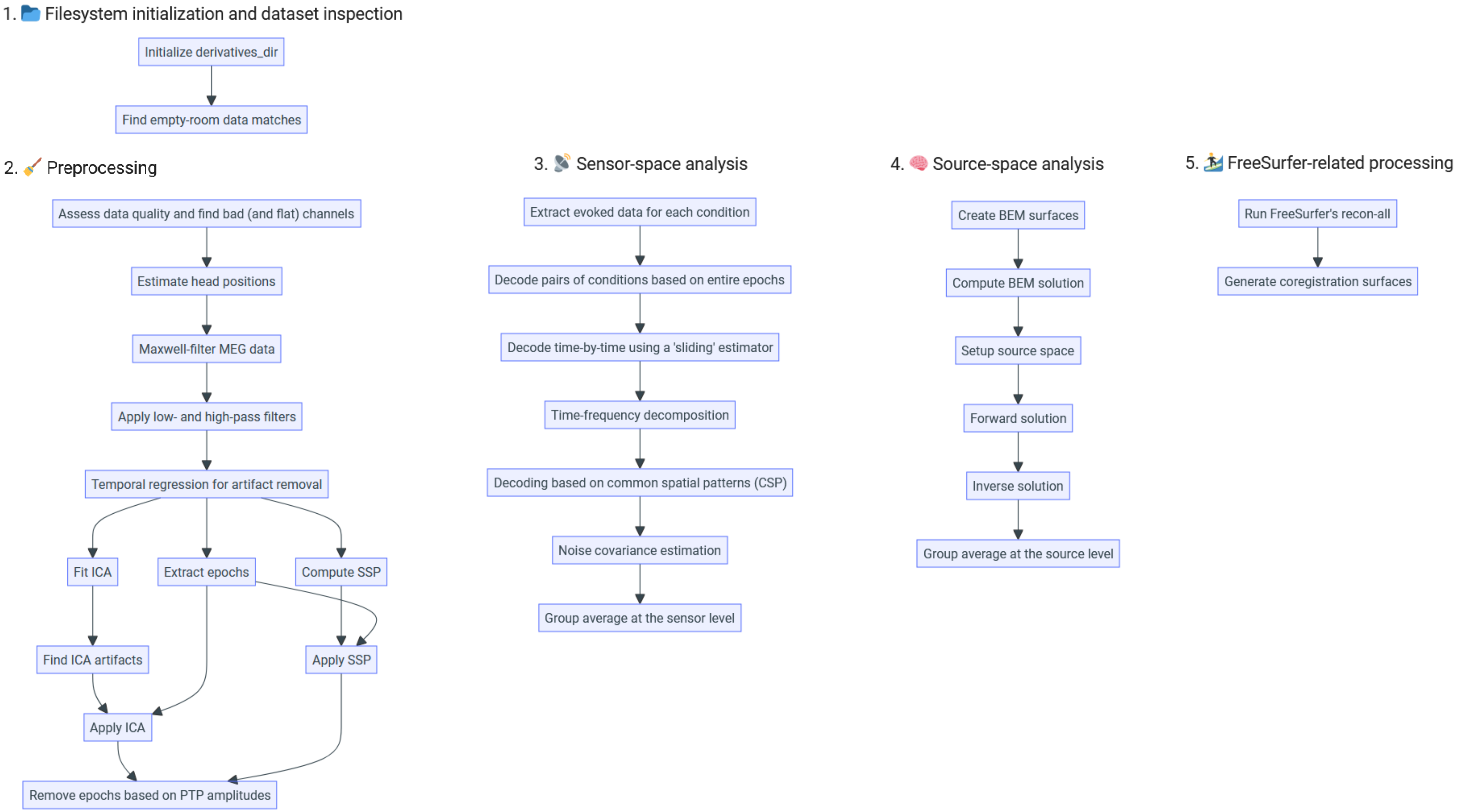
MNE-BIDS-Pipeline is a full-flegded processing pipeline for your MEG and EEG data.

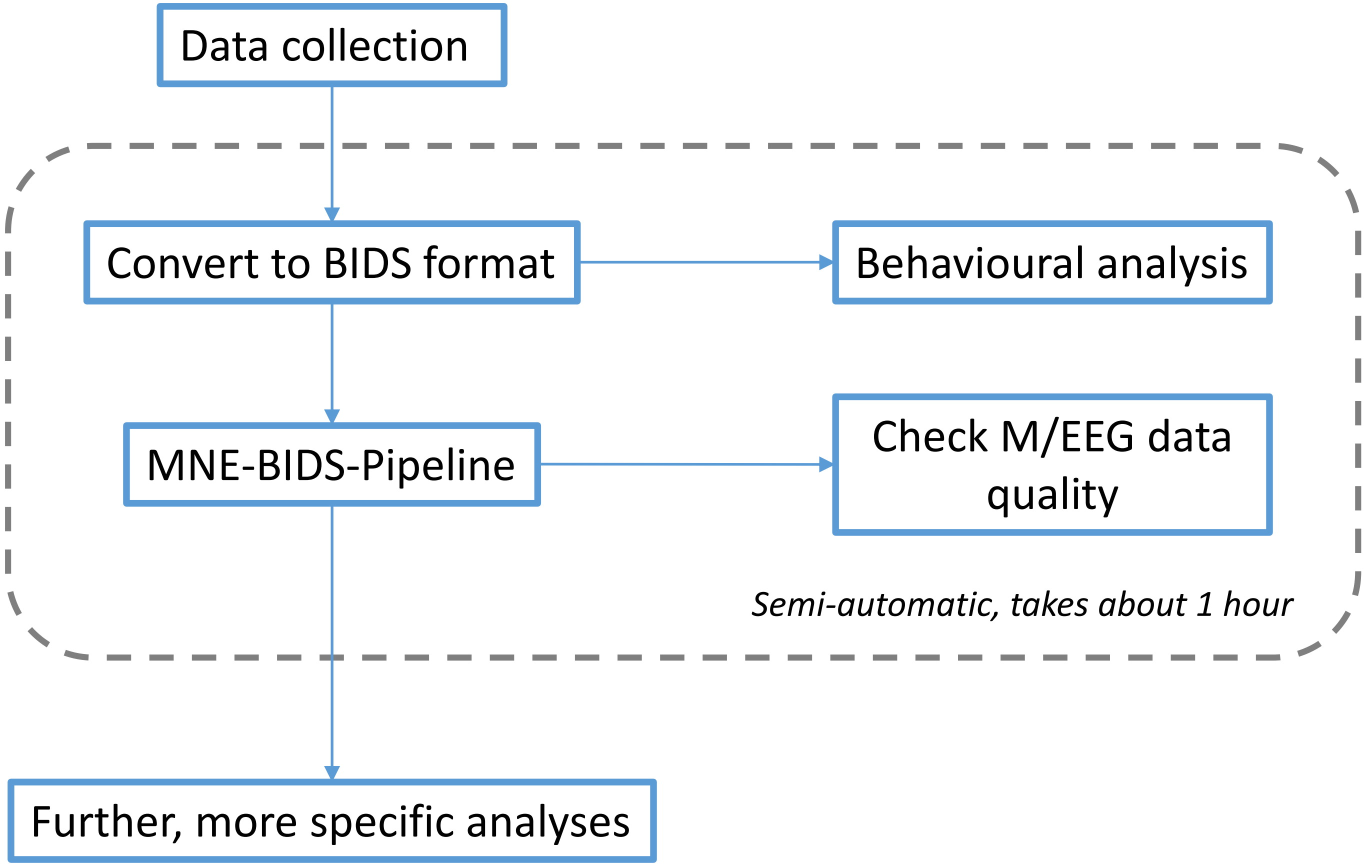
- It operates on data stored according to the Brain Imaging Data Structure (BIDS).
- Under the hood, it uses MNE-Python.

💡 What the pipeline offers

- 🏆 Automated processing of MEG and EEG data from raw data to inverse solutions.
- 🛠️ Configuration via a simple text file.
- 📘 Extensive processing and analysis summary reports.
- 👫 Process just a single participant, or as many as several hundreds of participants – in parallel.
- 💻 Execution via an easy-to-use command-line utility.
- 🆘 Helpful error messages in case something goes wrong.
- 👣 Data processing as a sequence of standard processing steps.
- ⏩ Steps are cached to avoid unnecessary recomputation.
- ⏏️ Data can be "ejected" from the pipeline at any stage. No lock-in!
- ☁️ Runs on your laptop, on a powerful server, or on a high-performance cluster via Dash.

https://mne.tools/mne-bids-pipeline/stable/index.html


1. 📂 Filesystem initialization and dataset inspection
Initialize derivatives_dir
Find empty-room data matches
2. 🧹 Preprocessing
Assess data quality and find bad (and flat) channels
Estimate head positions
Maxwell-filter MEG data
Apply low- and high-pass filters
Temporal regression for artifact removal
Fit ICA
Extract epochs
Compute SSP
Find ICA artifacts
Apply SSP
Apply ICA
Remove epochs based on PTP amplitudes
3. 📡 Sensor-space analysis
Extract evoked data for each condition
Decode pairs of conditions based on entire epochs
Decode time-by-time using a 'sliding' estimator
Time-frequency decomposition
Decoding based on common spatial patterns (CSP)
Noise covariance estimation
Group average at the sensor level
4. 🧠 Source-space analysis
Create BEM surfaces
Compute BEM solution
Setup source space
Forward solution
Inverse solution
Group average at the source level
5. 🏄 FreeSurfer-related processing
Run FreeSurfer's recon-all
Generate coregistration surfaces



Data collection

Convert to BIDS format

Behavioural analysis

MNE-BIDS-Pipeline

Check M/EEG data quality

Semi-automatic, takes about 1 hour

Further, more specific analyses