NFT & NIST
Neuroelectromagnetic Forward and Inverse Head Modeling Toolbox

Zeynep AKALIN ACAR
17th EEGLAB Workshop, San Diego
November, 2013
Key Features:

- A complete framework for accurate forward problem solution.
- Easy-to-use MATLAB environment with GUI and command-line functions.
- Ability to use available subject information
  - T1-weighted 3D MR images
  - Digitized sensor (electrode) locations
Comparison with Dipfit

- The realistic model in Dipfit is a three-layer MNI head model represented with 3000 vertices.
  - The forward matrices are pre-calculated, so there is no need for FP calculations.

- NFT generates subject-specific models.
  - NFT does model generation and forward problem calculations.
  - More accurate.
Head modeling from MR images

From a magnetic Resonance Image

- Image Segmentation
- Mesh Generation
- Source Space Generation
- Electrode Co-Registration

T1-weighted MR image

Segmentation

Electrode Registration

BEM mesh
Classifies four tissues from T1-weighted images
Scalp, Skull, CSF and Brain
Head Modeling from Electrode Position Data

- Warp a template mesh to electrode positions
  - When no MR images are available
  - Non-rigid thin-plate spline warping
Forward Problem Solver

- MATLAB interface to numerical solvers
- Boundary Element Method or Finite Element Method
  - EEG Only (for now)
  - Interfaces to the Matrix generator executable written in C++
- Other computation done in MATLAB
- Generated matrices are stored on disk for future use.
Forward Problem Solution with FEM

- Tetgen for mesh generation
  - Uses BEM meshes as boundaries
- METU-FEM to generate transfer matrix
  - Compiled from source
  - Requires PETSc for matrix operations
- metufem .mex file for forward solutions in MATLAB
- Instructions available under README.FEM file.
Dipole Fitting

- Requires EEGLAB integration to access Component indices.
- Uses FieldTrip in EEGLAB for dipole fitting.
NIST – Neuroelectromagnetic Inverse Source Localization Toolbox

- Generates a cortical source space using Freesurfer
- Generates patches of cortex
- Solves distributed source localization using methods:
  - Patch-based Sparse Bayesian Learning (SBL) method
  - Sparse, compact, and smooth (SCS) method
NIST main window
EEG source localization

scalp
skull
CSF
brain
NFT download and reference

- http://www.sccn.ucsd.edu/nft