#7: Introduction Into Data Analysis at CBU MEG Lab

Yury Shtyrov
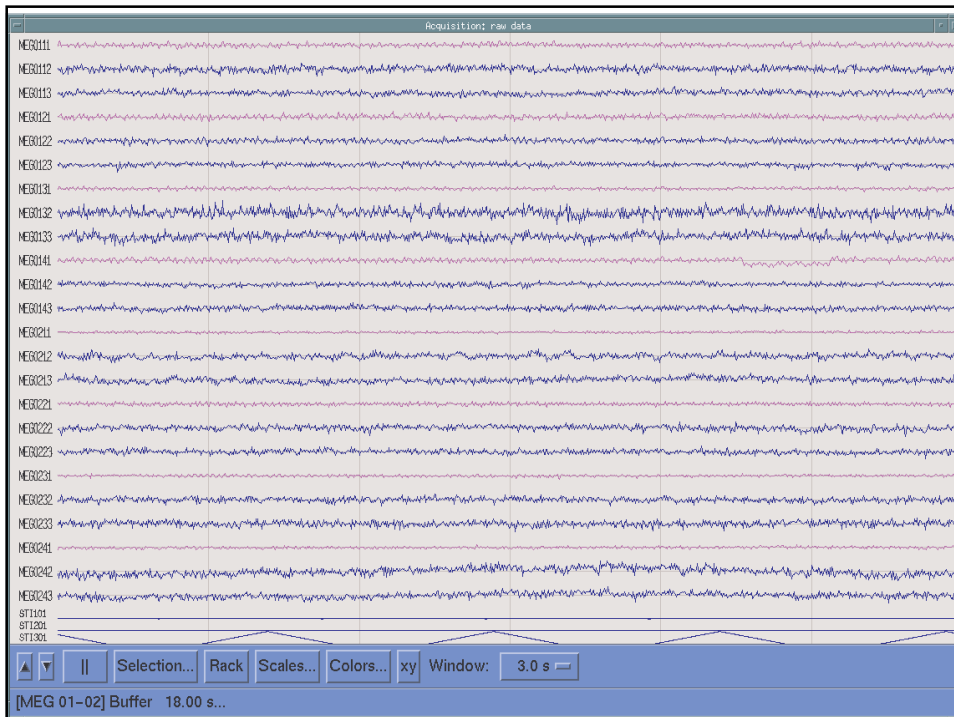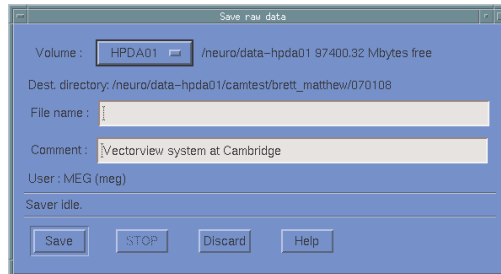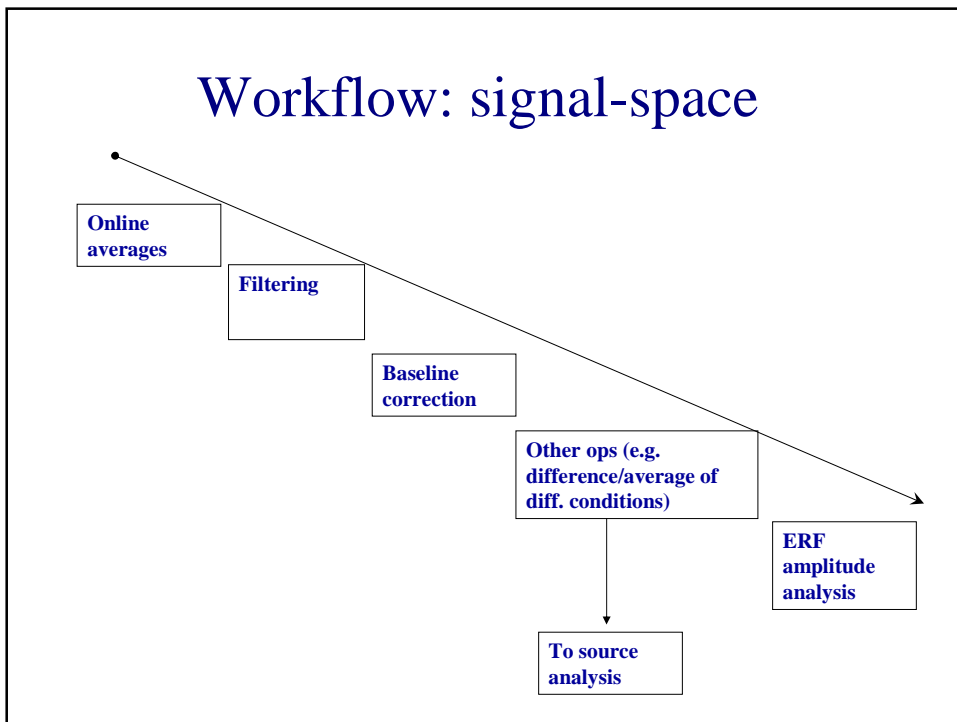
MRC Cognition and Brain Sciences Unit

The main points

- Workflow
- Practicalities: the what and where
- Continuous data pre-processing
- Data viewing
- ERFs
- Dipoles
- Dipoles-MRI integration
- Other programs

Two main data types

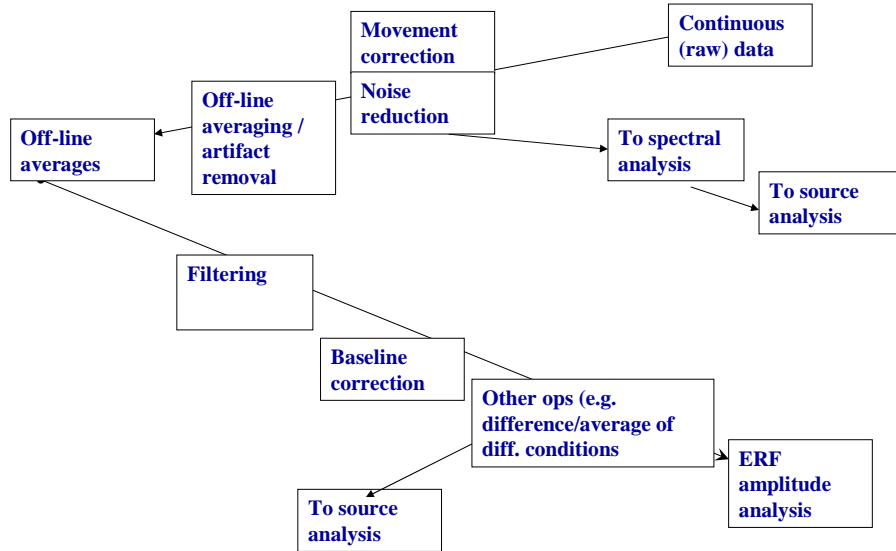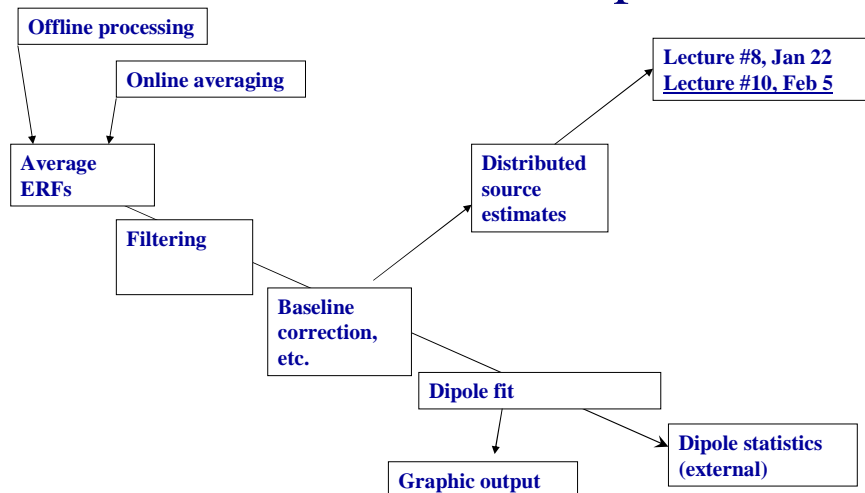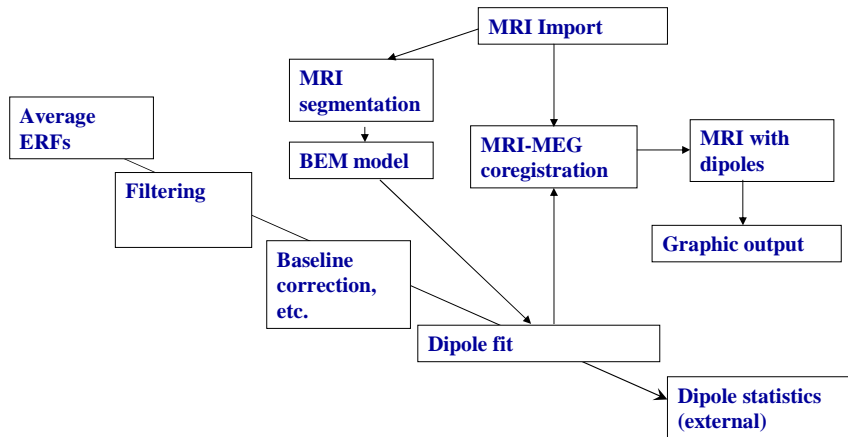• Save averages
AND raw data: two
separate fiff-files

Workflow: signal-space

Online averages

Filtering

Baseline correction

Other ops (e.g. difference/average of diff. conditions)

ERF amplitude analysis

To source analysis

Workflow: signal-space

```
                    ┌──────────────┐              ┌──────────────┐
                    │ Movement     │─────────────▶│ Continuous   │
                    │ correction   │              │ (raw) data   │
  ┌────────────┐    │              │              └──────────────┘
  │ Off-line   │    │ Noise        │
  │ averaging /│◀───│ reduction    │
  │ artifact   │    └──────────────┘        ┌──────────────┐
  │ removal    │                            │ To spectral  │
  └────────────┘                            │ analysis     │
┌────────────┐                              └──────────────┘
│ Off-line   │                                     ┌──────────────┐
│ averages   │                                     │ To source    │
└────────────┘                                     │ analysis     │
                                                   └──────────────┘
         ┌──────────────┐
         │ Filtering    │
         └──────────────┘
               ┌──────────────┐
               │ Baseline     │
               │ correction   │
               └──────────────┘    ┌────────────────────┐
                                   │ Other ops (e.g.    │
                                   │ difference/average │
                                   │ of diff.conditions │  ┌──────────┐
                                   └────────────────────┘  │ ERF      │
                    ┌──────────────┐                       │ amplitude│
                    │ To source    │                       │ analysis │
                    │ analysis     │                       └──────────┘
                    └──────────────┘
```

Workflow: source-space

```
┌──────────────────┐
│ Offline processing│
└──────────────────┘              ┌──────────────────────┐
      ┌──────────────────┐        │ Lecture #8, Jan 22   │
      │ Online averaging │        │ Lecture #10, Feb 5   │
      └──────────────────┘        └──────────────────────┘
┌────────────┐               ┌──────────────┐
│ Average    │               │ Distributed  │
│ ERFs       │               │ source       │
└────────────┘               │ estimates    │
      ┌──────────────┐       └──────────────┘
      │ Filtering    │
      └──────────────┘
            ┌──────────────┐
            │ Baseline     │
            │ correction,  │
            │ etc.         │
            └──────────────┘
                  ┌──────────────┐
                  │ Dipole fit   │
                  └──────────────┘
                                      ┌──────────────────┐
          ┌──────────────┐            │ Dipole statistics│
          │ Graphic output│           │ (external)       │
          └──────────────┘            └──────────────────┘
```

Workflow: source-space

Practicalities: data stream

– Data recorded to /megdata/

Subdirectories, e.g.

/megdata/cbu	=	CBU
/megdata/cbu_csl	=	CSL data collected at CBU

– Access to these is read-only

– Data private to institutions

– For further processing, cp your data to your imaging space, /imaging/user-name for CBU

Practicalities: analysis
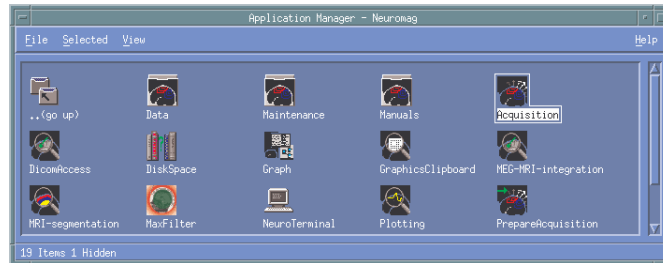
- – On HPs: /opt/neuromag/bin/vue
- – Continuous data access: Graph (Signal Processor), Maxfilter
- – Movement correction, noise reduction: MaxFilter
- – Averaging: Graph, MaxFilter

Practicalities: analysis
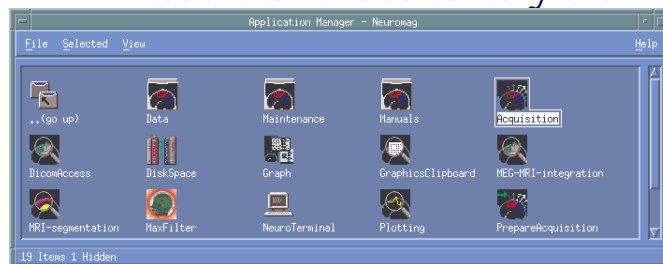
- – Averaged ERFs: Plotter
- – Source analysis: Xfit (dipoles), MCE (min norm)
- – MRI:
  - • DicommAccess – import into fiff format
  - • MRILab – MEG-MRI integration
  - • MRI-segmentation

Pre-processing of continuous data

– Viewing continuous data: Graph
– Powerful, can be used for batching
– Can control other applications
– The only tool for spectral/freq analysis in Neuromag package
– Complicated, user-unfriendly
– No linux version

Pre-processing of continuous data

MaxFilter:
– SSS noise reduction techniques
– Movement correction
– Offline averaging

– Simple GUI
– Command line interface

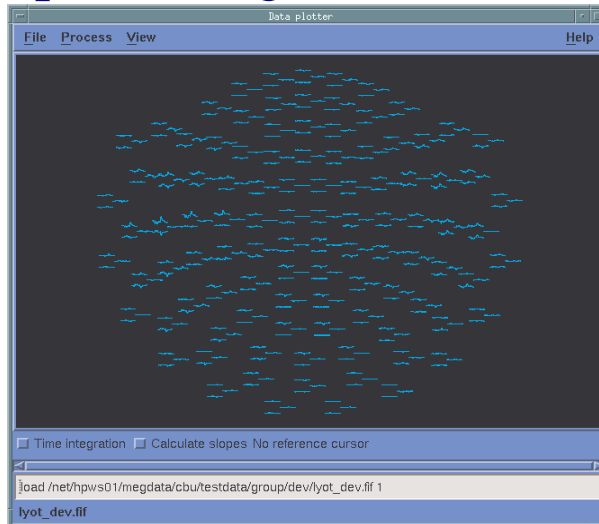– Averaging requires online averaging parameters to be pre-set

MaxFilter
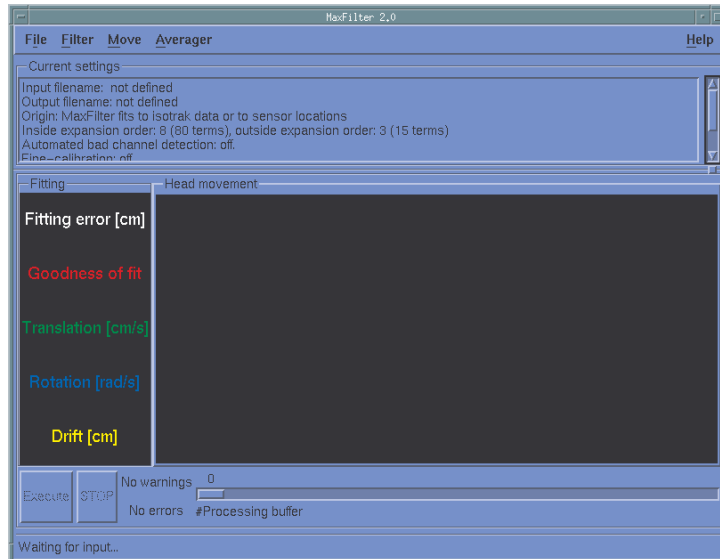
Workflow: signal-space
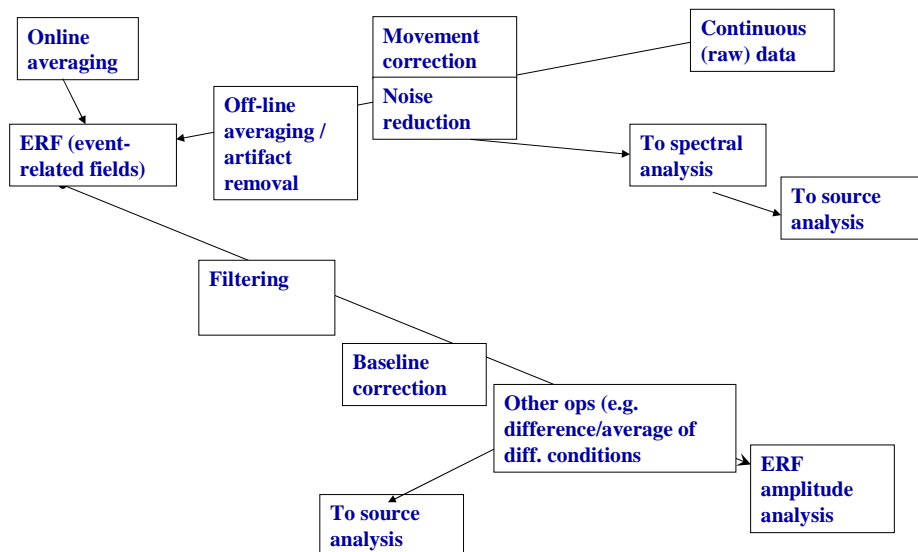
ERF viewing and basic processing: X-Plotter

ERF viewing and basic processing: X-Plotter

- Checking ERFs/bad channels
- Filtering, baseline correction
- Basic operation: subtraction, grand-average ERFs, etc.
- Peak detection and extraction for statistics
- Graphical output

Dipole source analysis: Xfit
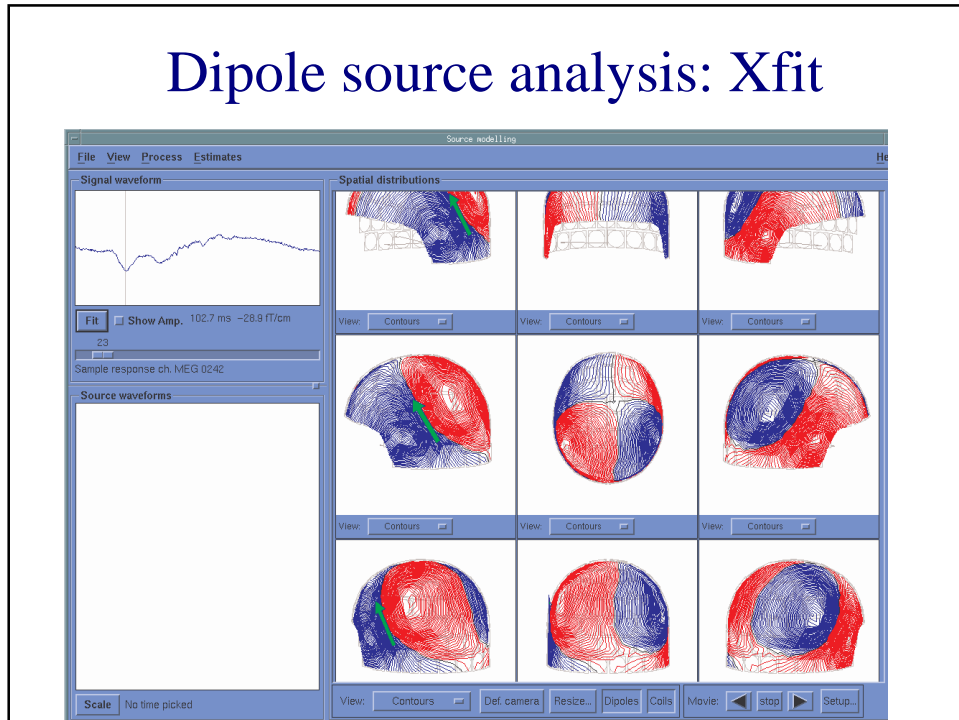
Dipole source analysis: Xfit

- Field maps
- Single and multiple dipoles
- Re-iterated dipole fitting for a time range
- Dipole selection
- Link to MRI module
- Dipole info output for reporting/statistics
- Graphics

MRI utilities

- DicomAccess – to convert dicomm slices into fiff-format readable by Neuromag software
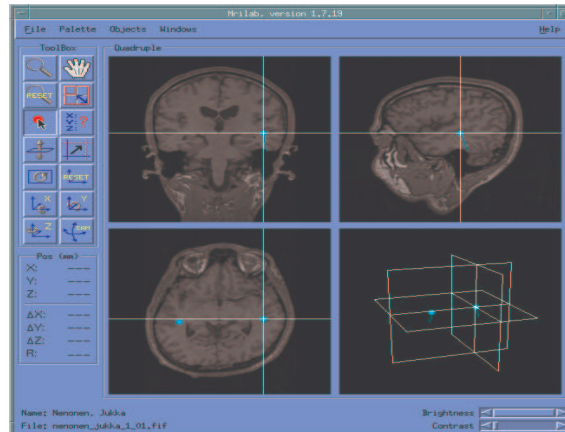

DicomAccess

MRI utilities

- MRILab –MEG-MRI integration

MEG-MRI integration

- Load MRI set (fiff-file)
- Co-register landmarks and or additional points
- Fit sphere (if not using BEM) and use in Xfit for head origin model
- Send dipoles from Xfit into MRILab

MEG-MRI integration

Other utilities

Neuromag:
- Minimum-norm current estimates
  - lectures by Olaf Hauk on 22.01 and
  - F. Pulvermuller on 5.02 (MCE)
- MRI Segmentation (seglab)
- Report composer
- Command-line utilities (MaxFilter, format conversion, access to fiff contents, etc.)

Other utilities

- CURRY
- BESA
- ASA
- MNE
- SPM5

Matlab access

- Fieldtrip:
http://www.ru.nl/fcdonders/fieldtrip/
- 4D toolbox:
http://neuro.hut.fi/~tanzer/d4d/
- FIFF Access:
http://www.kolumbus.fi/kuutela/programs/meg-pd/

HP, Linux
>ls /group/erp/bin/neuromag
>4Dtools-v1.1 meg-pd-1.2

Matlab access

- FIFF Access (Linux, HP):

>ls /group/erp/bin/neuromag/meg-pd-1.2

loadbdip.m   loadtri.m   rawdata.m   writeraw.m

badchans.m   loadfif.m   megmodel.m   savefif.m

chaninfo.m   loadmri.m   projmat.m   savemri.m

channames.m   loadtrans.m   rawchannels.m

subjno.m

- fiff2ascii conversion utility on HP machines
- Open-source Matlab tool for data access in progress

Next week

Lecture 8

Dr Olaf Hauk: Introduction and overview to EEG/MEG distributed source information

22.1.2007

THE END