

Lecture:

- Einführung in die Akquisition und Auswertung von MRT-Daten -

- Introduction to the Acquisition and Analysis of MRI Data -

Summary:

This lecture series is a comprehensive introduction to various tools for analyzing Magnetic Resonance Imaging (MRI) data, with a special focus on tools that are available at the Frankfurt Brain Imaging Center (BIC). After an introduction to the operating system Linux (which is common on servers used for scientific data evaluation), the most common image formats DICOM and NIfTI (including tools for conversion and viewing) are described, followed by the presentation of several FSL tools for segmentation, coregistration, normalization, distortion correction, and DTI analysis of brain data. For the creation of scientific graphics, the most important Matlab functions are described.

Target audience and prerequisites:

The lecture series is open to everybody who wants to learn about MRI data analysis. Importantly, there are no prerequisites.

Language:

English or German, as requested by the audience.

Place and Time:

In presence: Seminar area of the Brain Imaging Center, Schleusenweg 2-16, Building 95H, Campus Niederrad; Time: Tuesdays at 3pm.

Online (if requested or if lectures in presence are not possible): Links will be sent to registered participants.

Script:

The lecture material can be made available to registered participants.

Registration:

Via E-Mail to Prof. Dr. Ralf Deichmann <Deichmann@med.uni-frankfurt.de>

(see next pages for an overview of the lecture series)

Overview of the different parts:

Linux 1

0. Important Keys on your Keyboard
1. The Linux Shell
2. Working with directories
 - 2a. The Linux File System
 - 2b. Orientation and Moving in the Directory Tree
 - 2c. Create, Rename, Move, Copy, Remove Directories
 - 2d. Listing the Directory Contents
 - 2e. Using Wildcards
 - 2f. Getting the Size of Files and Directory Contents

Linux 2

1. Working with Files
 - 1a. How to rename, move, copy and delete files
 - 1b. How to get information on files
 - 1c. How to read from a text file
 - 1d. How to write into a text file
2. Searching for Files
3. Concatenating Commands: The "pipe"
4. Avoid unnecessary typing!
5. Access Rights
6. Stopping a Process

Linux 3

1. Shell Variables
2. Text Editing Tools: General
3. The command "sort"
4. The command "sed"
5. The command "awk"

Linux 4

1. Shell Scripts: Motivation
2. Coding and running a simple shell script
3. Calling a shell script with arguments
4. "if" statements in shell scripts
5. "while" loops in shell scripts
6. Interrupting a loop
7. "for" loops in shell scripts
8. "case" statements in shell scripts

Linux 5 - The "vi" Editor

0. Introduction
1. The concept
2. The first steps
3. Moving around in the text
4. Writing and modifying text
5. Separating and combining lines
6. Deleting, moving, copying and duplicating text
7. Undo/Redo changes, Repeat commands
8. Setting line numbers
9. Finding and replacing strings
10. Saving changes and quitting vi
11. Getting help on vi

Image Formats

1. The DICOM and the NIfTI format
2. Converting DICOM into NIfTI
3. Viewing NIfTI data with MRICRON
4. Reading NIfTI data into Matlab

Segmentation using FSL

1. Introduction: What is "Brain Extraction", "Nonuniformity Correction" and "Segmentation"?
2. Brain Extraction using "bet"
3. Nonuniformity Correction and Segmentation using "fast":
 - T1-weighted data with low signal bias
 - T1-weighted data with strong signal bias
 - T2-weighted data
4. Creating binary tissue masks with "fslmaths"

Coregistration and Normalization using FSL

1. Introduction: What is Coregistration ?
2. Coregistration of example data using "flirt"
 - Coregistration of congruent and non-congruent data
 - Application of existing coregistration matrices
 - Inversion and concatenation of coregistration matrices
 - When coreg. fails: a trick to improve results
 - Coregistration of binary masks
 - Resampling data with a different spatial resolution
3. Introduction: What is Spatial Normalization ?
4. Normalization of example data using "fnirt"

Distortion Correction of EPI Data using FSL

1. Introduction: Distortions of EPI Data
2. General: The Field Mapping method
3. General: The TOPUP method
4. Performing the Field Mapping method in FSL
5. Performing the TOPUP method in FSL

DTI Data Analysis with FSL - Part 1 (Provided by Manoj Shrestha)

1. Preparation of DTI data:
 - Denoising
 - Removal of Gibbs Ringing
 - Distortion Correction
 - Eddy Current Correction
2. Calculation of the most important maps:
 - Eigenvalues
 - Mean Diffusivity
 - Fractional Anisotropy (FA)
 - Eigenvectors

DTI Data Analysis with FSL - Part 2 (Provided by Manoj Shrestha)

1. Fibre Tracking

Creating Plots with Matlab

1. Creating 2D-Plots
2. Creating 3D-Plots

Encoding analysis of fMRI data

Provided by Seung-Goo Kim, under preparation

(Potentially, 2 parts about Matlab)