Measuring and Analyzing Brain Connectivity in Electrophysiological Measurements of Spike and Local Field Potential activity using Fieldtrip
[CosMo 2014 - Thilo Womeldorf - www.attentionlab.ca]

FieldTrip: http://fieldtrip.fcdonders.nl/
FieldTrip Download: http://github.com/fieldtrip/fieldtrip
Function Overview: http://fieldtrip.fcdonders.nl/reference
Fieldtrip Community: https://www.facebook.com/fieldtriptoolbox

• SPIKE ANALYSIS, COMMON MEASURES

Tutorial link: http://fieldtrip.fcdonders.nl/tutorial/spike

Content / Tutorial Objectives:
- Memory efficient representation of spike data; trial selection, spike waveform analysis,
  Interspike-interval distribution and return maps; raster plot / peri-stimulus time histograms (PSTH); cross-correlations; joint (j)PSTH,

Questions:
- What are the pros and cons of the two main ways to represent spike data in Fieldtrip?
- Why is it useful to analyze waveforms of spikes ?
- Which information conveys an interspike interval ?
- What is measured with a joint peristimulus time histogram (JPSTH) analysis?
- What does a shuffle predicted JPSTH control for and how does it do this?

• SPIKE - LOCAL FIELD POTENTIAL ANALYSIS

Tutorial link: http://fieldtrip.fcdonders.nl/tutorial/spikefield

Content / Tutorial Objectives:
- Representing point processes (spikes) and continuous data (LFP), Spike-Triggered LFP Averages; Circular statistics on spike-phases; Unbiased and refractoriness corrected Pairwise-Phase Consistency (PPC), Phase Locking Values (PLV)

Questions:
- What additional information is provided by the PPC compared to the Spike Triggered (LFP) Average ?
- What is the advantage of the PPC over the PLV in spike-field synchronization analysis
• TIME FREQUENCY ANALYSIS

Tutorial link: http://fieldtrip.fcdonders.nl/tutorial/timefrequencyanalysis


Content / Tutorial Objectives:
- Time-frequency Analysis of Power; Similarity and differences of frequency analysis methods (Hanning, multitaper, Wavelet); Multitaper time frequency analysis; Effects of analysis time windows on frequency resolution; Effects of taper smoothing width on time frequency results.

Questions:
- What are differences between multitaper- and wavelet- methods ?
- Why is it not recommended to use multitapers for low (<20 Hz) frequencies ?
- Which criteria do you use to determine the time window width for a time-freq analysis of experimental data?
- Which criteria are you applying to choose the taper smoothing frequency ?

• COHESENCE ANALYSIS

Tutorial link: http://fieldtrip.fcdonders.nl/tutorial/coherence


Content / Tutorial Objectives:
- EMG - MEG coherence analysis; Filtering and preprocessing of signals; Changing frequency resolutions; Analysis of Power-spectra and cross-spectral densities; Influence of different taper smoothing of EMG and/or MEG channels on EMG-MEG coherence; Influence of number of trials on coherence estimates.

Questions:
- What is cortico-muscular coherence ?
- How do results change with low versus high taper smoothing of the multitaper fourier analysis preceding coherence ?
- How do the number of trials available for analysis influence the coherence results?

• CONNECTIVITY ANALYSIS (Optional)

Tutorial link: http://fieldtrip.fcdonders.nl/tutorial/connectivity