OHBM 2014 Electrical Neuroimaging course 2014

EEG & ERP - baselines

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Baseline

• Baseline vs reference
• Baseline state
• Baseline condition
• Baseline correction, filtering
• Informed baseline choice
EEG sources, map zero, baseline

Radial dipoles on a gyrus

Tangential dipoles in a sulcus

Baseline (t) ≠ reference (x,y,z)
but implicit zero baseline at recording reference
Baseline - reference

Baseline \( (t) \neq \) reference \( (x,y,z) \)
but implicit zero baseline at recording reference

Mismatch negativity: Gottselig et al 2004
Michel et al 2009
EEG, Microstates

From Michel et al: *Electrical Neuroimaging*

**EEG Baseline: amplifier technical zero + filter settings**
**EEG: envelopes**

- **Slow**
  - +100 µV
  - -100 µV

- **Fast(er)**
  - +100 µV
  - -100 µV

*Brookes et al 2011; Hipp et al 2012*

**Event-related EEG changes (ERD, ERS): baseline as reference interval**
Maps and waveshapes: displaying the same data

ERP Baseline: technical zero + filters; not prestimulus activity
Event-related potentials (ERP) – phase locked averaging of EEG

1. Event
2. Event
... Event
30. Event

Average

--- ERP: time course of information processing

ERP Baseline: noise mean zero, prestimulus mean?
Baseline

VEP > P300

+ CNV

- Baseline (CNV)

= VEP-correction > CNV- inversion

Lehmann et al 1982, 1984; Koenig & Gianotti 2009
Deconvolution

Deconvolving / separating overlapping activity requires jitter between events

Woldorff et al 1993

Lütkenhöner 2011
Typical ERP Attention Test

cued Continuous Performance Test (CPT O-X, A-X)
Regular letter sequence: press for O-X sequence (10%)
fixed SOA 1.65s – systematic time estimation & preparation

Attention, preparation & Go-NoGo-Test

Attention - baseline

Attention: Preparation before 0 s, Filter after 0.1 s, Resource after 0.4 s …
Baseline – preparatory CNV

Figure 2 Familial effects on cue and no-go P3 components. Control participants in red, fathers in green and ADHD participants in black, with maps.

McLoughlin et al 2011
CNV relevant preparatory prestimulus activity

Flanker-CPT

-- Controls
-- Nonaffected Sibs
-- ADHD

Reduced CNV in ADHD - Impaired preparation is familial
Baseline – correction vs distortion

Subtraction assumes constant, sustained, irrelevant baseline activity
Baseline - affects variance
fMRI – EEG (t)

Activations - Synchronization
Summation - Cancellation
Localise – Estimate
Indirect - Direct
Slow - Fast
fMRI: Methods (SPM)

- Image time-series
- Spatial filter
- Design matrix
- Statistical Parametric Map
  - Statistical Inference
    - RFT
    - $p < 0.05$

- Realignment
- Smoothing
- General Linear Model
- Parameter estimates
- Normalisation
- Anatomical reference

No baseline correction
Baseline

- Baseline - technical zero, filter, zero mean
- Baseline - state, condition
- Baseline „correction“ - often inadequate
- Baseline - analysis & informed choice