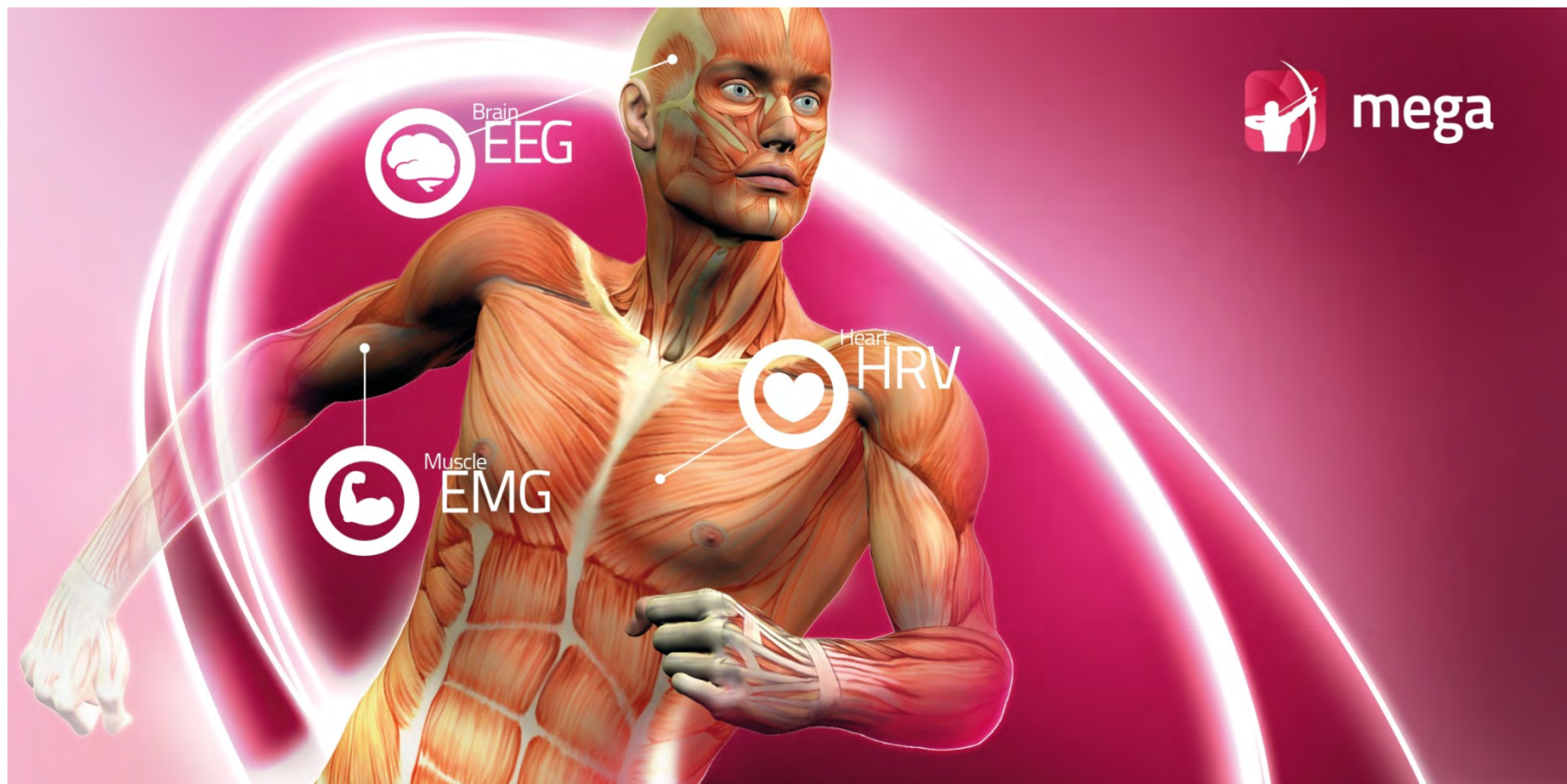# NeurOne – EEG and applications

Jukka Kinnunen – Distributor meeting 2014

NeurOne – EEG and applications

Content:
- Brain anatomy and physiology
- Background of EEG and MEG
  - EEG -electroencephalography vs. MEG - magnetoencephalography
  - Electrodes
  - Placing of electrodes – 10/20 system
  - Amplifier / how it works
    - Referential channels
    - Bipolar channels
  - Digitizing signals
  - EEG montage
- NeurOne Applications
  - EEG & ERP
  - TMS EEG
  - EEG during fMRI study
  - Group Studies
- NeurOne hardware
- NeurOne software
- NeurOne options: Video, BCI2000, SIMULINK

NeurOne – EEG technology

Aalto university – NeurOne, Magstim TMS

NeurOne – Tesla amplifier

- Tesla and Tesla MRI
- 24 bit resolution
- Wide band DC-3500 Hz
- Sampling rate up to 80 kHz/channel
- Large dynamic range +/- 430 mV
- AC and DC measurement modes switchable channel by channel
  - AC: gain=50 ➜ +/- 86 mV
  - DC: gain=10 ➜ +/- 430 mV
- 40 channels amplifiers having 32 EEG and 8 bipolar channels
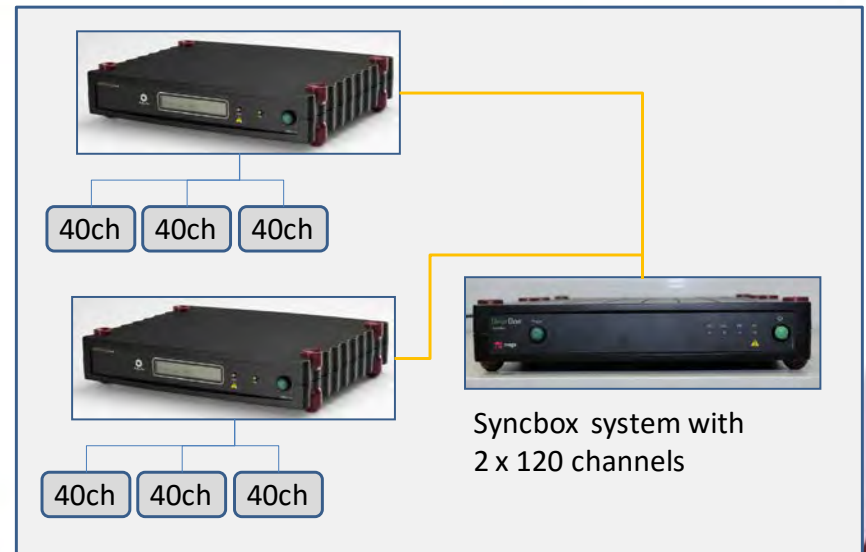- 40 to 160 channels in basic version

Highlights

NeurOne system

- Neurone Syncbox allows NeurOne system to be synchronized to external clock or allowing 10 main units to be synchronized
- Up to 1200 channels – resolution for Dense Array EEG
- Up to 30 amplifiers running in synchrony allowing multiperson studies

Syncbox system with 2 x 120 channels

Brainstorm technology

NeurOne – specs

Specs:	DC Mode	AC Mode
Analog band:	LP: 3.5 kHz	HP: 0.16Hz, LP: 3.5 kHz
Full scale Input Range:	± 430 mV	± 86 mV
System Gain:	10	50
Sensitivity:	51 nV/bit	5.1 nV/bit
Noise:	<0.8 µV RMS (0-200 Hz)	<0.6 µV RMS (0.16-200 Hz)
	<2.0 µV RMS (DC-3500 Hz)	< 1.5 µV RMS (0.16-3500 Hz)

| Max. sampling rates: technology with Syncbox	Neurone	NeurOne Brainstorm
80 kHz (up to 20 ch)	80 kHz (max. 10 x 20 ch – one amp/main unit)	
40 kHz (up to 40 ch)	40 kHz (max. 10 x 40 ch – one amp/main unit)	
20 kHz (up to 80 ch)	20 kHz (max. 1200 ch)	
10 kHz (up to 160 ch)		

Specifications

NeurOne Software

- Windows 7 or later
- SQL database
- 64 bit architecture – version 1.4
    - totally rewritten driver to support Brainstorm technology with Syncbox allows recording of 1200 channels with 20 kHz sampling
- Workflow – Measurement protocol guarantees that signals are recorded same way every time
- Online averaging and TMS artefact correction
- Basic EEG Review

NeurOne Software

NeurOne options:
- Video - Full HD support
- Matlab reader + EEGLAB plugin - free
- Mediator – Matlab/.NET interface
- BCI2000 Driver
- Matlab SIMULINK
- BESA Analysis software
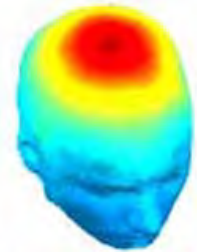
Options
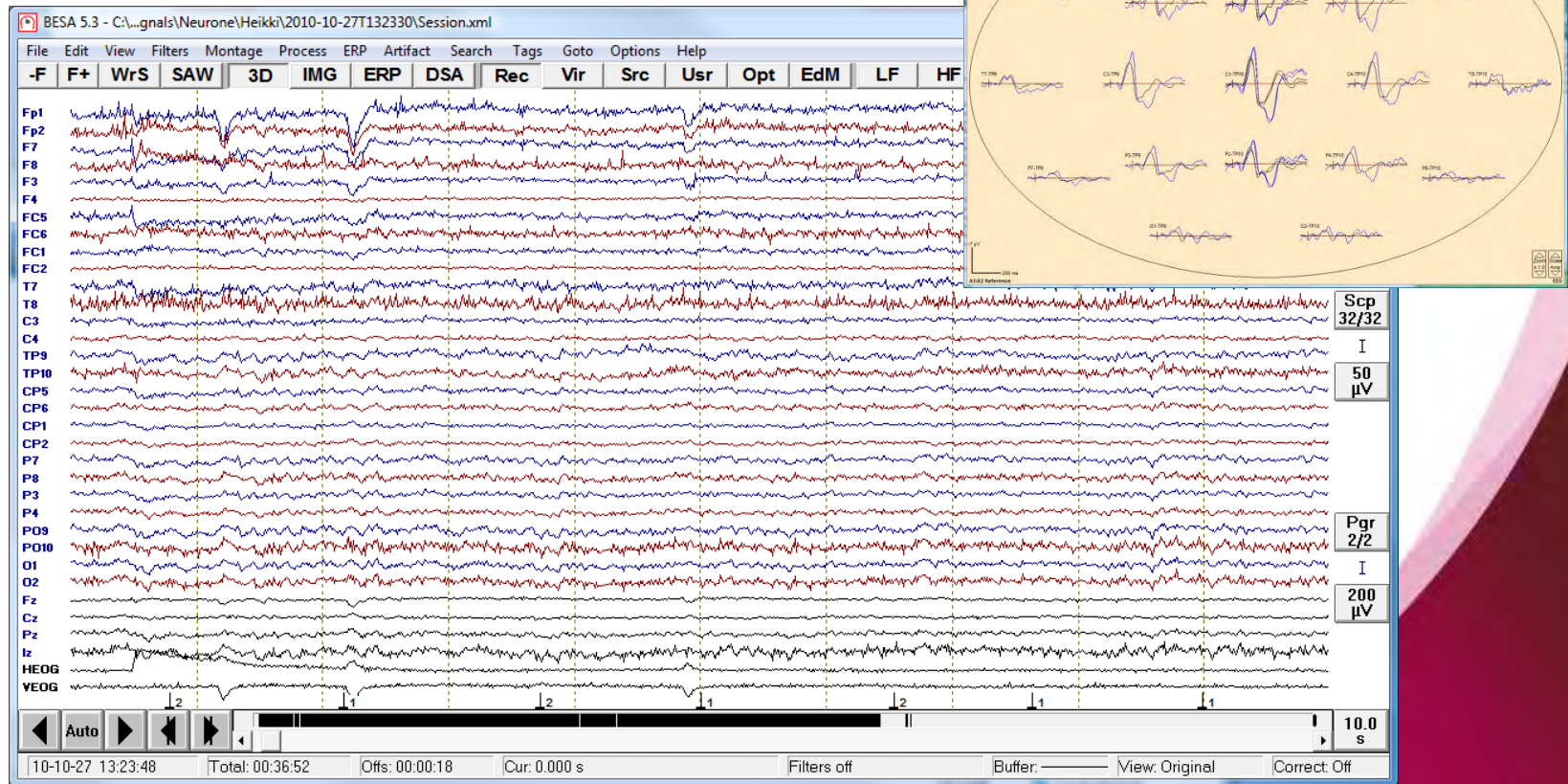
NeurOne –EEG/ERP/EP

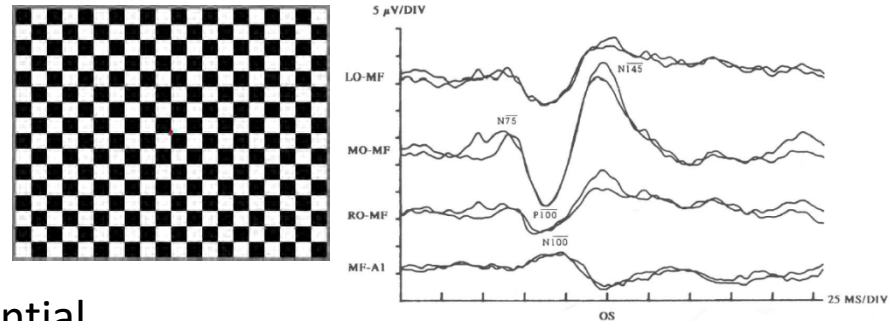ERP: Event Related Potential (auditory, visual, …..)
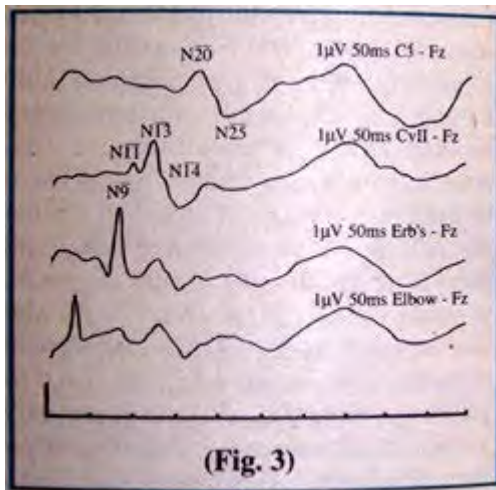
Applications – P300

NeurOne –EEG/ERP/EP

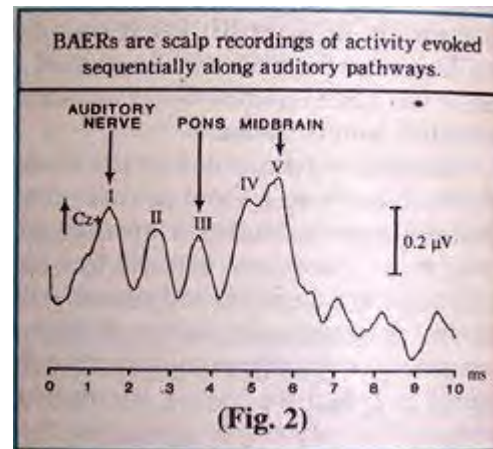EP: Evoked potential (auditory, visual, electric, cold, heat, pain)

VEP – Visual Evoked Potential

SEP – Somatosensory Evoked Potential

BAEP – Brainstem Auditory Evoked Potential

(Fig. 3)

(Fig. 2)

Applications – Evoked Potentials
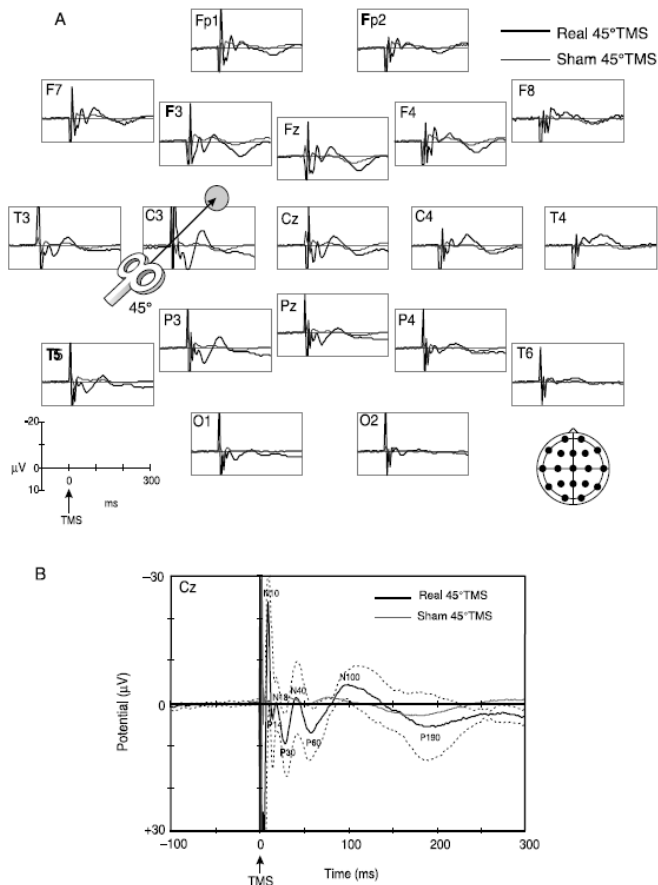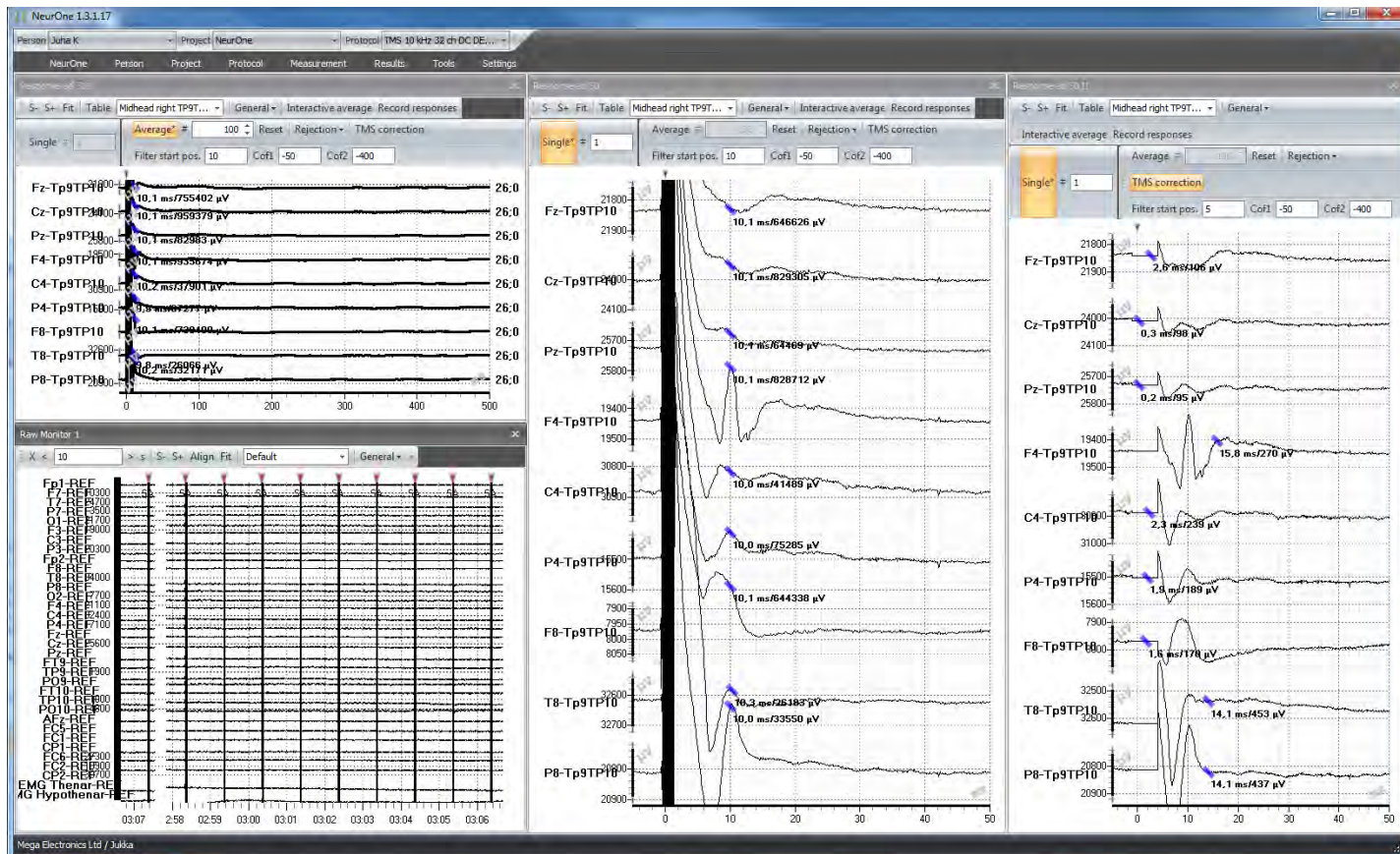
NeurOne – TMS EEG

Fig. 1. (A) **Grand average** of the electroencephalographic (EEG) responses from 100 ms pre to 300 ms post-transcranial magnetic stimulation (TMS) at all scalp locations recorded during real-TMS and Sham-TMS. This figure refers to stimulation of the left primary motor cortex (MI) performed with the coil oriented 458 away from the midline and with the handle pointing backwards and laterally. The grey point indicates the site of stimulation (between F3 and C3), while the arrow indicates the orientation of the coil in respect to the stimulation site (45° to the sagittal plane). The electrode montage used for the experiment is shown at the bottom. Polarity of the waveforms is plotted with negative values upward in this and subsequent figures. The two Sham-TMS conditions (Sham 1- TMS and Sham 2-TMS) have been averaged. (B) Grand average of the EEG responses recorded at the vertex (Cz) during the real-TMS (thick solid line) and the Sham-TMS (thin solid line) conditions of the left MI performed with the coil oriented 45° away the midline and with the handle pointing backwards and laterally. Standard deviation of real TMS is also shown (dashed line). The onset of the TMS stimulus (at 0 ms) is labelled. Main features are marked in these sample waveforms for orientation. The two Sham-TMS conditions (Sham 1-TMS and Sham 2-TMS) have been averaged.

N=450-500

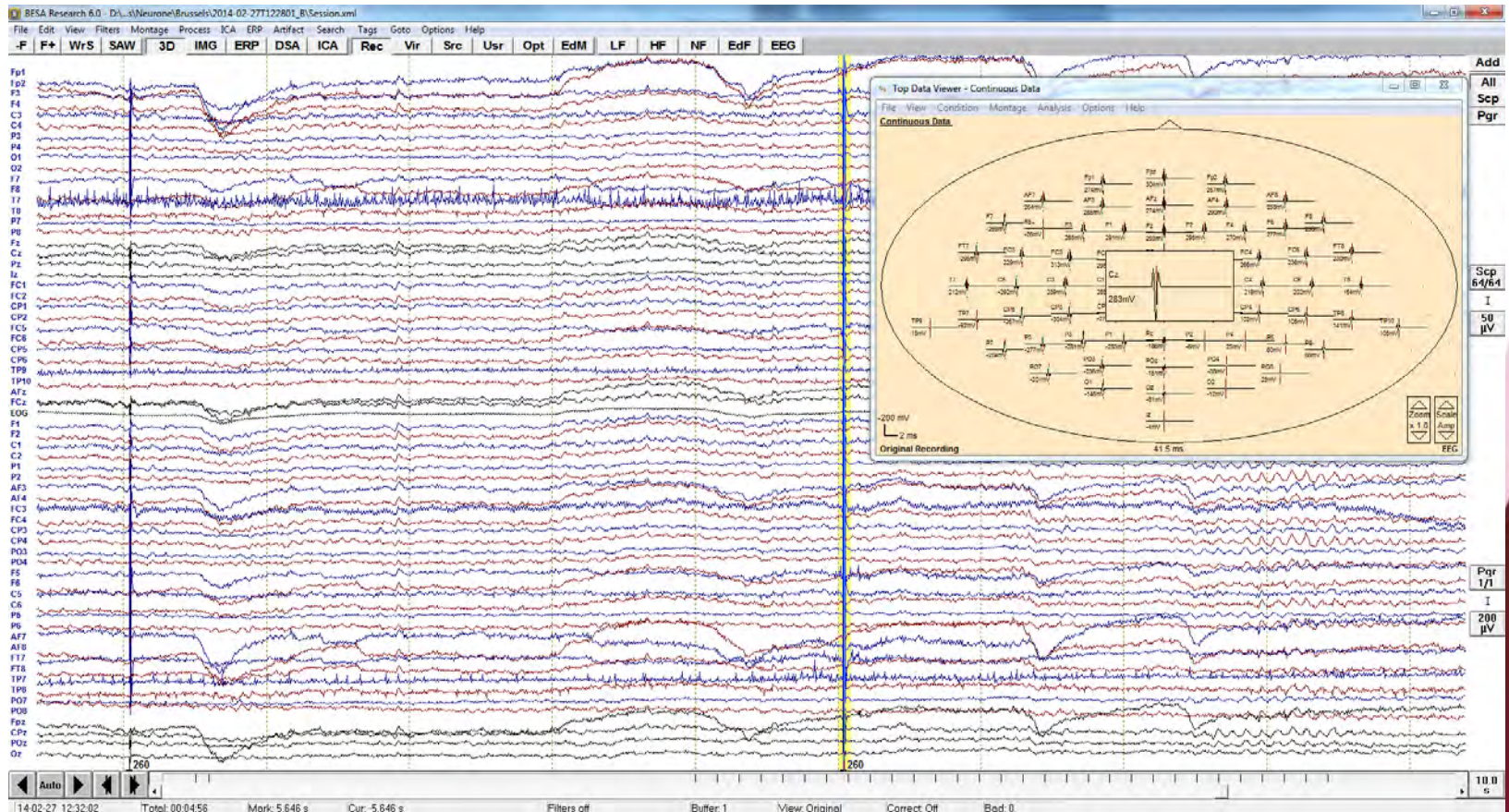C. Bonato et al. / Clinical Neurophysiology 117 (2006) 1699–1707
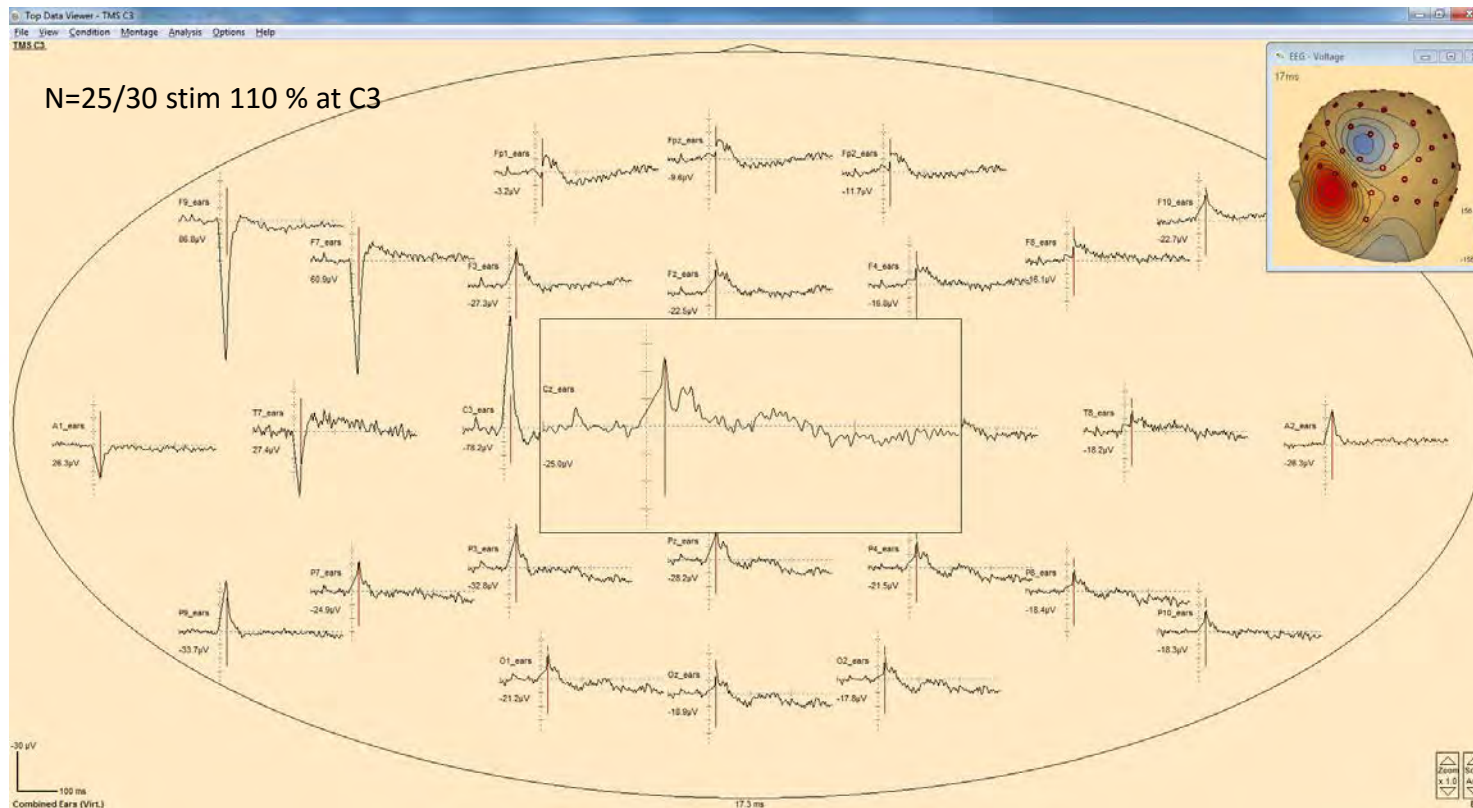
Applications ➔ NeurOne Tesla with TMS compatible cap

NeurOne – TMS EEG

Applications ➔ NeurOne Tesla with TMS compatible cap
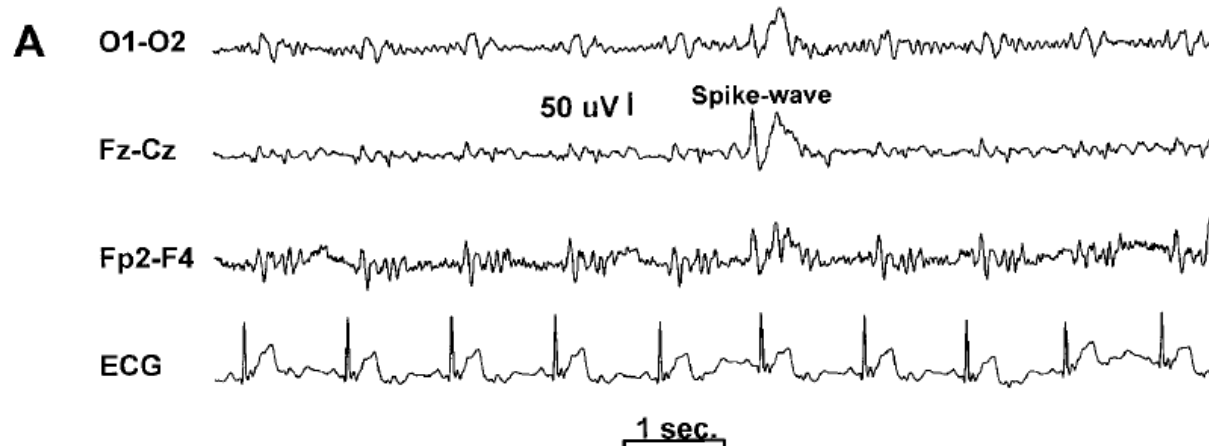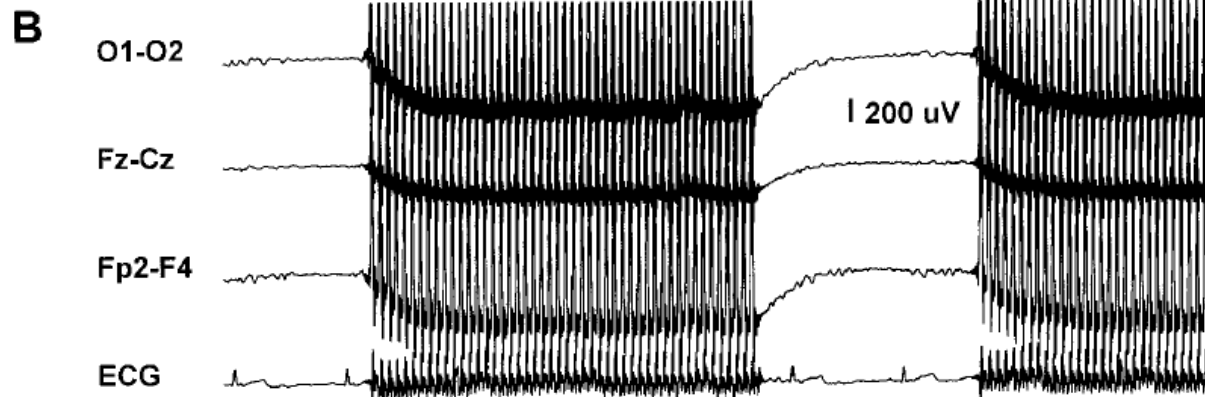
NeurOne – TMS EEG

Applications ➔ NeurOne Tesla with TMS compatible cap

NeurOne – TMS EEG

N=25/30 stim 110 % at C3

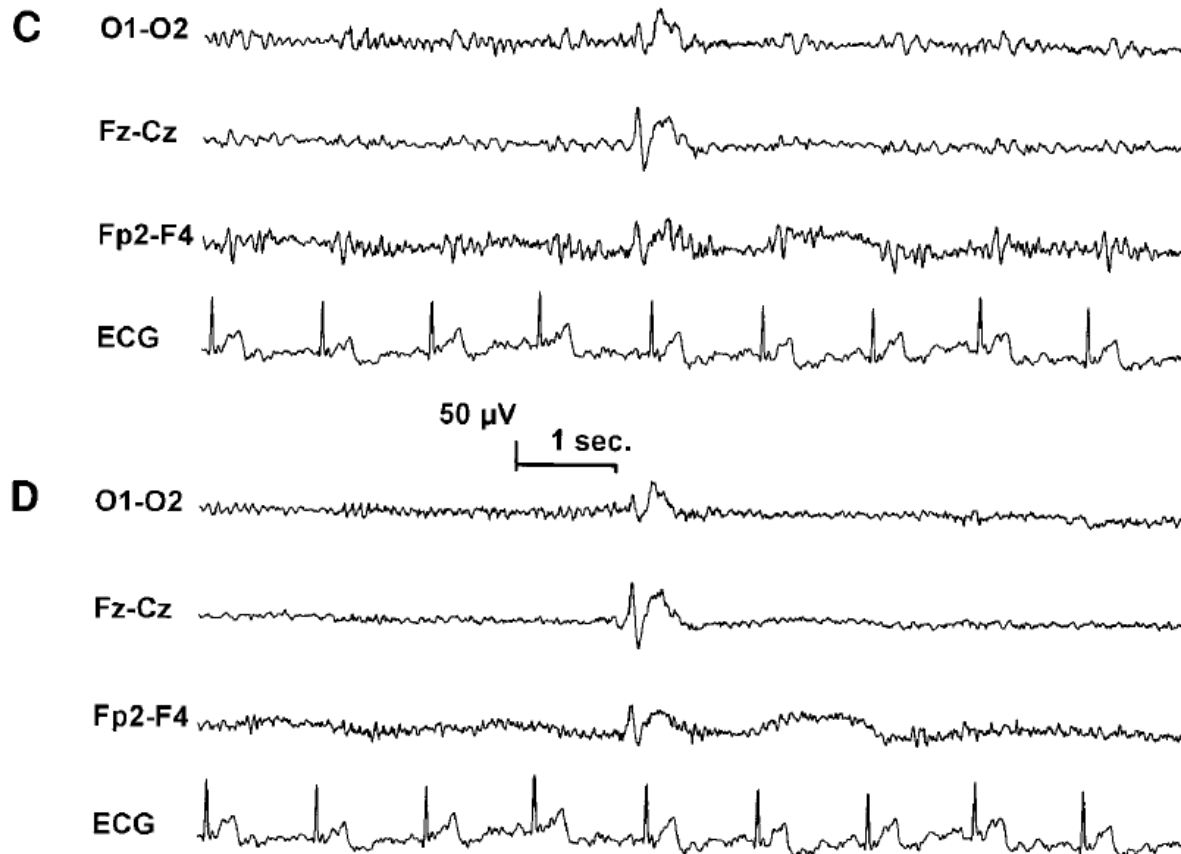**Applications ➜ NeurOne Tesla with TMS compatible cap**

NeurOne – EEG with fMRI

Allen 2000:
A) EEG in scanner
B) Scanning On/Off
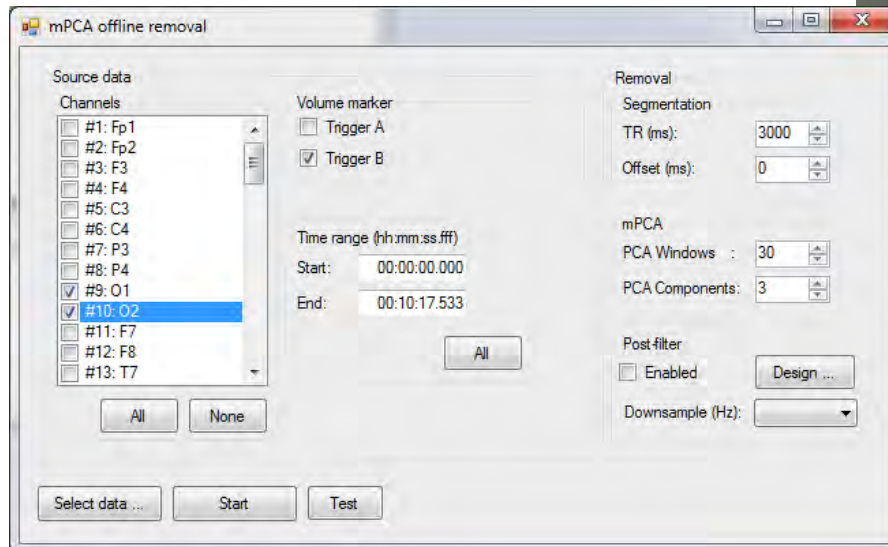
Applications

NeurOne – EEG with fMRI

Allen 2000:
C) Gradient artefact removed
D) Ballistocardiac artefact also removed

Applications

NeurOne – EEG with fMRI

Applications: NeurOne Tesla MRI with MRI compatible cap