Motor Threshold

Introduction to MEP Monitor

Guideline for performing motor threshold with MagPro and MEP Monitor
When performing Transcranial Magnetic Stimulation (TMS) the relative intensity or strength of stimulation is often referred to as % of Motor Threshold (MT).

MT is a patient specific value for each subject or patient which is determined before the TMS session. When a magnetic coil is discharged over the motor cortex and the discharge energy is over threshold value neurons are activated and the targeted muscles might twitch.

MT is regarded as an indicator for the subject ability to respond to TMS or an indicator for the relative cortical excitability. Some patients have a high TMS value other a lower value. In the literature MT is the most common reference measure for stimulation intensity.

The visible twitch is associated with an electrical signal from the muscle action or a Motor Evoked Potential (MEP) which can be recorded by surface electrodes connected to an EMG instrument (MEP Monitor).

The signal obtained gives information about:
- Time between the TMS pulse and the onset of TMS (latency time).
- MT the minimum TMS energy required to evoke a MEP.
- The size of MEP.
The motor cortex area on the brain is used as the indicator area because it’s one of few areas in the brain where TMS is associated with easily observable phenomena.

The MT is defined as: the minimum single pulse TMS energy needed to observe an Abductor Pollicis Brevis contraction (APB or muscle in the hand that functions as an abductor of the thumb).

MT is believed relatively stable over time so it’s customary to only do a full determination every 1 or 2 weeks.

MT can be determined in two ways:
  • visual determination, in which the APB is defined as a minimal twitch of the muscle.
  • by MEP recording which this note is about.

Stimulation of a specific area

Upper limb: over the left hemisphere for recording on the right limb.

Lower limb: over the vertex
Motor threshold is measured on the right APB muscle

To minimize the noise level grounding of MagPro through mains power cord is required. Make sure wall-outlet includes ground.

Grounding electrode must be placed between the recording electrodes and the stimulation point, eg. on the dorsum of the hand. If surface grounding electrode is not sufficient a wrist grounding electrode type can improve the noise level.

Make sure that all electrodes have good contact with the skin. Clean skin using alcohol swab. If using wrist grounding electrode the electrode must be soaked with saline.
The MEP Monitor is a one channel EMG amplifier mounted on the back of MagPro, optimized for Motor Evoked Potentials (MEP) recordings.

The MEP Monitor settings are available via the MEP softkey in the configuration menu.

**Time Base:** 1-10ms/div. Recording always 100ms!

**Sensitivity:** 100uV-10mV/div

**Panning:** Panning through all 100ms recordings

**Curve No:** Number of displayed curve. 1-10 shows all curves

**Common Baseline:** On/off when showing more than one curve

**Lower/upper freq.:** Filter settings

**Trigger Mode:** Stimulus or level trig mode

**Display Size:** Full or reduced

**Stay on top:** Display on or off

**Save:** No / Yes to USB stick
**Trigger Facilities**

**Recording of the MEP signals are default started by the stimulus trigger signal**

(MEP Trigger Mode: Stimulus)

- Output Trig Delay possible from -100ms to +100ms
- For Twin- or Dual Pulses Trig Output can be selected for Pulse A, Pulse B or both A+B
- Latency time base on MEP curve is calculated from the recording start. If real latency is required, trigger delay and trig pulse values must be included.
The motor threshold is determined with the MEP Monitor

1. Set “Amplitude” at 60-70%

2. Place the coil above the APB motor cortex approximately 5cm below the centerline of the head. For figure of 8 coil: in a 45° angle. Coil must be tangential to the scalp!

3. With successive Biphasic Single Pulse (IPI 3-5 seconds), find the highest response by moving in 3D the coil around the target point.

4. Keep coil in position and reduce “Amplitude” until the lowest response is reached (50 µV peak-peak by 10 consecutive stimuli).

5. Take note of the new “Amplitude” and the “Realized di/dt”, this is the Motor Threshold (MT).
MEP settings – Motor Threshold

**Important note:**
In many cases, you have to increase the sensitivity when you are close to the motor threshold.
Post processing of MEP curves

After recording of MEP curves post processing is possible

Time Base: Possible to change
Sensitivity: Possible to change
Curve No.: Possible to step through last 10 recorded MEP curves or see all curves at once

Lower/upper freq.: Change of filters is not possible

Save: If Yes, the information on the display curve area is exported to USB stick

Time Cursors | Amplitude Cursors | Average Curve
Export to USB and Excel

**MEP recordings on the display can be exported to a USB stick**

- USB stick mounted on the upper USB connector on the MagPro rear panel
- USB stick must be max. 2Gb with FAT16 format
- Select SAVE in the MEP Menu to export display curves to USB in csv-format
- Filename is displayed on the screen

After export the csv-file can be imported into Microsoft Excel or other spreadsheet program

*Note: if the computer is not using the semicolon “;” as separator the Excel will import all curve data into one cell instead of separated cells, to prevent this the csv-file must be renamed to a .txt file.*

With the .txt file the Excel will ask for separator sign during the open file process and here the semicolon sign is chosen.

- Select the curve data (red rectangle below)
- Create a chart based on XY scatter type
Printout of MEP settings and MEP curves from Excel