Navigated Brain Stimulation
Neurosurgery starts here
Plan with confidence
In surgical treatment for brain tumors, there is increasing evidence that an aggressive resection approach correlates with survival time free from recurrence. However, achieving good outcomes when tumors are close to the central sulcus, requires reliable information on the location of vital eloquent areas.

NBS mapping helps plan surgical approaches in challenging cases. Using NBS may also help avoid multiple or exploratory operations and allow patients, who earlier might not have been considered, to benefit from advanced preoperative workup.

What is NBS?
NBS is neuronavigated transcranial magnetic stimulation (TMS). The induced electric field (E-field) is accurately displayed in a 3D rendering of the individual patient’s magnetic resonance image (MRI). Patient responses to E-field stimuli, motor evoked potentials (MEPs), are detected by EMG recording of the muscles. In essence, NBS is direct cortical stimulation without craniotomy.

Fulfilling the promise of TMS
NBS builds on the proven accuracy of stereotactic navigation. Harnessing recent advances in the understanding of intracranial E-field behavior and advances in stimulator technologies, Nexstim has fulfilled the promise of TMS. Much like driving a car with GPS, the operator can freely guide the E-field through the intracranial structures, just by moving the TMS coil over the patient’s head.

Advantages of NBS
• Non-invasive, direct
• No patient tasks
• Maps paretic patients
• Cost-effective
• DICOM-export
• Maps adults and children

Benefits of NBS in cortical mapping
• Helps surgical decision making
• More informed approach lowers risk of damage to eloquent motor cortex
• May help avoid multiple or exploratory operations
• Saves time in the OR
• Improves patient dialogue

Clear functional maps of the brain help facilitate discussions with patients prior to decisions on treatment and the images can be transferred to the surgical neuronavigator for further planning and intraoperative reference. In surgery, NBS data can significantly reduce the time spent on electrode placement if invasive mapping is required.

Why choose NBS?
The NBS System is the only non-invasive cortical mapping device with FDA clearance for pre-procedural planning. NBS has been compared to intraoperative DCS and has been shown to localize the primary motor cortex to the same cortical gyrus as DCS.

Earlier methods, like indirect fMRI, perform well in healthy subjects. However, edema surrounding large tumors complicates the use of BOLD-imaging, and paresis prevents the use of tasks. NBS is unaffected by edema, and mapping can be performed in paretic patients as well as in those unable to co-operate.

Nexstim NBS System
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1. Prepare
Upload a standard MRI and the NBS System computes a detailed 3D rendering of the head and intracranial structures. Peeling layer-by-layer you can view the brain at any desired intracranial depth. Place surface electrodes over the desired muscles. The 6-channel EMG module automatically calculates and records all MEP amplitudes and latencies.

2. Align
With the patient wearing a head tracker (eyeframe), you can use the pointer to register 12 scalp points to the 3D rendering in just 40 seconds. Computer-aided landmark identification ensures accurate alignment to the MRI data. Once aligned, everything you need for mapping is displayed on the NBS System screens.

3. Stimulate
Individual motor threshold finding
Trigger the foot switch and the TMS coil stimulates the underlying cortex. Once you find the representation area for the target muscle, the NBS System finds the patient’s individual motor threshold (MT) for you. With the stimulator output now set to the optimal mapping intensity, the NBS System reliably measures MEPs – enabling the high spatial resolution needed for accurate mapping.

4. Analyze
As the session proceeds, you create a map of the cortical somatotopy, clearly marked with the motor representation areas. Full, automatic documentation of the session parameters and responses enables post-hoc analysis offline. Stored data and on-screen help enable you to precisely replicate any session at a later date.

5. Export
Export images in DICOM to planning systems or direct to the neuronavigator. In the OR, NBS cortical maps help optimal placement of DCS electrodes and facilitate surgical guidance. In radiosurgical planning, cortical maps help ensure safety of eloquent areas.

Map with E-field
The NBS System uniquely determines the actual location of the stimulating electric field (E-field) in the cortex, taking into account the size and shape of the individual patient’s head, as well as the TMS coil and stimulator parameters. As you move the TMS coil over the patient’s head, you can always see, in real-time, the E-field location, strength and direction in the 3-D intracranial rendering. Trigger the stimulation coil and you instantly see the MEP responses on the EMG screen. On-screen grids and other tools guide your session. As you map, the areas in the cortex with maximal EMG responses are highlighted.
Coil type recognition: automatic

40% of maximum stimulator output

Adult), MT of hand muscle (healthy adult) is approximately

Maximum stimulator output: ~ 2.5x MT of hand muscle (healthy

correspond to E-field intensity (V/m)

User-adjustable stimulator output (% of maximum) to

conductor model representing the human head)

25 mm (1.0 in) below the Nexstim Focal coil in spherical

Accurate TMS control and delivery

Nexstim TMS II stimulator module (integrated in mobile NBS cart)

DICOM export of EMG-response amplitude maps

Recalculation of EMG amplitudes and latencies

Crosshair tool for online/offline manual review and

response data for later replication or offline analysis

Documentation of session workflow and stimulation and

interactive analysis table for EMG responses

Review of stimulus locations synchronized with EMG responses,

Display of EMG response-based somatotopy map, channel color

EMG response amplitude maps

Automatic MEP peak-to-peak and latency calculation

(user-selected muscle labeling)

Automatic: MEP peak-to-peak and latency calculation

Automatic: generation of colored (linear fading) voltage-scaled

EMG response amplitude maps

Display of EMG response-based somatotopy map, channel color

identified by strongest response value

Review of stimulus locations synchronized with EMG responses,

interactive analysis table for EMG responses

Documentation of session workflow and stimulation and

response data for later replication or offline analysis

Crosstool tool for online/offline manual review and

recalculation of EMG amplitudes and latencies

Integration into neurological clinical workflow

DICOM export of EMG-response amplitude maps

Nexstim TMS II stimulator module (integrated in mobile NBS cart)

Nexstim Focal coil and Nexstim Cooled coil

General features

Type: figure-of-8, integrated cable

Trackers: coil-integrated

Winding accuracy: <0.55 mm (0.022 in)/0.2 degree

Precision manufacture

Handle: upward position, facilitates E-field positioning

Electro-magnetic properties: individually modeled

Winding diameters: mean ~50 mm (2.0 in), outer ~70 mm (2.8 in)

External dimensions: height (with coil handle)19.0 cm (7.5 in),

width 17.3 cm (6.8 in), depth 9.9 cm (3.9 in)

Cable (integral to coil): 2.3 m (91 in)

Overheating protection: automatic

Coil lifetime: up to 2 million pulses or 2 years from date of

manufacture (software-controlled)

Nexstim Focal coil

Maximum output (calculated from baseline coil and

environment temperatures +23°C(±10°F)): 1900 pulses at 1 Hz

(40% stimulator intensity).

Nexstim Cooled coil (option)

Cooling: forced air system (air hose integrated in coil and cable)

Note: requires Nexstim coil cooling system (option)

Streeteasy navigation

3D Optical tracking unit

Polaris® Viva (or optionally Spectra with floor-stand),

manufactured by Northern Digital Inc., Canada

Unit accuracy for one marker: 0.25 mm (rms)

Passive-tracker tools

Coil tracker: 4 elements, each with 3 markers

Adjustable head tracker: 4 markers

Y-point (digitizer pos): 3 markers

EMG

6-channel, 1 common ground EMG amplifier (external module)

with TMS-artefact rejection circuitry

Sampling rate: 3 kHz (per channel), resolution: 0.3 µV, Scale:

-7.5 µV to 7.5 µV (CMRR > 90 dB), Noise <5 µV peak-to-peak,

freq. band: 10-500 Hz

Dimensions (external module): height 6.2 cm (2.4 in), width 17

(6.7 in), depth 19.8 cm (7.8 in). Weight: 620 g (1.3 lbs)

Cables: shielded, single-channel cables for EMG electrodes with

1.5 mm touch-proof female safety connectors (DIN 42-802)

Electrodes recommended: Ambu® Neuroline 720 electrodes,

model number 720 01-K

DICOM-compatible data export

NBS mapping results exported as DICOM images with voxel

coloring according to motor response amplitudes

- Above-threshold and below-threshold maps for procedural

planning (user-determined threshold)

- Heat map and rainbow color maps for advanced analysis of

motor cortex, requires optimization of the import system settings

(e.g. neuronavigator) for intended visualization

Screen captures of NBS 3D mapping views stored as DICOM

images

Mobile NBS cart (dual arm)

Dimensions (floor footprint): width 80 cm (32 in),

depth 70 cm (28 in)

Height at minimum arm extension: 209 cm (82 in)

Total weight: 223 kg (491 lbs)

Nexstim coil cooling system (option)

Cooling method: forced air (via hose from NBS cart to Nexstim

Cooled coil)

Air flow: 60-100 L/min

Dimensions: height 24 cm (9.5 in), width 22 cm (8.5 in),

depth 47 cm (18.6 in)

Patient chair (option)

Height and recline: remote control-adjustable

Maximum load: 180 kg (397 lbs)

Electrical specifications

System power supply

Supplies CPU, LCD displays, EMG amplifier, tracking unit

and coil cooling system (option)

110-120 VAC, 60 Hz

Power consumption: 1800 VA

TMS II module power supply

110-120 VAC, 60 Hz

Power consumption: 2000 VA (peak)
**Certification**
Nexstim Oy is ISO 13485 certified, all Nexstim products comply with relevant safety and performance standards. The Nexstim NBS System 4 is CE-marked in the EU according to Medical Device Directive 93/42/EEC as amended by 2007/47/EC.

FDA 510(k) cleared, number K112881

IEC 60601-1 (Edition 3, General Requirements for Safety)
IEC 60601-1-2 (EMC)
IEC 62304 (Software)
IEC 62366 (Usability)
IEC 60601-1-6 (Usability)
IEC 60601-2-40 (EMG)

**Classification**
- MDD Classification: IIa
- IP Classifications: IPX0, foot switch IPX8, chair IPX1
- Electrical Classification: Class I
- Applied Part BF (TMS, EMG), B (Chair)

**Compatibility**
DICOM: conformance statement available

**Indications for Use**
The NBS System is indicated for non-invasive mapping of the primary motor cortex of the brain to its cortical gyrus. The NBS System provides information that may be used in the assessment of the primary motor cortex for pre-procedural planning. The NBS System is not intended to be used during a surgical procedure. The NBS System is intended to be used by trained clinical professionals.

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Specifications subject to change without notice.