A Virtual Trainer for Transcranial Magnetic Stimulation

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BACKGROUND

Transcranial Magnetic Stimulation (TMS) is a form of non-invasive brain stimulation that works by delivering short bursts of magnetic energy and inducing electric fields to stimulate nerve cells in the brain.

Neurological clinics around the country are gaining access to TMS equipment, thus, they are requiring intensive training in TMS. However, currently there are no readily-available applicable trainings in Alberta. Resources are lacking in terms of the time and equipment required to train individuals in performing TMS. Applying treatment to the wrong part of the brain or at an inaccurate threshold can result in unsafe treatment being administered to vulnerable patients.

Figure 1. TMS Robot

APPLICATIONS OF TMS

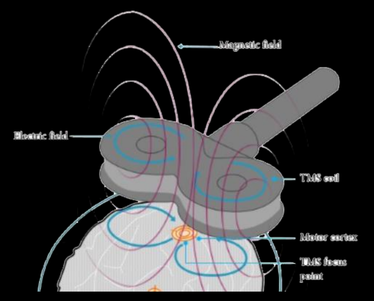


Figure 2. How TMS works. Electric field produced from current flowing through coil, which creates a magnetic field around the coil.

Repetitive TMS is commonly used as a treatment for depression and other neurological disorders including:

- post-traumatic stress disorder (PTSD)
- stroke rehabilitation
- Schizophrenia
- Parkinson's disease
- Alzheimer's disease
- anxiety disorders such as obsessive compulsive disorder (OCD)

In order to be most effective, TMS treatment must be applied to the motor hotspot. **The motor hotspot** is the location in the brain which produces the largest motor output when stimulated.

AIM

Aim 1: To develop a novel virtual TMS training tool.

Aim 2: To test the tool on healthy individuals with no prior TMS experience.

Hypotheses:

- When performing TMS with prior training from the developed tool, the user will demonstrate greater speed and accuracy in determining the motor hotspot.

METHODS

A prototype was developed using Unity to mimic performing TMS in a virtual realm.

The system contains 2400 electromyography (EMG) signals per patient, recorded at various intensities. All signals were recorded from a real patient using the TMS Robot and the Brain Sight and Signal softwares.

Results of two control groups will be compared. The first group will be trained using the tool prior to performing TMS while the second group will immediately perform TMS. Differences in speed and accuracy will strengthen the need for further advances in the development of this tool.

Inclusion Criteria:

- No prior TMS experience

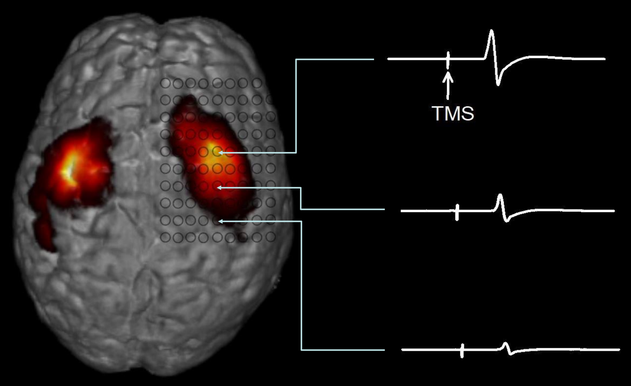
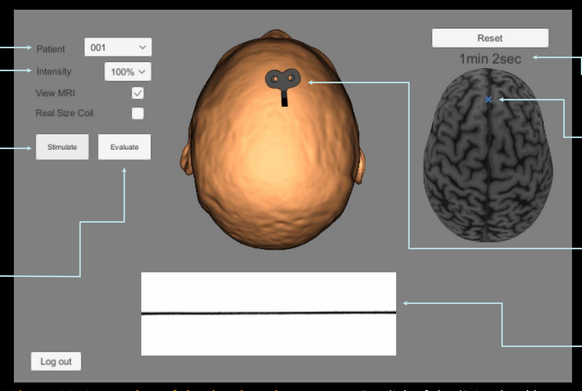


Figure 3. Finding the hotspot. The closer the stimulation is to the hotspot, the larger the size of the motor evoked potential (MEP) will be.

SOFTWARE FEATURES



Ability to choose patient

Ability to choose stimulation intensity

Button to send stimulation

Button to evaluate user-found hotspot

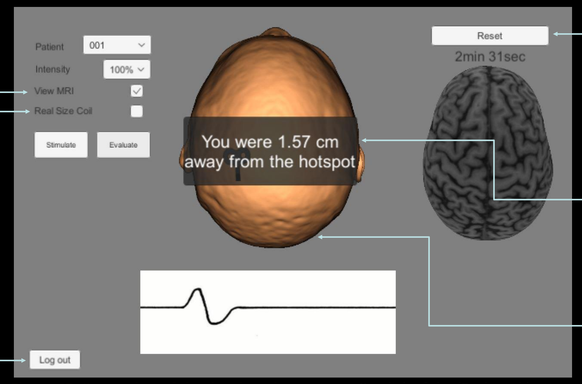
Three minute timer before freezing the system for reset

Marker to show area of brain beneath coil

Simulated TMS coil

Respective EMG signal displayed on click of the 'Stimulate' button based on coil location

Figure 4A. Screenshot of the developed prototype. On click of the 'Stimulate' button.



Ability to view MRI

Ability to use a realistically sized coil

Ability to reset the trainer and timer

Accuracy feedback displayed for user on click of the 'Evaluate' button

Patient head with grid mapping

Ability to have an account and store data from practice trials

Figure 4B. Screenshot of the developed prototype. On click of the 'Evaluate' button.

Using the trainer, the user can stimulate various points in the patient's brain to determine their motor hotspot. On stimulating any point, the corresponding signal is displayed. The size of the motor evoked potential (MEP) on the EMG is a deciding factor in determining the hotspot - **the larger the MEP, the closer the hotspot is.**

NEXT STEPS

Additional Features For Future Versions

- 3D brain with grid mapping
- Choice of coil type
- Choice of muscle EMG being viewed
- Grid mapping more accurately positioned on brain
- Ability to view trends in stored data from practice trials
- Ability of find the resting motor threshold (RMT)
- Greater accuracy in EMG reading
  - Ability to pan across signal
  - Ability to zoom into signal

Data is to be collected from participants. The speed and accuracy of the two control groups are then to be compared in order to determine the value of the developed training tool.