differences. This pilot study suggests that greater measures of local excitability on TMS-EEG are related to worse cognition.

Keywords: Transcranial Magnetic Stimulation, Electroencephalography, Alzheimer's disease, Biomarkers

P2.095

AN OPEN-SOURCE PLATFORM FOR ROBOTIZED TRANSCRANIAL MAGNETIC STIMULATION

Renan H. Matsuda[1], Victor H. Souza[2], Thais C. Marchetti[1], Victor D. Araki[3], Glauco A.P. Caurin[3], Hélio R. Machado[1], Risto J. Ilmoniemi[2], Oswaldo Baffa[1]. [1] *University of São Paulo, Ribeirão Preto, Brazil;* [2] *Aalto University School of Science, Aalto, Finland;* [3] *University of São Paulo, São Carlos, Brazil*

Abstract

Neuronavigation systems increase precision and accuracy in clinical and experimental procedures with transcranial magnetic stimulation (TMS). Small variations in the positioning of the stimulator evoke distinct responses in the brain. Collaborative robots (cobots) have been used to decrease variability and improve the reproducibility of the TMS coil positioning on the patient's scalp. However, TMS robotic positioning is not widely used due to low portability, high cost, and limited features due to closed-source development platforms. To increase the accuracy and reliability of TMS procedures, we aim to develop an open-source platform for the robotized positioning of brain stimulators, providing research centers with access to the latest technology in this scenario. Our group has developed the open-source neuronavigation system InVesalius Navigator, for navigated TMS, written in Python and compatible with multiple spatial tracking devices. InVesalius Navigator was selected as a suitable platform to develop the control of cobots. Two models of cobots have been integrated into the platform, the iiwa cobot (KUKA Robotics) and the Elfin cobot (HAN*S Robots). The precision and accuracy of the cobot TMS position were recorded with the navigation system. The precision error was defined as the Euclidean distance between the coordinates measured in the image space during navigation and the real coordinate in the simulated image. The average precision error ($\pm$ standard deviation) was 1.05 ± 0.49 mm. The estimated error was smaller than those commonly reported for manual TMS placement.

The cobot-navigated open-source platform might improve the reproducibility and accuracy of the TMS experiments, creating an integrated development environment for new technologies on robotized TMS and allowing users to build their features on demand.

Keywords: Transcranial magnetic stimulation , Neuronavigation, Robotics, cobot-navigated

P2.096

A PILOT TRIAL APPLYING 18-SESSIONS OF REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION TO THE DORSOLATERAL PREFRONTAL CORTEX OF PARTICIPANTS UNDERGOING ACUTE MEDICALLY-MANAGED WITHDRAWAL FROM OPIOIDS OVER THREE-DAYS

Gregory L. Sahlem[1], Lauren A. Campbell[2], Chanda D. Funcell[3], Mark S. George[2,4], Aimee L. McRae-Clark[2,4]. [1] *Stanford, Palo Alto, CA, USA;* [2] *Medical University of South Carolina, Charleston, SC, USA;* [3] *Charleston Center of South Carolina, Charleston, SC, USA;* [4] *Ralph H Johnson VA Medical Center, Charleston, SC, USA*

Abstract

Opioid Use Disorder (OUD) is an impactful condition with only moderately effective treatments available and relapse especially common early in treatment. This project determined the feasibility of delivering an accelerated course of repetitive transcranial magnetic stimulation (rTMS) to participants with OUD during medically managed withdrawal. If feasible, delivering rTMS at this early stage of treatment may improve outcomes.

Participants included those with moderate or severe OUD who were undergoing medically-managed withdrawal using either buprenorphine or methadone. During the taper, eighteen-sessions of rTMS were applied over three days (6-sessions/day separated by 30-minutes, 10Hz, figure-of-eight-coil, EEG coordinate F3, 3000 pulses each, 120% rMT, delivered during opioid image presentation). The first participant underwent open-label study-treatment, while the final six were treated in a double-blind sham-controlled fashion. The primary outcome measures included provoked craving following a standardized cue paradigm, as well as subjective pain measures.

Four participants received active stimulation, three of which (27F, 27M, 31F) completed treatment at 120%rMT, and one (27M) withdrew due to symptoms of opioid withdrawal. Three participants received sham stimulation (30F, 27M, 51M) two of which completed treatment at 120%rMT and one other completing treatment at 100% rMT. The blind was effective and only one headache occurred as an adverse event. No statistics were run due to the small sample size, however the participants who received active stimulation reported that composite craving (want, resist, crave opioids) dropped numerically more in the active-group (mean decrease 10.3 ± 8.1) then in the sham-group (mean decrease 7.0 ± 4.6) following a standard opioid cue paradigm. Clinical pain was low at baseline and changed minimally following the intervention.

No firm conclusions can be drawn from this pilot trial, which was stopped early due to the COVID19 pandemic, however accelerated treatment with rTMS appears to be well tolerated by those undergoing medically managed withdrawal.

Keywords: opioid, craving, clinical trial, rTMS

P2.097

UNCERTAINTY QUANTIFICATION IN BRAIN STIMULATION USING UNCERTAINSCI

Jess Tate[1], Sumientra Rampersad[2], Chantel Charlebois[1], Zexin Liu[1], Jake Bergquist[1], Dan White[1], Lindsay Rupp[1], Dana Brooks[2], Akil Narayan[1], Rob MacLeod[1]. [1] *The University of Utah, Salt Lake City, UT, USA;* [2] *Northeastern University, Boston, MA, USA*

Abstract

Predicting the effects of brain stimulation with computer models presents many challenges, including estimating the possible error from the propagation of uncertain input parameters through the model. Quantification and control of these errors through uncertainty quantification (UQ) provide statistics on the likely impact of parameter variation on solution accuracy, including total variance and sensitivity associated to each parameter. While the need and importance of UQ in clinical modeling is generally accepted, tools for implementing UQ techniques remain limited or inaccessible for many researchers.

We have developed UncertainSCI as an open-source, flexible, and easy-to-use tool to make modern UQ techniques more accessible in biomedical simulation applications. Our goals in developing UncertainSCI were to provide numerical accuracy, a simple application programming interface (API), adaptability to many applications and methods, and an interface with diverse simulation software. UncertainSCI implements polynomial chaos expansion (PCE) to estimate uncertainty of a model non-invasively, allowing UQ with a vast array of modeling applications, and uses Python to create a simple API that can interface with many simulation packages.

To demonstrate the functionality and adaptability of UncertainSCI, we implemented UQ on three brain stimulation modeling pipelines: electrocorticography (ECoG) stimulation, transcranial current stimulation (tCS), and transcranial magnetic stimulation (TMS). We used UncertainSCI to predict the model uncertainty due to variations in tissue conductivities and electrode positions in simulations of ECoG, tCS, and TMS with realistic human head models solved in SCIRun. We compared the results between these modalities and with other UQ packages, which showed that UncertainSCI was equally accurate and more efficient. The UQ predicted by UncertainSCI allows researchers to gain insight into the behavior of these