Transcranial Magnetic Stimulation Procedure Automation

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This paper presents the development of an automated Trascranical Magnetic Stimulation (TMS) system at Wilkes University. TMS is commonly used as a therapy technique for cases of treatment resistant depression but can also be used in a variety of other neurological treatment applications. The procedure works by using a coil that generates electromagnetic pulses which produce eddy currents in the brain in order to stimulate neurons. Current TMS processes involve probing using single pulses from the TMS coil until a physical response is observed in the patient. The coil is then positioned in reference to the physical response location.

Manual coil positioning is subject to low accuracy and low repeatability. In this work we automated the TMS procedure using an articulated robotic arm to position the coil. This is accomplished by using patient MRI images to locate target areas in the brain for treatment. These target areas are then processed through several software programs in order to generate spatial coordinates and Euler angles for desired location of the TMS coil. The coordinate and orientation data are then used to properly position the articulated robotic arm with attached TMS coil.

TMS treatment sessions typically last 30-40 minutes and require the coil to be repositioned several times per session to target different brain areas. During treatment sessions, it is required that the patient remain as stationary as possible. Manual coil positioning methods do not account for patient head movement, which can cause inaccuracy in treatment. The automated system incorporates an optical scanning device in order to compensate for patient head movement during treatment sessions.

Overall, this project stands to supplement current TMS technology by providing a more accurate and repeatable coil positioning method for treatment. Automated coil positioning methods will also likely take less time than manual methods, thus shortening individual treatment sessions. Due to increased accuracy and repeatability, the number of total overall sessions may also decrease. These points will lead to a more effective method of treatment in terms of accuracy, repeatability, and cost.