Zachary C. Higgs

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Masters of Science

**Thesis Title**

Analyzing Temporal Interference for use with Dual Site Transcranial Magnetic Stimulation

**Abstract**

Transcranial Magnetic Stimulation (TMS) coils often are specific to deep brain or focal stimulation for use with many different TMS treatments for human neurological conditions. A new technique is investigated, which allows for deep and focal stimulation using temporal interference (TI), originally developed for electrical stimulation via implanted electrodes. The TI stimulation frequencies used here are in the kHz range and are demodulated by the brain’s complex biophysics. The frequency difference between the two induced electric fields results in the demodulated, low frequency envelope that allows for focal stimulation of the brain. It has been established that TI has the ability for steerability, focality, and depth of tissue penetration. These TI advantages would allow several key TMS advantages such as, non-target areas of the brain to be avoided, as a result of increased focality. TI also allows for multiple brain locations to be stimulated without coil movement or the need for multiple coils or simulators. Because of TI's compatibility with TMS, TI has recently been applied to TMS, as reported by several recent studies. Applying the concepts from TI TMS, a custom coil was designed, simulated, and tested for use with an established TMS protocol, called dual site TMS (dsTMS). This proposed dsTMS coil design uses multiple TI coil pairs for the goal of stimulating several distinct regions of the brain to inhibit or facility inter-cortical activity. The underpinnings of TI TMS and dsTMS are explored to see if a single, TI TMS coil assembly can satisfy key dsTMS criteria to allow the two TMS technologies to be used together. After simulating and testing the TI TMS coil design for focality and steerability, it is shown that a TI TMS coil can meet many of the key criteria for use with dsTMS for medical applications.