

Breakthrough expected in electromagnetic therapy: Multi-locus, closed-loop transcranial magnetic stimulation

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In transcranial magnetic stimulation (TMS), brief ($\sim 100 \mu\text{s}$) pulses of strong (~ 1 tesla) magnetic fields are targeted to the brain where they induce weak ($\sim 0.1 \text{ mA/mm}^2$) electric currents that depolarize neurons and trigger action potentials. It has been demonstrated that repeated stimulation of the cortex can be used as therapy, for example to ameliorate severe depression or pain, or to improve post-stroke recovery. However, with current technology, the treatment is done in predetermined, non-individualized manner, and the stimulus is given to one and the same target in established therapeutic protocols. Our plan is to build multi-locus TMS (mTMS) with which one can change the location and pattern of the stimulating electric field (E-field) quickly (~ 1 ms) without moving the pulse-generating coils. Using simultaneous electroencephalography (EEG), we can produce a bidirectional coupling to the brain that can serve as the basis for closed-loop brain stimulation. We have demonstrated new research paradigms with an mTMS transducer covering a small part of the cortex. By extracting in real time information about the state of the brain from the EEG, we will let a computer algorithm guide the TMS sequence based on the brain state and its stimulation-dependent changes during the procedure. We believe that this will help us produce a breakthrough in the efficacy of TMS brain therapies.

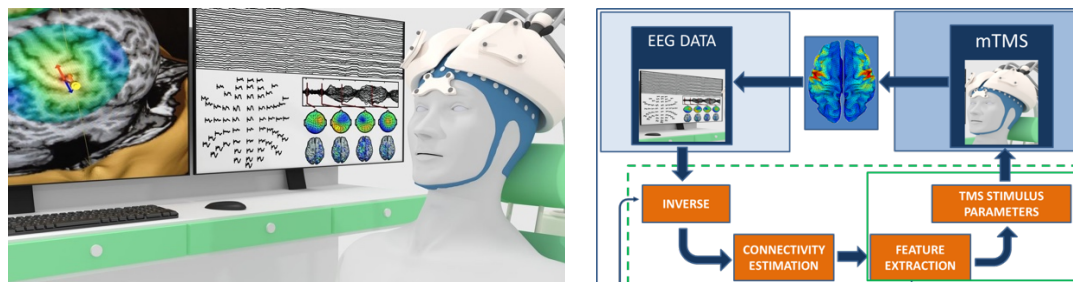


Figure 1. *Left:* Artist's view of the future ConnectToBrain system. *Right:* Closed-loop brain stimulation.

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References

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