Noninvasive Neuromodulation does not represent a treatment for an illness, but offers tool that allows modulation of the neural substrate of symptoms and disabilities caused by brain illnesses or dysfunctions.

Present  Helping Patients
However……only the beginning

Future  Realize the Promise of Neuromodulation
Present
Helping Patients Learning about the Brain

Future
Realize the Promise of Neuromodulation
Precision Medicine Approach

1. Target symptoms/complaints – not simply diagnostic entities
   • Identify disability localization
2. Measure and guide the intervention by the physiologic effect
   • Monitor physiologic effects (fMRI, EEG, etc)
3. Leverage state-dependency effects
4. Monitor behavioral effects and adapt parameters and target using close loop approaches
Realize the Promise of Neuromodulation

Future

Spatial precision
- Imaging-guided targeting
- Electric field modeling
- Focal/multifocal stimulation

Temporal precision
- Waveform optimization
- Patterned stimulation
- Closed-loop stimulation

Contextual precision
- Online stimulation
- Biological rhythm
- Combinatorial therapy

Jannati et al. Neuropsychopharmacology 2023
μTMS

Giorgio Bonmassar

Colella et al. Med Phys. 2023

Computer + dual signal generator
Audio Storeroom Amplifier Rack and switch

Multilayer μTMS coils

Physical m-Coil

Surface view
Cross section
Longitudinal section

Recording site
Stimulation area

PLEASE DO NOT COPY
Multi-locus TMS
### Accelerated TBS (SAINT)

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Accelerated TBS (SAINT) results

Graphs showing mean percent change in MADRS score and mean MADRS score over weeks for SNT, Active SNT, and Sham SNT conditions.
Symptom-specific targeting

Siddiqi and Fox 2024 Biol Psych
Personalized parameters

(b) Raw EEG → Adaptive Filtering → Gamma Amplitude

(c) S04: Theta: 4.0 Hz, Gamma: 60 Hz
S12: Theta: 6.2 Hz, Gamma: 51 Hz

(d) Mood rating

Chung 2019 HumBrMap
Closed-loop EEG-TMS modulation

Left: Zrenner & Ziemann BiolPsych 2024; Right: Humaidan 2024 Clin Neurophys
TMS + drugs