combining rTMS with operant learning can induce long-lasting after-effects not achievable neither with rTMS alone nor with operant learning alone.

Methods: Experimental approach:

Forty-six subjects were randomly assigned to three experimental groups. Experimental groups 1 & 2 received a psychophysical pretest of tactile discrimination abilities with the left ring finger, a training procedure to improve performance with this finger, and a posttest. In experimental group 1 the training procedure was combined with 15 Hz rTMS over the primary sensory cortex (SI) while in experimental group 2 the training was combined with sham rTMS. In the third experimental group, psychophysical pre- and posttests of tactile discrimination abilities were assessed. However, they received 15 Hz rTMS over SI without training.

Computational approach:

As a preliminary simulation trial we developed a neural model, which enabled us to discriminate between the encoding and decoding of particular input frequency represented in several scenarios.

Results: Combining rTMS with operant learning induced long-lasting after-effects not achievable neither with rTMS alone nor with operant learning alone.

A conceptual framework for the efficiency of combining cortical stimulation with operant learning can be derived from the Bienenstock–Cooper–Munro theory of bidirectional synaptic plasticity. According to this theory the change of synaptic efficiency during learning processes is dependent on the preactivation level of the involved neural network, suggesting that high-frequency rTMS can transiently decrease the threshold for the induction of LTP-like effects and thereby gate practice-dependent plasticity.

Conclusions: Our findings provide important implications for the use of rTMS in combination with operant learning as a therapeutic tool for neurorehabilitation.

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P094

Method for EEG guided transcranial Electrical Stimulation without models—**A. Cancelli [a,*], C. Cottone [a], F. Tecchio [a], D. Truong [b], J. Dmochowski [b], D. Adair [b], M. Bikson [b] ([a] LET'S – CNR, Rome, Italy, [b] City College of New York, New York City, United States)**

Figure 1.

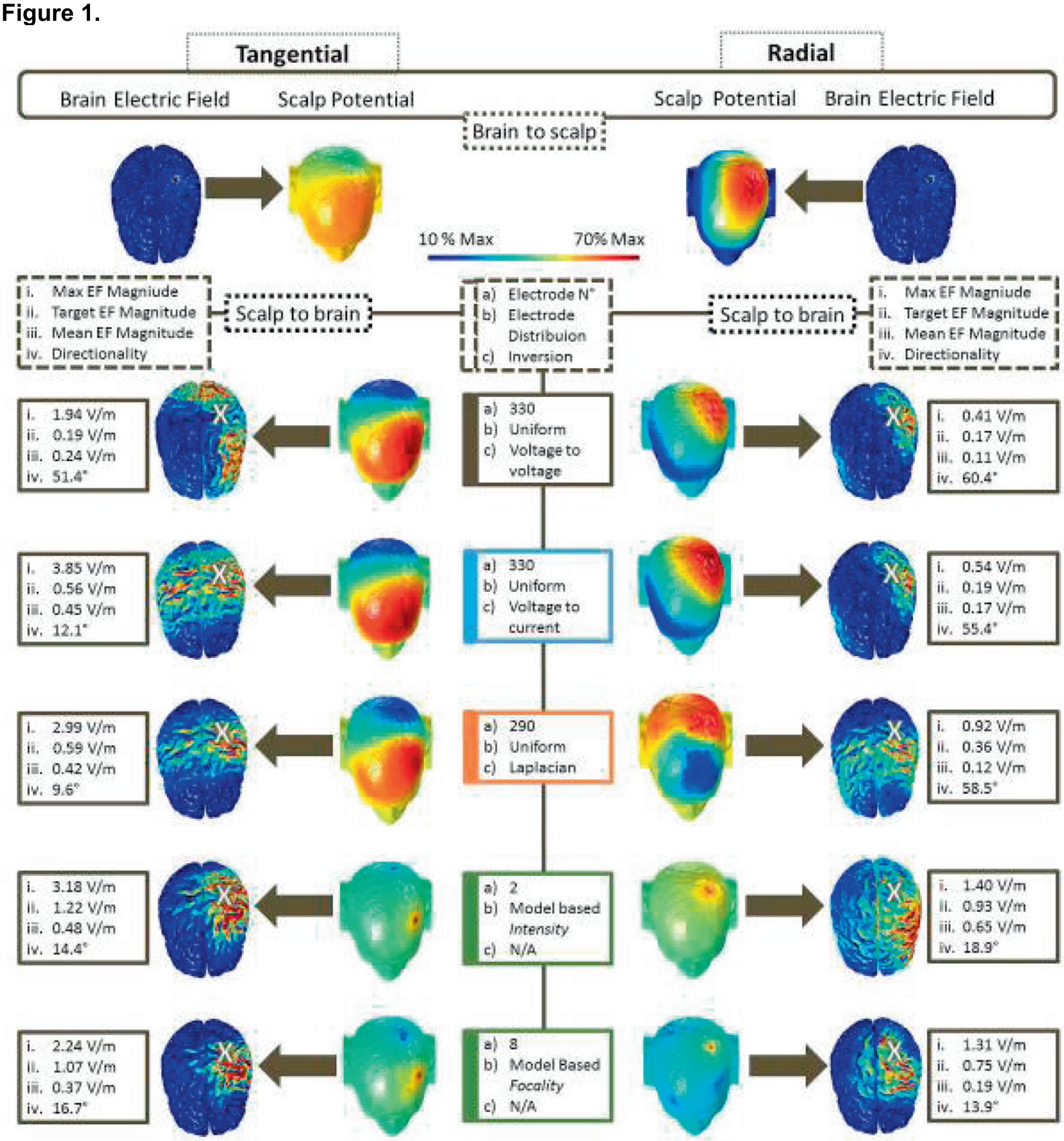
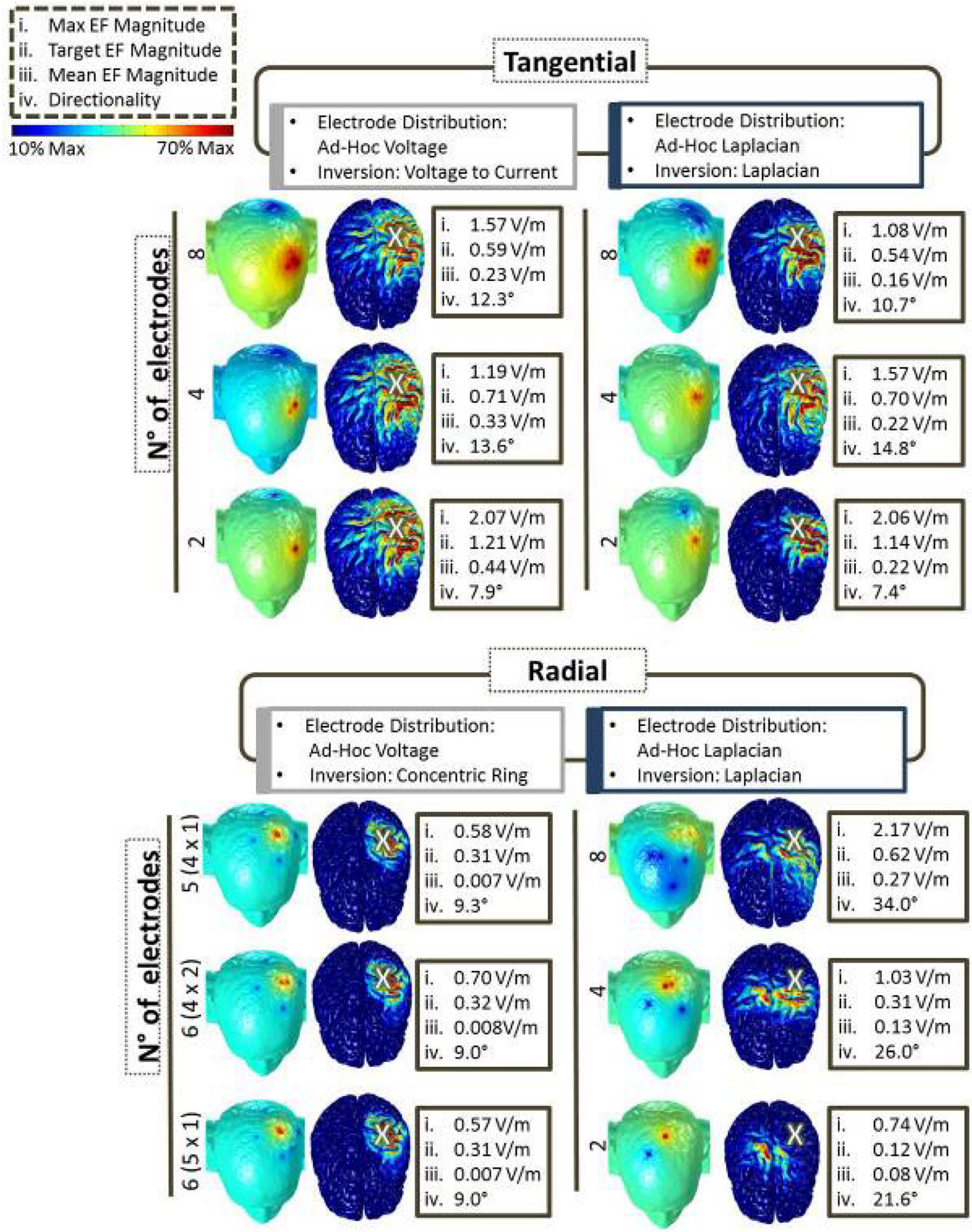


Figure 2.



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Objective: There is a long interest in using EEG measurements to inform transcranial Electrical Stimulation (tES) but adoption is lacking. The conventional approach is to use anatomical head-models for both source localization (the EEG inverse problem) and current flow modeling (the tES forward model), but this approach is computationally demanding, requires an anatomical MRI, and strict assumptions about the target brain regions. We evaluate techniques whereby tES dose is derived from EEG without the need for an anatomical head model or assumptions.

Approach: The approaches are verified using a Finite Element Method (FEM) simulation of the EEG generated by a dipole, oriented either tangential or radial to the surface, and then simulating brain current flow produced by various model-free techniques including: (1) Voltage-to-voltage, (2) Voltage-to-Current; (3) Laplacian; and two Ad-Hoc techniques (4) Dipole sink-to-sink; and (5) Sink to Concentric Ring. These model-free approaches are compared to a numerically optimized dose that assumes perfect understanding of the dipole location and head anatomy. We vary the number of electrodes from a few to over three hundred, with focality or intensity as optimization criterion.

Main results: Our results demonstrate how simple Ad-Hoc approaches can achieve reasonable targeting for the case of a cortical dipole with 2–8 electrodes and no need for a model of the head.

Significance: For its simplicity and linearity, model-free EEG guided lends itself to broad adoption and can be applied to a static (tDCS), time-variant (e.g. tACS, tRNS, tPCS), or closed-loop tES.

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P095

Optimal tDCS electrode montages to stimulate nonsuperficial cortex: A simulation study—**C.-H. Im *, S.J. Lee, C. Lee (Hanyang University, Department of Biomedical Engineering, Seoul, South Korea)**

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To effectively stimulate target cortical areas using of transcranial direct current stimulation (tDCS), determination of proper locations of electrode pair is of great importance. Most previous studies focused on stimulating superficial cortical areas such as hand motor cortex, dorsolateral prefrontal cortex, and so on, and researchers generally attached the stimulation electrode right above the target area. This strategy might not be a bad choice for superficial cortex; however, for nonsuperficial cortical areas, locations of electrodes need to be optimized based on computer-based electric field analyses because it is relatively difficult to predict the current flows around the deep cortical areas. In this study, we simulated various electrode montages to find the optimal electrode montages for stimulating nonsuperficial cortical areas.

We considered three different targets located in nonsuperfical cortex such as foot motor cortex, dorsomedial prefrontal cortex (dmPFC) and primary visual cortex (V1). We used the international 10–20 system for EEG placement to test candidate electrode positions, and the results were compared with the results of conventional electrode montages used in previous studies (an example is depicted in Fig. 1). Two realistic head models were generated for finite element analysis.

Optimal electrode montages were C3-C4, F3-F4/Fp2, and Oz-Fpz for foot motor, dmPFC, and V1 stimulations, respectively. In all cases, the optimal electrode montages were more effective for stimulating the targets compared to the conventional ones.

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P096

COMETS2: A MATLAB toolbox for numerical simulation of electric fields generated by transcranial direct current stimulation—**C.-H. Im [a,*], C. Lee [a], S.J. Lee [a], Y. Jung [b] ([a] Hanyang University, Department of Biomedical Engineering, Seoul, South Korea, [b] Dongseo University, Department of Radiological Science, Pusan, South Korea)**

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Since there is no way to directly measure the electric current flow inside the human head and no imaging modality can visualize the electric field generated by transcranial direct current stimulation (tDCS), numerical analysis based on finite element method (FEM) has been widely studied. However, because there has been no open software package designed to simulate electric fields generated by tDCS, only a few research groups could use this important technology. In 2013, our group released a GUI-based MATLAB toolbox named COMETS (COMputation of Electric field due to Transcranial current Stimulation), which could simulate various electrode montages in a standard head model. Now, we are releasing a next version

Figure 1.