

COMETS2

A MATLAB Toolbox for Numerical Simulation of Electric Fields Generated by Transcranial Direct Current Stimulation

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COMETS2: a new software for tDCS analysis

We just released COMETS2 (COMputation of Electric field due to Transcranial current Stimulation 2), which is a new version of our previous tDCS analysis software COMETS. COMETS2 has several features:

- Windows GUI-based tDCS analysis toolbox
- Realistic head model (more realistic than COMETS1: now CSF-brain interface is considered)
- Automatic generation of sponge electrode pads
- Fast solver by Intel MKL
- Fast computation technique for repeated analyses
- Advanced users can import their own head models

System Requirements

We successfully tested COMETS2 in the following environments

- Windows 7 or Windows 10
- Matlab 2015a or higher version
- Intel i5 or higher
- 8 Gbyte RAM (dependent on mesh size) or higher

Freely Downloadable NOW at

<http://www.cometstool.com>

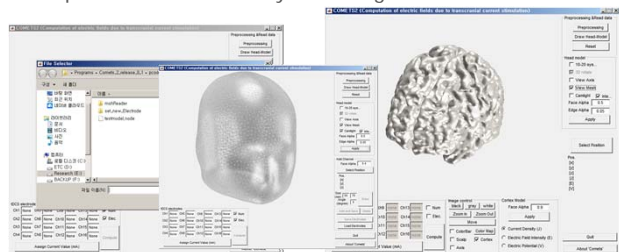
or <http://cone.hanyang.ac.kr>

Contact: cometstool@gmail.com



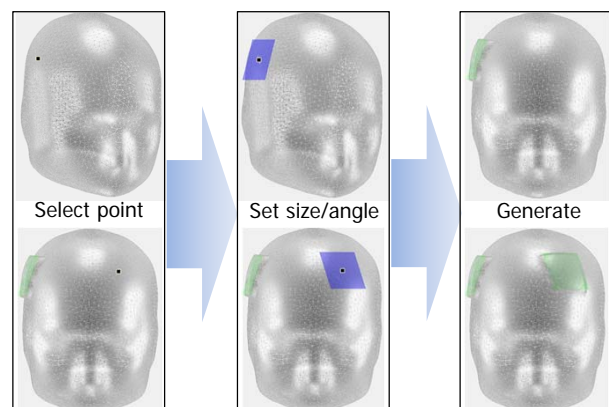
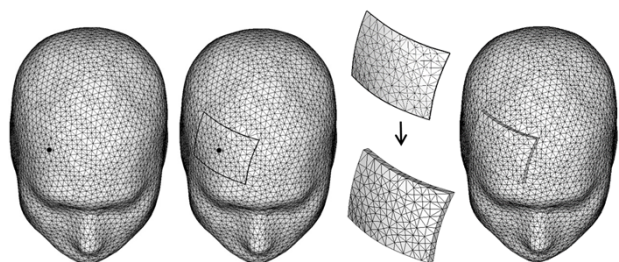
Windows® GUI-based tDCS analysis

We implemented user-friendly GUI using MATLAB.



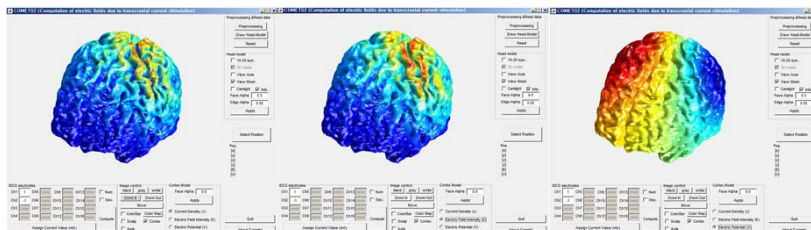
Easy way to attach sponge electrode pads

Saline-soaked sponge electrodes have been frequently used for tDCS. However, generating finite element models with sponge electrodes has been a difficult and time-consuming process. Just a few steps are needed for generating electrodes in COMETS2. Just a few seconds are enough for the automatic generation of an electrode. It took 47.63 seconds to regenerate the 3D finite element model from surface mesh data with two 50 x 70 cm size electrodes, whereas it took just 5.72 seconds to separately generate electrode mesh and merging it into the initial mesh.



Finite element method (FEM) with a fast direct solver (DSS)

Finite element method (FEM) with a fast direct solver (direct sparse solver: DSS of Intel math kernel library(MKL)) was used for the calculation of electric potential, electric field intensity, and electric current density on the cortical surface. Some subroutines were programmed using OpenMP so that time-consuming iterations can be calculated using parallel processors.



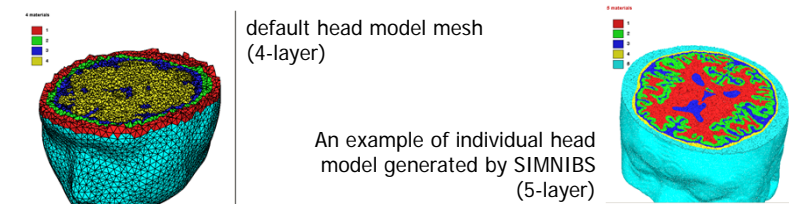
current density

electric field intensity

electric potential

Four layer head model as a default

COMETS2 contains a default finite element head model consisting of brain, CSF, skull, and scalp regions (129,103 nodes and 804,251 elements). Advanced users can import their own head models extracted from individual head MRI data, by which they can apply COMETS2 to the planning of individualized, image-guided neuromodulation. However, the individual models should be generated using other software such as CURRY7, SIMNIBS, etc. A converter for SIMNIBS file is included in the package.



A new technique for fast repeated analyses

When the global stiffness matrix for initial mesh without electrodes is constructed, calculation of element stiffness matrices is needed only for the elements that are newly generated inside the sponge electrodes and for elements that include nodes slightly moved on the surface to form the rectangular shape of bottom of the electrodes. The input variables of DSS were updated only for the newly generated or modified element data, which considerably reduced the overall computational burden. It took 9.55 seconds to construct the global stiffness matrix with the entirely regenerated head mesh data, while it took just 0.43 seconds to construct the global stiffness matrix with the partially regenerated mesh data.

