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## ABSTRACT PREVIEW

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**Realistic vOlumetric-Approach to Simulate Transcranial Electric Stimulation – ROAST – a fully automated open-source pipeline**

Proposal Category: Abstract Submission

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**My Abstract**

Background: Research in the area of transcranial electrical stimulation (TES) often relies on computational models of current flow in the brain. To build such a model, the magnetic resonance images (MRI) of the human head have to be segmented, virtual electrodes have to be placed, the volume is then tessellated into a mesh, and the finite element model is solved numerically to estimate the current flow. Various software tools are available for each step, as well as processing pipelines that connect these tools for batch processing. However, existing pipelines are either not fully automated or difficult to use. A recent software SimNIBS becomes popular for its ease of use, but it's based on the surface approach to represent the head anatomy, which has its own limitations (e.g., cannot capture the detailed structures of the skull, leading to un-realistic skull segmentation). Here we propose a new software, ROAST, to provide an end-to-end solution that aims to address all these problems in the modeling process.

Methods: We put together the segmentation algorithm in SPM8, our in-house Matlab script for segmentation touch-up and automatic electrode placement, the open-source finite element mesh generator iso2mesh and solver getDP. The complete pipeline is a Realistic vOlumetric Approach to Simulate Transcranial electric stimulation and has therefore been named ROAST. We tested it on the MNI-152 standard head and compared the results with those obtained with a commercial mesher and solver (ScanIP and Abaqus), and with SimNIBS.

Results: ROAST only leads to a 9% difference in predicted electric field distribution when compared to commercial FEM software. The difference is higher (47%) when comparing the output of ROAST with that of SimNIBS.

Discussion: This paper proposes a new pipeline for TES modeling, which we have termed ROAST. It is a fully automated simulator based on free software (except Matlab). Using the volumetric segmentation from SPM, it allows for a more realistic modeling of the anatomy and runs faster (15–30 minutes) compared to SimNIBS (10 hours). Also, as the dependent libraries are included in a single package (for Linux, Windows, and Mac), it is easy and straightforward to use (compared to other tools, e.g. SCIRun), without the need to install software (other than Matlab). It only gives a 9% difference in predicted electric field distribution when compared to commercial FEM software, and a higher difference of 47% when comparing with that of SimNIBS, mainly because SimNIBS builds the model based on the surface segmentation of the MRI, as opposed to the volumetric segmentation generated by SPM. Further work is needed to validate which pipeline gives more accurate model predictions using direct measurement of in vivo electric fields in the human brain. Nonetheless, we release ROAST now at http://www.parralab.org/roast/