Realistic Human Head Model for Simulating the Effect of Electrical Stimulation

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Abstract

INTRODUCTION:
Using Realistic Human Head model to simulate the effect of electrical stimulation can be useful in understanding field distribution in the brain and therefore, the actual point of stimulation before doing it on human subject. This is important because electrical stimulation of the brain can be uncomfortable due to stimulation of pain receptors (nociceptors). With the help of this model, parameters like the stimulus strength as well as electrode placement and its effect can be tested much more easily while targeting a specific location in the brain model. Field distribution can be obtained using the Electrical potential contour from COMSOL Multiphysics software.

USE OF COMSOL:
This model uses two software viz. MIMICS and COMSOL Multiphysics. MIMICS is used for creating Volume meshes from MRI/CT images. Obtained Volume meshes are imported into COMSOL Multiphysics for simulation and analysis. Electrical current and Electrical circuit interfaces of AC/DC Module and a Time dependent study has been used for this model.
Two electrodes were used for generating the pulse wave of certain properties. Then depending upon the part of the brain to be stimulated, the Electrodes position and waveform properties were optimized so as to get accurate information.

RESULTS:
In this study, Human head was divided into three parts namely Brain, Bone and the remaining part as a whole. 3D assembly of brain was successfully built and used for simulation and analysis. Figures of the model and the simulations are attached.

CONCLUSION:
This model can provide useful insight about the effect of electrical stimulation. This model can also be used in Magnetic stimulation and Radio Frequency applications, as COMSOL Multiphysics has specific physics defined for those purposes.

Reference

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5. http://www.itsi.pollub.pl/~mikrobi/mimi/Mimics%20Student%20Edition%20Course%20Book.pdf.

Figures used in the abstract

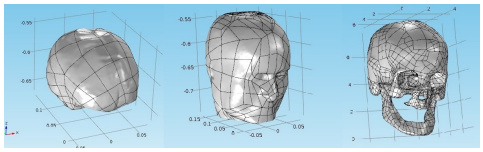

Figure 1: Screen shot of 3D models of brain, bone and the remaining part as a whole.

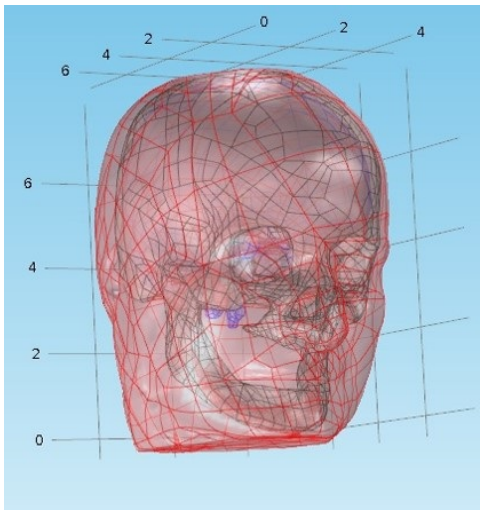

Figure 2: Assembly of brain, bone and the remaining part. Here the blue part represents brain and red represents the remaining part.

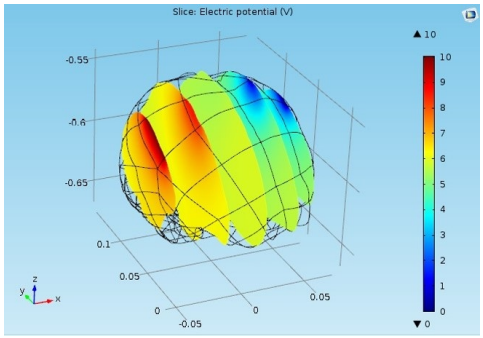

Figure 3: Electric potential contour of brain.

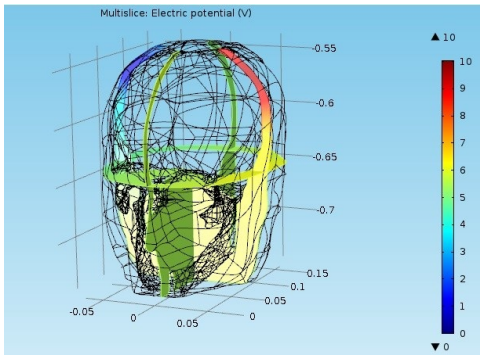

Figure 4: Electric potential contour of the remaining part.