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To Estimate the Minimum Electrical Voltage Treat the Epileptic Event via Deep Brain Stimulation Technique

Mariam Barkaat

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N*ame: Mariam Barkaat*
Riph*ah international university*
Isl*amabad, Pakistan*
Barkaat59@gmail.com

***Abstract*— Biological Applications require experimentations to make them in practical or clinical use. Simulation modeling efficiently solves reality-based problems and provides the right of simplex systems. Simulation of the reality-based system is preferred before applying any procedure realistically. The response of the system in case of maximum values of stimulus can also be checked through simulation of the desired model. COMSOL (Computer solution of) Multiphysics is a simulation environment which is designed to mimic re*al* world applications. To understand the realistic systems modeling and their response, this study provides the simulation of deep stimulation Deep brain stimulation (DBS) has recently been proven to be an effective therapy for medication-refractory symptoms of Parkinson's disease. Deep brain stimulation (DBS) is remarkably effective for a range of neurological and psychiatric disorders that have failed pharmacological and cell transplant therapies. Clinical investigations are underway for a variety of other conditions. Yet, the therapeutic mechanisms of action are unknown. In addition, DBS research demonstrates the need to re-consider many hypotheses regarding basal ganglia physiology and pathophysiology such as the notion that increased activity in the globus pallidus internal segment is causal to Parkinson's disease symptoms.**

Keywords—Bain, simulations, Parkinson's, disease, clinical investigators, basal ganglia.

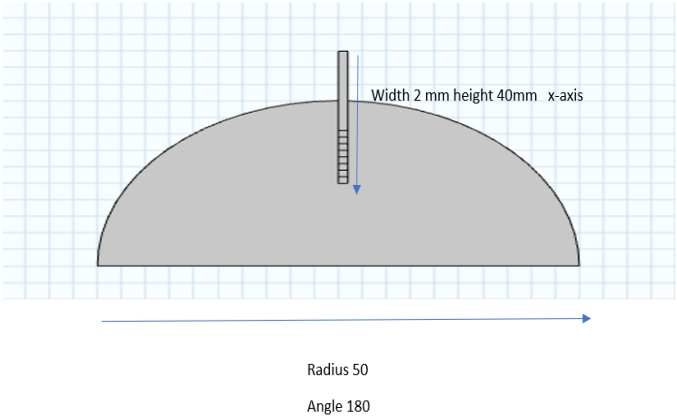
I. INTRODUCTION

Model is the physical, logical or mathematical representation of the real system. The steps and requirements used to design model is called modeling. Processing on the model in the controlled environment is simulation. Models are simulated to analyze the physical phenomenon occurring in the system and making predictions about the real system. Physiological models are the mathematical models which help in studying the biological and physiological phenomena occurring in human body. In Parkinson's disease, both motor and neuropsychiatric complications unfold as a consequence of both incremental striatal dopaminergic denervation and intensifying long-term dopaminergic treatment. Factors associated with clinical outcome after DBS for epilepsy are electrode location, stimulation parameters, type of epilepsy, and longer time of stimulation. Recent advancements in anatomical targeting, functional neuroimaging, responsive neurostimulation, and sensing of local field potentials could potentially lead to improved outcomes after DBS for epilepsy and reduced sudden, unexpected death of patients with epilepsy. Biomarkers are needed for successful patient selection, targeting of electrodes and optimization of stimulation parameters. The influence of varying electrode position on the generated electric field intensity was thoroughly investigated. In this study, potential electrode was kept at a fixed position whereas the position of ground is varied among the array of electrodes placed around the brain tissue to evaluate the response of changing electrode position on the electric surface potential. The values of temperature, electric potential and surface electric field norm at seven different positions of ground potential are compared at different voltages. This is an effective technique for the treatment of Parkinson's disease. Treatment includes the stimulation of ventral intermediate nucleus of thalamus which can dramatically relieve the tremors associated with Parkinson.

II. MATERIALS AND METHOD

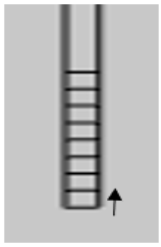
A. Geometry design

Figure 1



We have used a semi-circle of 50mm radius and 180 angles.A rectanglee of 2in mm width andin 40mm height is insertinto in the semi-circle .as show the Figure 1.

Figure 1b



Rod of 2mm width and 40mm height is inserted in the semi-circle which is represented as the Brain and the rod is represented as a polyamide rod having electrodes, The bottom 2mm by 2mm rectangle represents the polyamide material the upper 2mm by 2mm rectangle represents the electrode. Then there is polyamide then the electrode and so

B. *Material Design*

The following material properties are added:

C. *Physics type*

- Electricalal physics
- Thermal physics

Table 1 Added Material properties and their units

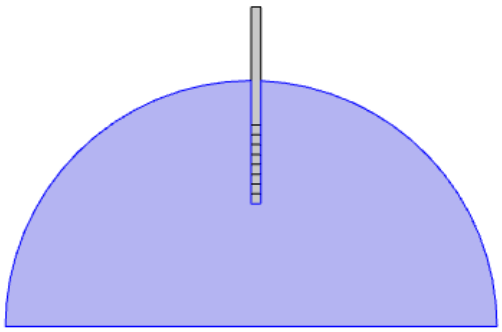
Properties	**Units**
Thermal Conductivity	W/m.K
Resistivity	Ohm.m
Electrical Conductivity	S/m
Density	Kg/m^3
Relative permittivity	1

Multi-physics i.e., electrical physic and thermal physic has been added to the model to study the electrical and thermal response of the model. The electrode distance is changed, and the result is recorded. The current generated creates the heating effect. This thermal or heating effect is more near the injecting electrode while moving toward the ground electrode the heating effect decreases. The inter-distance of the electrodes is varied at 5V. The current generates and creates the heating effect. The thermal effect and potential difference are more near injecting electrode and the least nearthe ground electrode and vice versa.

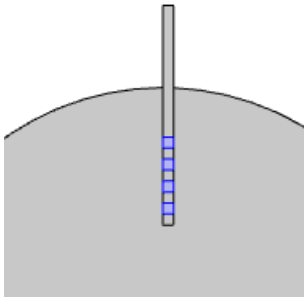
D. *Material used*

From the option of adding library brain is added havithe ng following material properties.

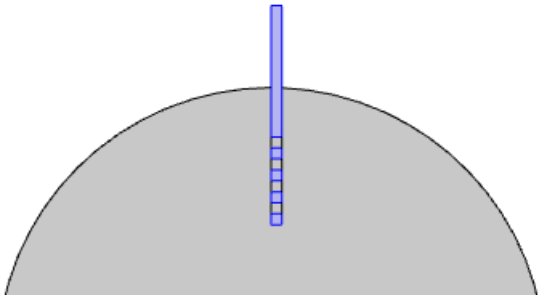
	Brain	
Density rho	1050	kg/m
Electrical conductivity	0.45	S/m
Heat capacity at constant pressure	Cp 3600J/(kg·K	
Thermal conductivity	00.5	W/(m·K)
Relative permittivity	1	



The electrode is of gold Material



Polyamide Material



RESULT

The geometry is designed using a semi-circle. The position of electrodes is changed and they are brought closer the results are recorded.

Figure 2 Mesh

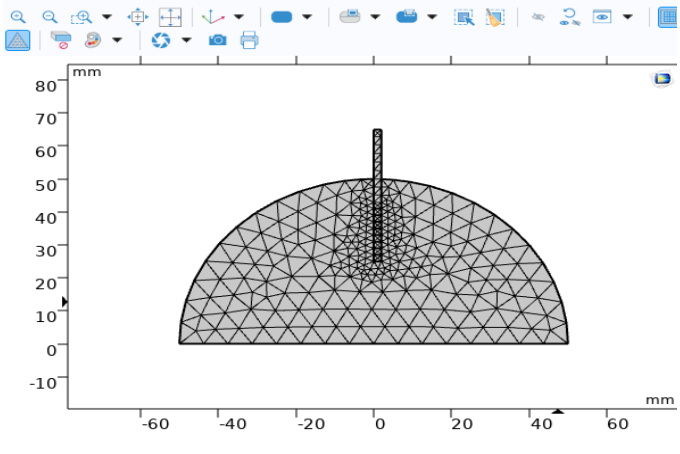


Figure 3 Electrodes at original position

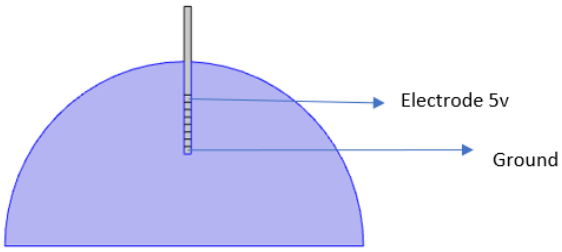


Figure 4 Electric potential at 5v

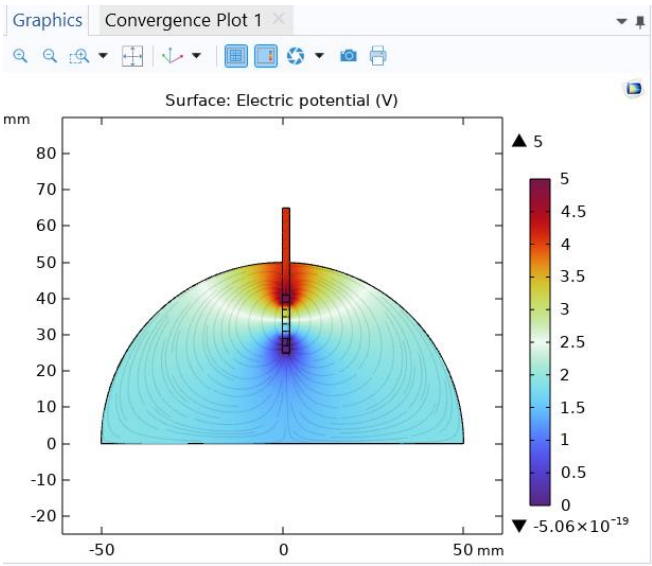


Figure 5 Electric field norm

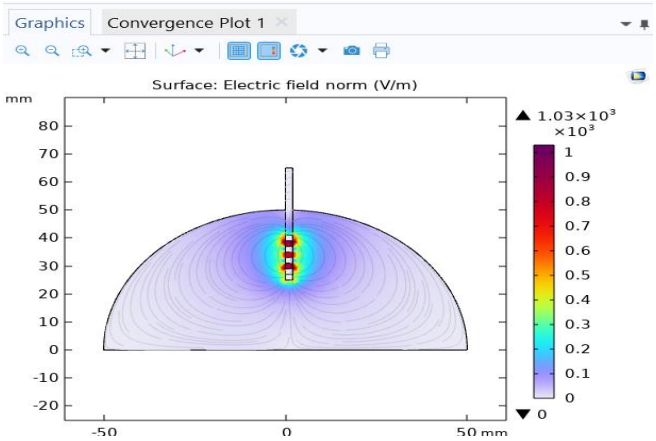


Figure 6 electrode is brought closer to ground

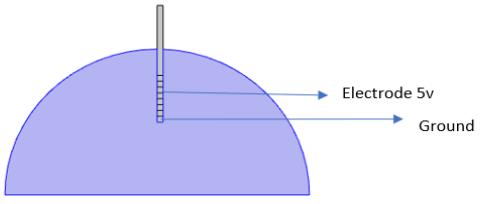


Figure 7 Electric potential at 5v

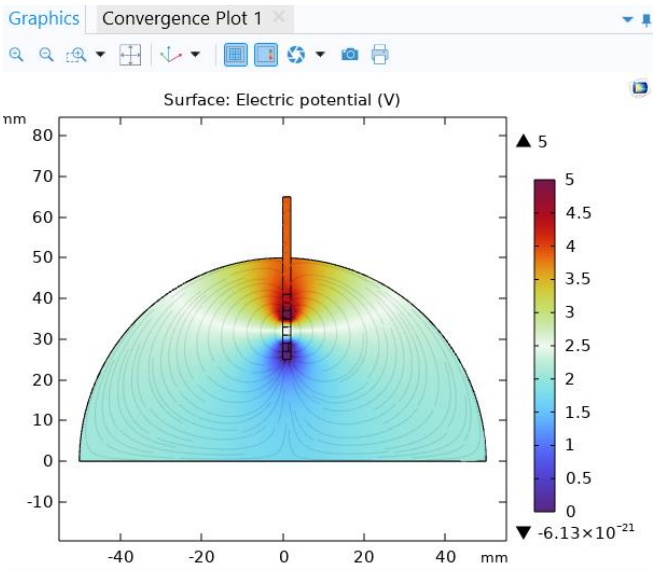


Figure 8 Electric field norm

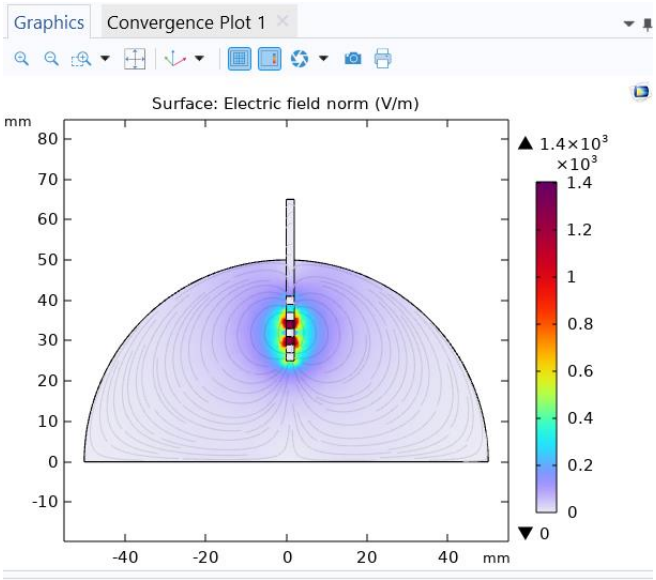


Figure 9 electrode is brought closer to ground

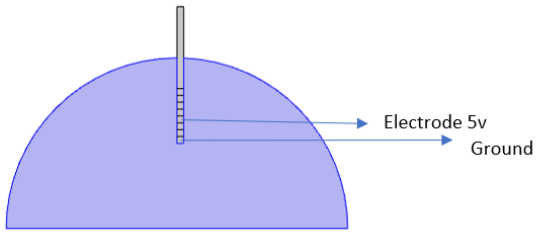


Figure 10 Electric potential at 5v

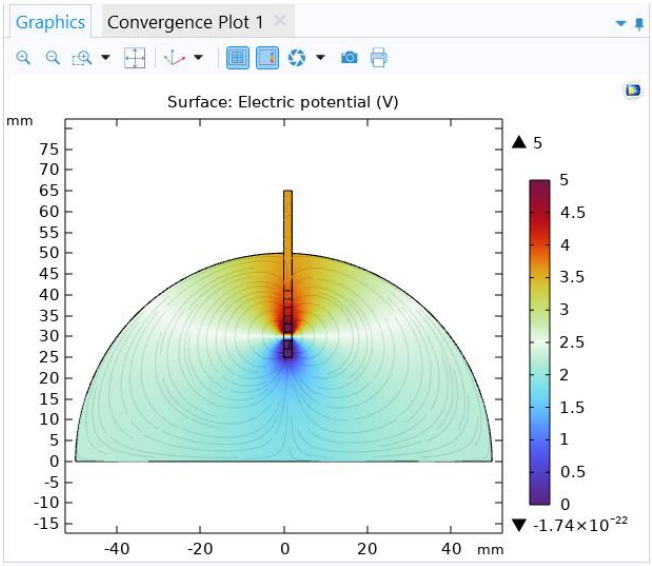


Figure 11 Electric field norm

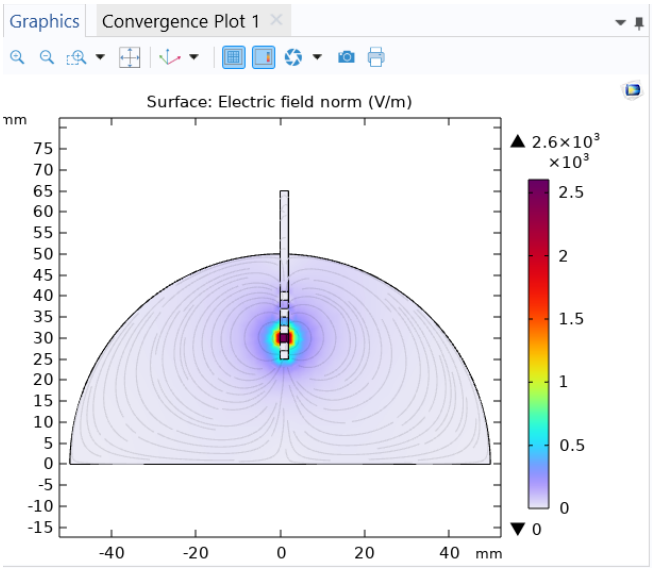
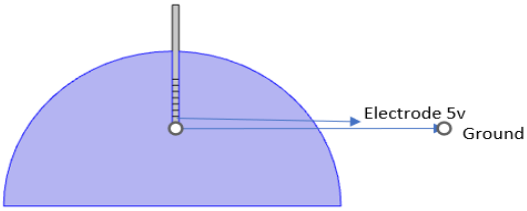
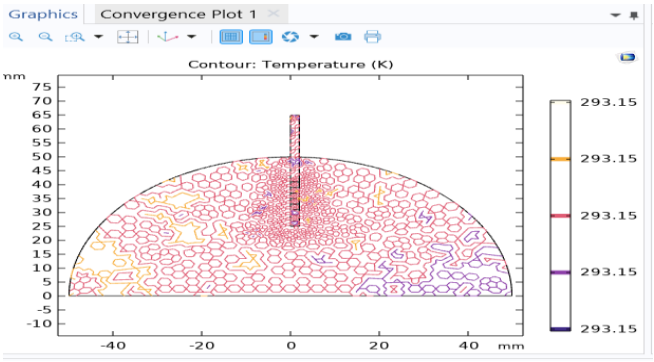


Figure 12 electrode is brought closer to ground



The above diagrams Figure1-12 show that as we decrease the distance between the electrode and the ground the electric field strength increase increasing the magnetic field lines.

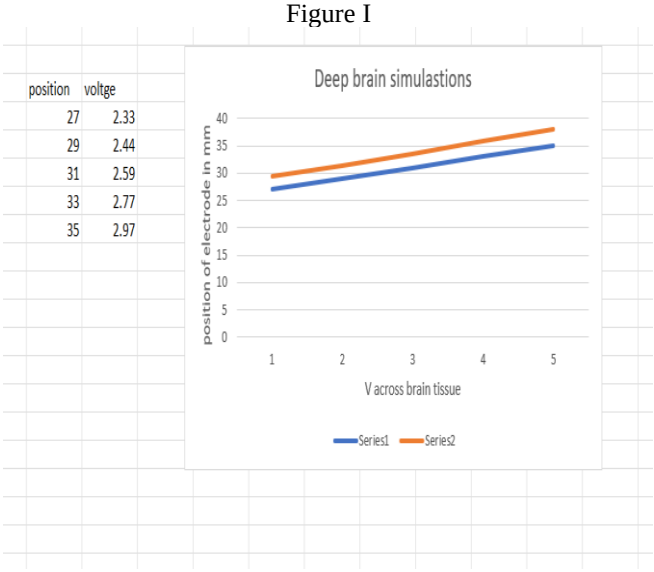
Figure I



The current generated creates the heating effect. This thermal or heating effect is more near the injecting electrode while moving toward the ground electrode the heating effect decreases.

III. Conclusions

Figure I



IV. Discussion

COMSOL Multiphysics is a software that replicates real-life systems into models where simulations are given that replicate the real time systems stimulus. This software saves the researchers hassle of taking permission to perform experiments on living things plus saves any accident harm that the living thing might get. In this software, we have complete freedom to use different materials and conditions where we can test our findings. Multiple electrodes are attached to the polyamide strip so that the change of position is made convenient and activating the electrodes as per the need. Material properties of electric current and heat are added to all the designed geometries. The injecting electrodes inject the pulse and due to the resistance, the potential is generated. When the potential of 5volts is kept constant at a position and the ground is shifted, there is a difference in potential which occurs in the brain tissue. With the increase in distance between the potential electrode and ground, the potential increases because of the large number of electric field lines that pass through the tissue. When there is a minimum distance between the surface and potential electrode, electric field lines hardly pass through the vessel generating minimum flux and the potential. The analysis is also made by giving high potentials up to 10 volts, by increasing the injecting potential the potential difference generated in the brain tissue and the surface temperature increases.

References

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