

Estimations of Volume of Tissue Activated in Deep Brain Stimulation

Background Deep Brain Stimulation (DBS) is an established therapy for movement disorders such as Parkinson's disease. In DBS, leads are implanted into the basal ganglia and electrical stimulation is applied to treat the symptoms of the disease. The exact mechanisms of the therapy are still unknown. Computational modelling of the Volume of Tissue Activated (VTA) has provided estimations of the stimulated area and has improved understanding (Figure 1) [1–4]. However, these estimations make a number of assumptions to reduce computational load, which in turn affect accuracy, in particular for bipolar stimulation.

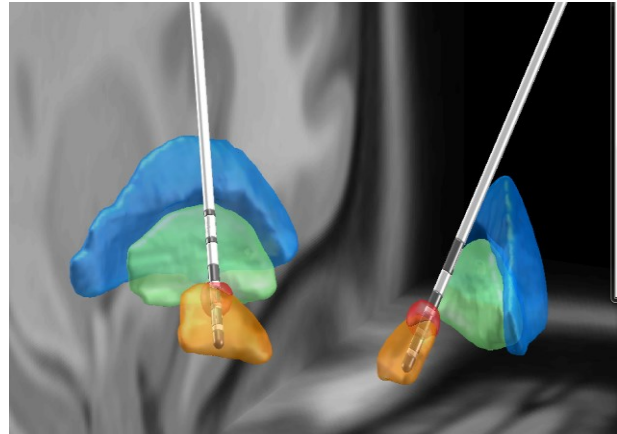


Figure 1. 3D illustration of DBS leads and subcortical structures. Subthalamic nucleus in orange and volume of tissue activated in red.

Aim The student will first compare and contrast different models of VTA that exist in the literature. Following this review, the student will then implement refined models of VTA within the open-source toolbox Lead-DBS. Specifically, these models will account for anisotropy.

Materials and Methods Based on existing models [1–4], the student will implement the VTA models in Matlab with the open-source toolboxes FieldTrip and/ or Lead-DBS.

Nature of the Thesis:

Literature review: 10%

Programming: 70%

Writing: 20%

Requirements:

Basic knowledge of electric fields, DBS

Interest in modeling and simulation

Programming knowledge primarily in Matlab

Supervisors:

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References:

- [1] McIntyre CC, Mori S, Sherman DL, Thakor N V., Vitek JL. Electric field and stimulating influence generated by deep brain stimulation of the subthalamic nucleus. *Clin Neurophysiol.* 2004;115: 589–595. doi:10.1016/j.clinph.2003.10.033
- [2] Mädler B, Coenen VA. Explaining clinical effects of deep brain stimulation through simplified target-specific modeling of the volume of activated tissue. *Am J Neuroradiol.* 2012;33: 1072–1080. doi:10.3174/ajnr.A2906
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