

Mapping the Synaptic Electric Field

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Abstract

In this note, the authors present the first 3D map of the electric field around a synapse, to the best of their knowledge. Specifically, it is the pre-synaptic terminal bouton's electric field.

We have developed a MATLAB program that simulates the electric field of an axon. In this extension, we develop a model for a synapse and simulate it. The synapse is modeled as a disc which represents the pre-synaptic terminal bouton. Within the disc are rings of ion channels. Rings of different radii cover the disc. In each ring equispaced ion channels are located. Each ion channel is modeled as a dipole, which reflects the peak charge separation obtained when the gate opens. The field of these dipoles is calculated around the bouton. Thus the figures below represent the peak field of the synapse. This result has several implications, specifically for neuroprosthetic implants and devices. It also has implications for disease modeling. Finally, cognition has often been thought as a field-effect and so implications for consciousness and cognition are present as well.

Acknowledgments

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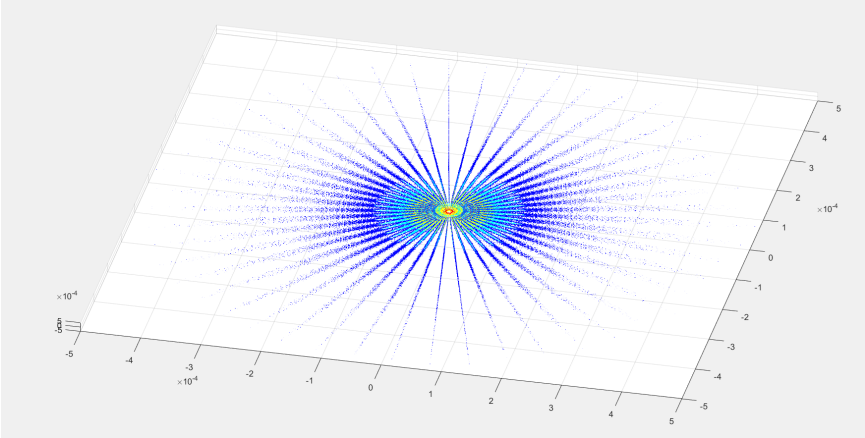


Figure 1: View 1

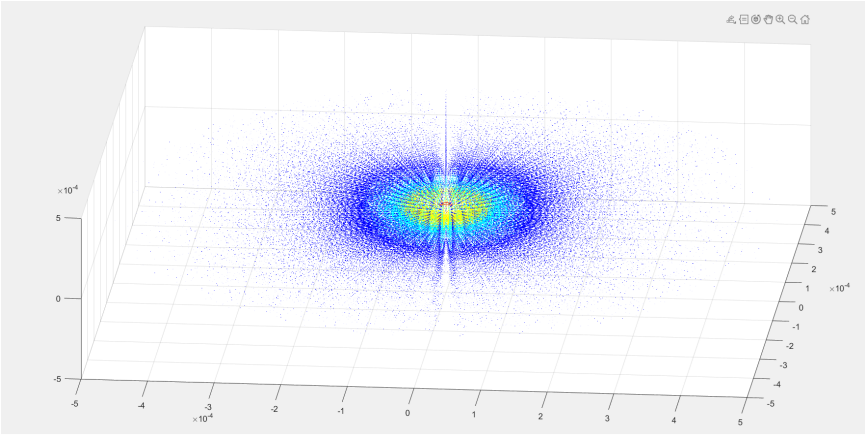


Figure 2: View 2

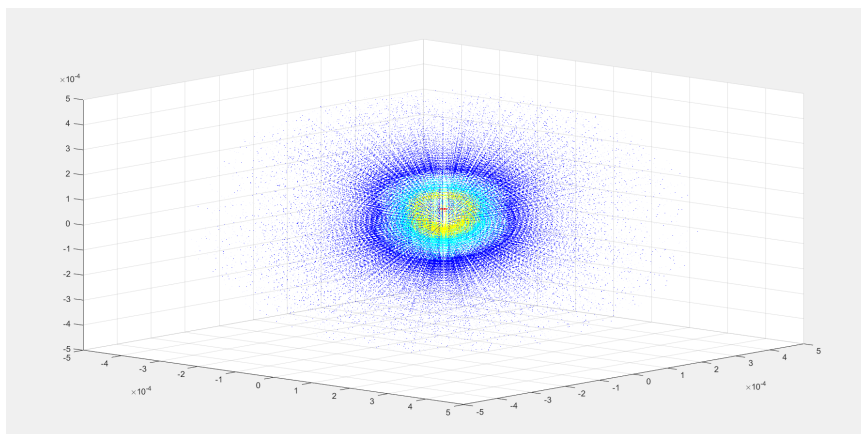


Figure 3: View 3

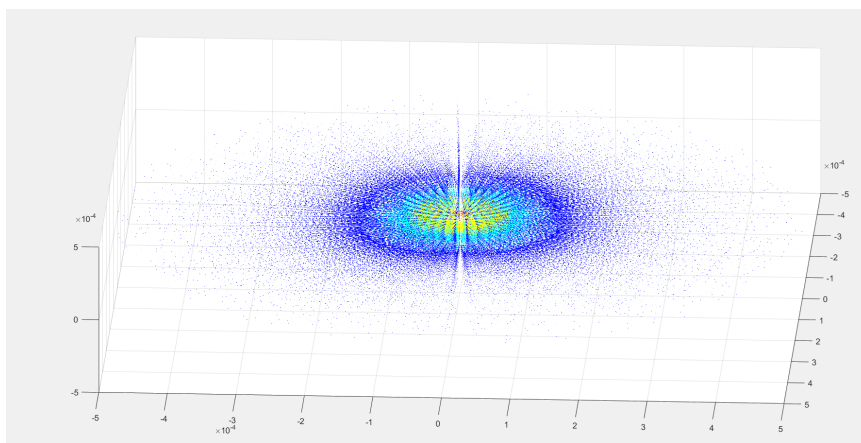


Figure 4: View 4