DEPARTMENT OF MATHEMATICAL SCIENCES

Colloquium

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Understanding Neuronal Response to a Ramped Input Current

ABSTRACT: In the nervous system, olfactory bulb dopamine-secreting neurons (OBDA neurons) process different odors by inhibiting other downstream neurons. Recently, novel experiments were performed in these OBDA neurons wherein current applied to the individual neurons was ramped to mimic biologically realistic neuronal input (at Florida State University, the Trombley lab performed). However, this new stimulus protocol raises the questions of what is the proper way to interpret these data and how can mathematical analysis help? We have developed a methodology to study transient dynamics in the electrical activity of single neurons while maintaining a collaboration with the biologists who carry out these experiments. This work was performed in collaboration with Kirill Korshunov, Paul Q. Trombley, and Richard Bertram and allows us to understand how different ion channels shape the transient response dynamics in OBDA neurons. In particular, we are using bifurcation analysis and fast-slow analysis, combined with linear regression techniques, to model a slow activating potassium channel and understand the influence of both the applied current and ramp duration in the spiking behavior. These mathematical tools we developed can be used to explore the behavior of other cell types as it is our belief that the ramping technique could be extended to study the dynamics of all neuron types. Ultimately, this work creates a positive feedback loop wherein data informs the model and the model directs future experiments, thus helping close the gap between mathematical modeling and biological data in computational neuroscience.

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Time:11AM-12:00PM
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