

Oral presentation

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Ion concentration dynamics: mechanisms for bursting and seizing

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The Hodgkin-Huxley equations are of fundamental importance in theoretical neuroscience. However, these equations assume that the intra- and extra-cellular ion concentrations of sodium and potassium are constant. While this is a reasonable assumption for the squid giant axon preparation, its validity in other cases, especially in mammalian brain, is subject to debate. It is therefore surprising that relatively little attention has been paid to the dynamics of ion concentrations in the years since Hodgkin and Huxley's seminal work was published. We develop a conductance-based model neuron that includes intra- and extra-cellular ion concentration dynamics. We further formulate a reduction of this model to identify the bifurcation structure. Using these models, we describe novel mechanisms for bursting and seizing behavior that is strikingly similar to that seen in experimental preparations.