Abstract Submitted
for the 4CS20 Meeting of
The American Physical Society

Exploring a Reduced Model of Neuronal Activity JOSHUA RASBAND, Brigham Young University — Mathematical models of neuronal activity are critical to understanding the brain. Two such models are the Hodgkin-Huxley (HH) and Fitzhugh-Nagumo (FN) models. The HH model is a mechanistic model. It uses underlying physical relationships to make predictions. In contrast, the FN model is a phenomenological model. It describes mathematically the behavior of the system, but is not derived from physical theory. These two types of models have complementary advantages and disadvantages. The FN model is phenomenological and has few parameters, making it easy to develop intuition about and computationally less expensive. The HH model is mechanistic and has a large number of parameters, making it difficult to develop intuition about or fit to data. We consider the problem of constructing a model that lends itself to human intuition while preserving the physical theory present in the HH model. We use model reduction techniques to remove irrelevant parameters from the HH model, i.e., parameters whose variation are unnecessary to explain a specific behavior. We then ask whether the reduced HH model can accurately mimic behavior exhibited by the FN model. In this way, we preserve the physical nature of the HH model while reducing its complexity to something more like the FN model.

Joshua Rasband
Brigham Young University

Date submitted: 29 Sep 2020 Electronic form version 1.4