Data Driven Optimization of Reduced Neural Models

With a Large Scale Analysis of Models and Data

by

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A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved Month Year by the
Graduate Supervisory Committee:

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ABSTRACT

ACKNOWLEDGMENTS

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0.1 Further Validation of Optimized Models

Models can continue to undergo validation checks subsequent to optimiztion. One way to do this is to move from a single spiking stimulus regime, to a multispiking regime, and then use different feature extraction libraries using a much larger number of features. The higher dimensional feature space can be reduced to a low dimensional space, where it is eaasier to discriminate between models and data.

Agreement between the optimized.

0.2   PCA and tSNE

Figure 1. Principal Component Analysis

Feature Variance distributed though-out a plane, the plane was output from applying dimension reduction to a high dimensional (552 dim) feature Space. The plane is related to two projection vectors that were point in the directions of maximal variance in the data. Data is comprised by a collection of reduced neuronal models, and real recordings of voltage traces from neurons. Data and models are so different in this space that they are easily discriminated, and they fall into several natural clusters. Random Forests variance explained was later used to identify, dimensions that contributed the most variance. *T-Distributed Stochastic Nearest Neighbour Spatial Embedding*

steady_state_voltage_stimend_3.0x versus AP1DelayMeanTest_3.0x
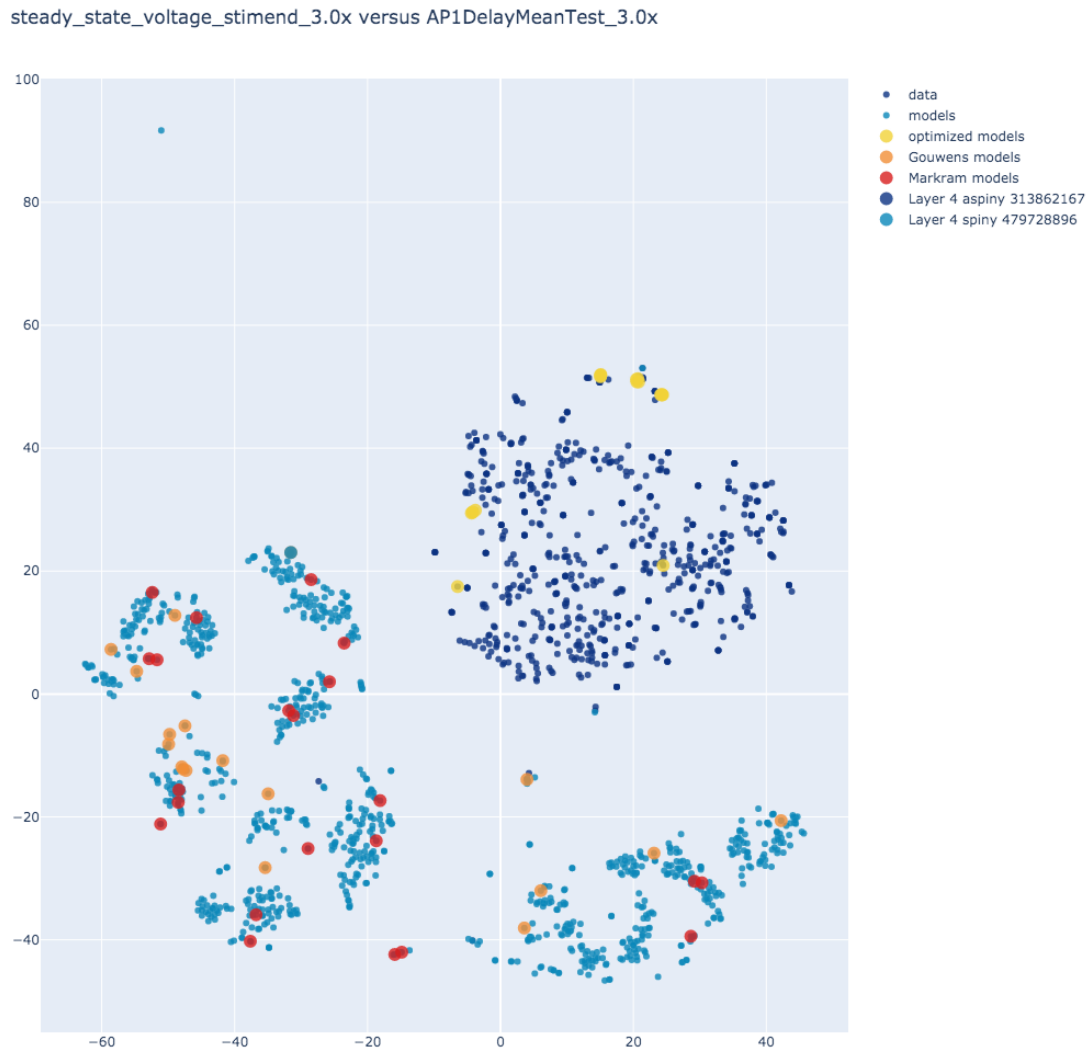
Figure 2. t distributed stochastic Neigherset Neighbour Spatial Embedding

Source: Krishnappa (2012)

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Chapter 1

INTRODUCTION

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In this research effort,

1.1 Specific Aims

1.1.0.1 1A:

Optimize reduced neuronal models across four different cell types, using two different classes of models:

olfactory bulb mitral cell	layer IV pyramidal neuron	cerebellar purkinje cell	ca1 pyramidal
HH model score	HH model score	HH Model score	HH model sc
Izhikitich model score	Izhikitich model score	Izhikitich model score	Izhikitich model

1.1.0.2 2A:

By fitting cellular models to experimental data, using spike waveform shape features, we can then take optimized models, and characterize and cellular behaviors using Allen SDK and EFEL feature extraction software to evaluate electrical robustness across a large number of features.

1.1.0.3 Aim 2:

Characterize and evaluate region-specific differences of cortical neuron-type data and models.

1.1.0.4 2A:

Using large, publicly available datasets for neuron classes, we will characterize region-specific differences and evaluate neuron-type models for agreement with experimental data.

1.1.0.5   2B:

Using models of neuron-types from different cortical regions we will identify the features underlying differences among neuron types and across regions, as well as the biophysical mechanisms that underlie those features.

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1.2   Citation examples

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1.3   Footnote examples

NOTES

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APPENDIX A

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