

Everton Agnes, University of Oxford

Spiros Chavlis, Foundation for Research and Technology-Hellas

Nassi Papoutsis, Foundation for Research and Technology-Hellas

Bill Podlaski, University of Oxford & Champalimaud Center for the Unknown

Tutorial 5

Simulating dendrites at different levels of abstraction

Overview

Morning session

1. Basics of compartmental modelling
2. Detailed modelling of dendrites
 - 1.a. *Introduction to NEURON*
 - 1.b. *Passive dendritic integration*
 - 1.c. *Active dendritic integration*
3. Simplified models of dendrites
 - 3.a. *Introduction to BRIAN*
 - 3.b *Adding dendrites to a LIF model*
 - 3c. *Non-linear synapses*
4. Role of dendrites in a working memory (network)

Afternoon session

Installation steps

1. Download the code on GitHub:

https://github.com/wpodlaski/ocns2019_simulatingdendrites

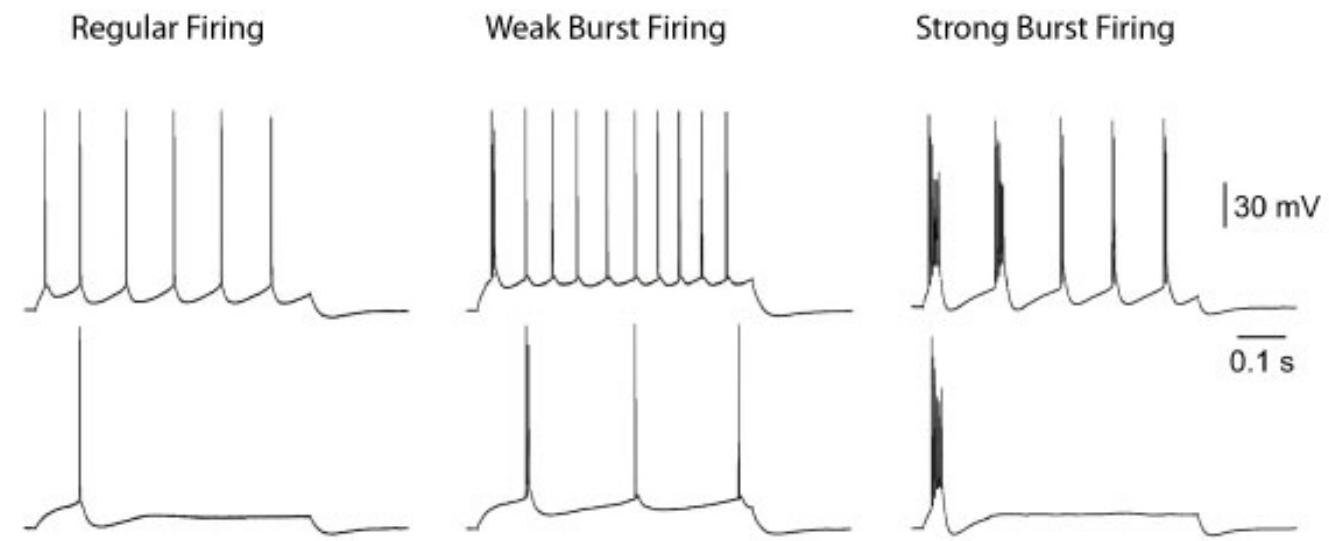
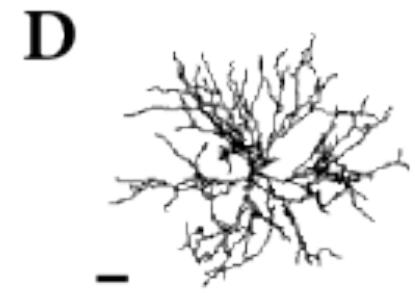
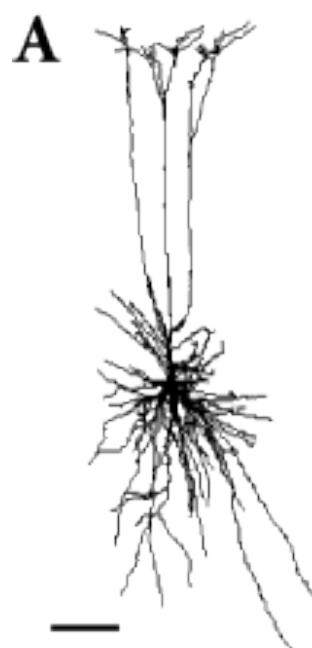
2. Install Anaconda 3 (Python 3)

3. Install NEURON

Neurons are (also) characterized by their dendritic tree

Neuron Types:

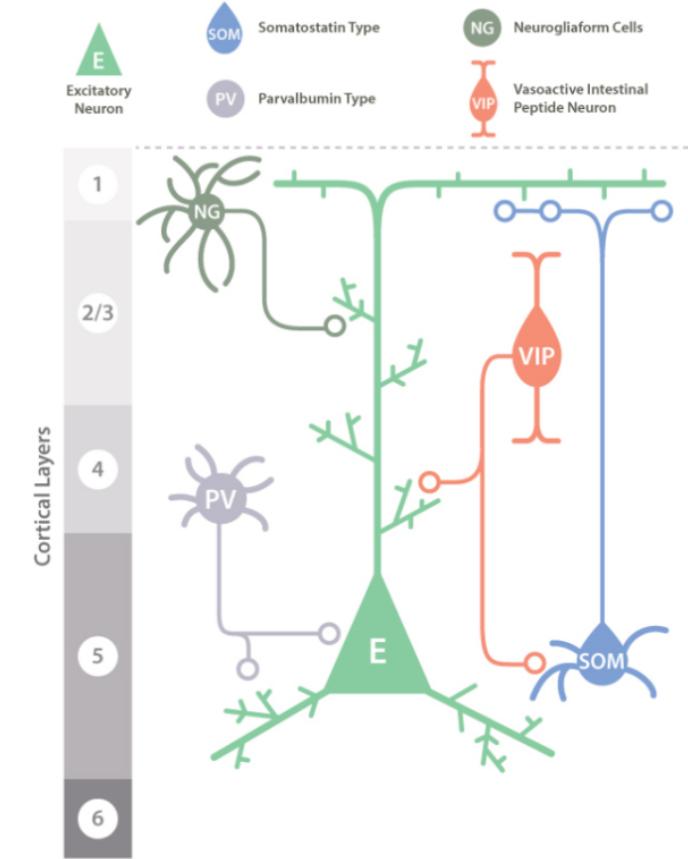
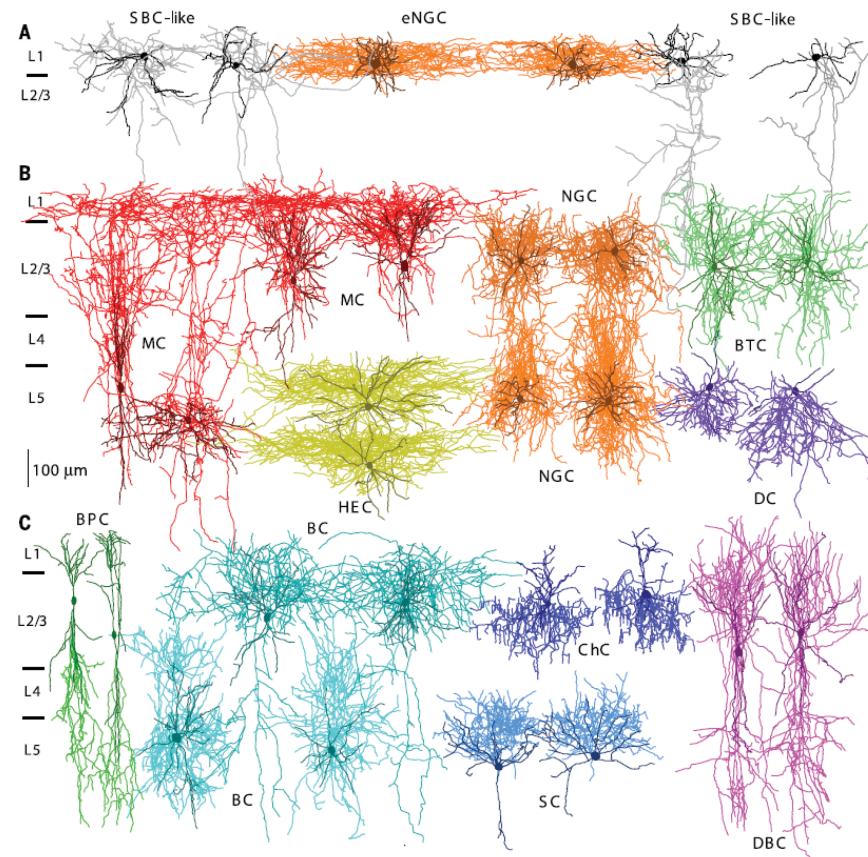
1. Classification using gene expression
2. Classification based on Excitatory or Inhibitory neurotransmission.
3. Classification using spiking activity
4. Classification by anatomical features



Williams, Stuart, J Physiol. 1999

Neurons are (also) characterized by their neurotransmission

Large variability of interneuronal subtypes.



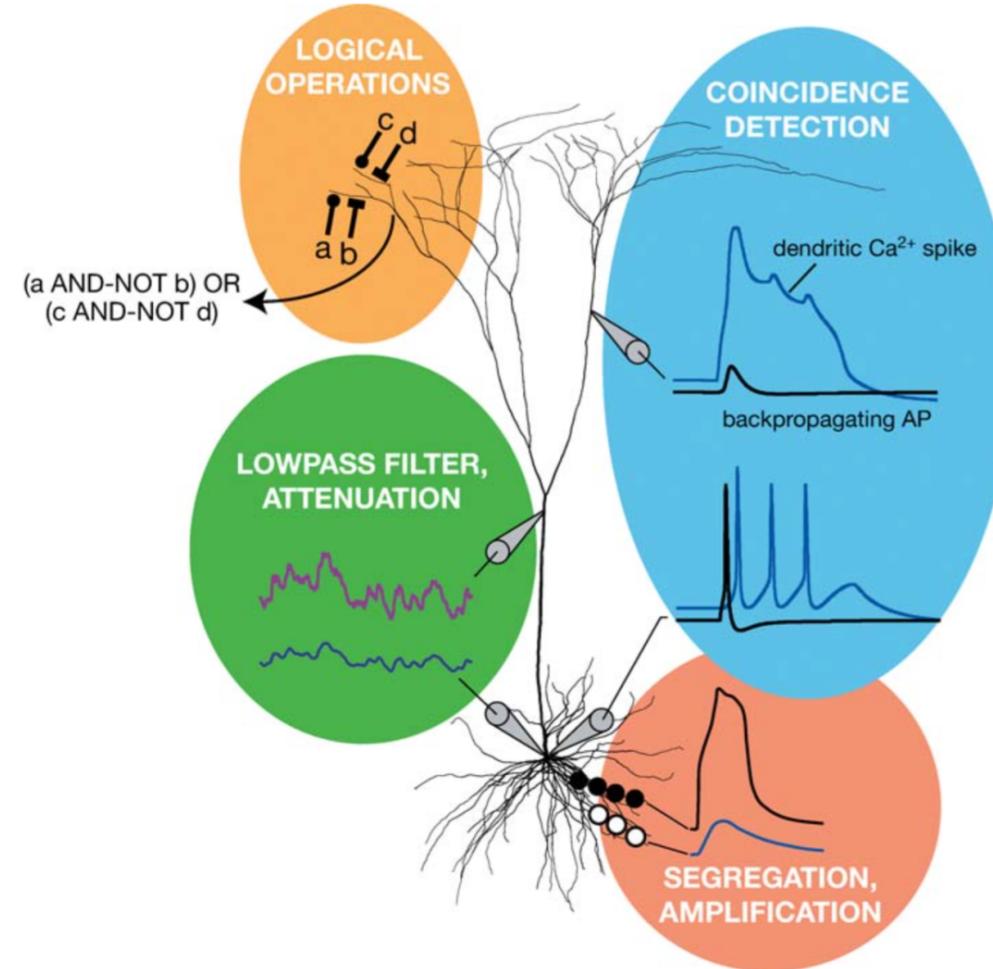
© Knowing Neurons <http://knowingneurons.com>

Jiang et al., Science 2015

13/07/2019

ocns2019

What can dendrites do?



Why model the details?

1. Interpretation of **experimental** results - Gain insights into key biophysical parameters.
2. Suggest possible computational (functional) role for the modeled system (**predictions**).
3. **Inspire** implementations in other fields.

Why abstract away the details?

1. Computational feasibility – simulate large networks / large number of parameter sweeps.
2. Analytical tractability-Comprehensive understanding of the underlying system.
3. Interpretability of results through the identification of key mechanisms in relation to a specific function.

Modeling dendrites: Compartmental Modeling

