Neuro-Mechanical Interactive Simulation Platform for Caenorhabditis elegans (C. elegans)

STUDENTS: James Jhong, Timothy Lee, Wujiarui Zheng

NeuroAI

Objective and Requirements

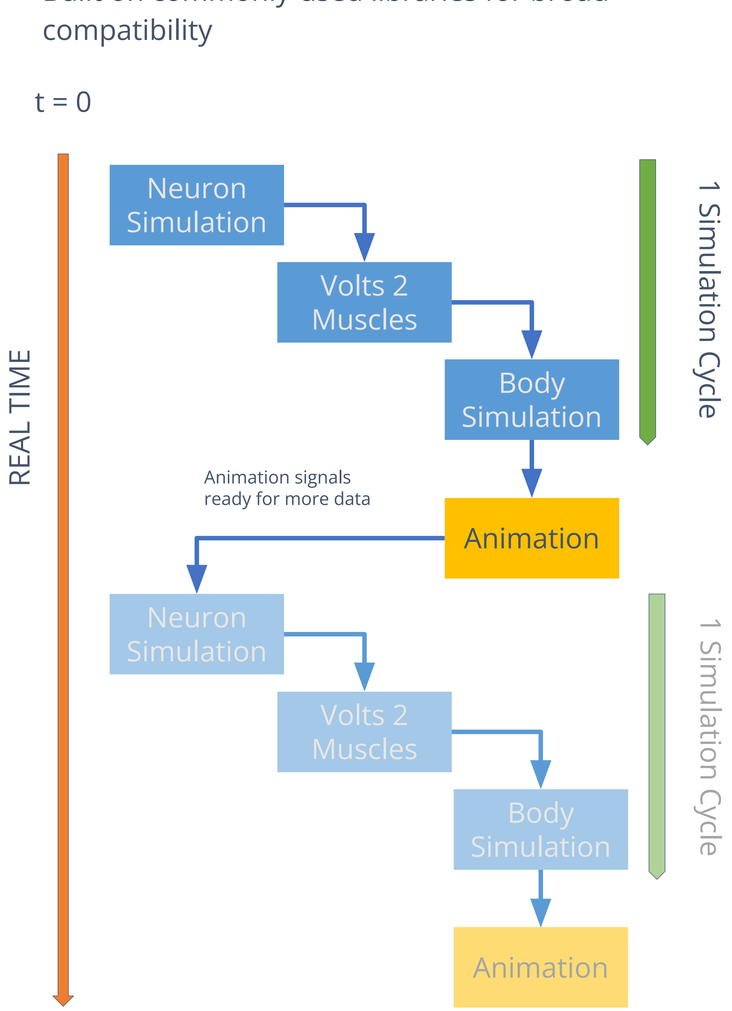
- A visual platform for an efficient investigation of the computational model
- Allows users to manipulate different layers of the organism (nervous system, body, environment) to observe their effects on behavior
- Potential to be used as a pre-experimental tool for neurobiology/C. elegans community

What is C. Elegans?

- Model organism for neuronal development and behavior
- Neural wiring map of the somatic nervous system (279 neurons) is fully resolved (White et al., 1986, Varshney et al., 2011)
- Data for muscles and body are available (Altun et al., 2006)
- A computational model integrating neural + body dynamics has been introduced (Kim et al., 2019)

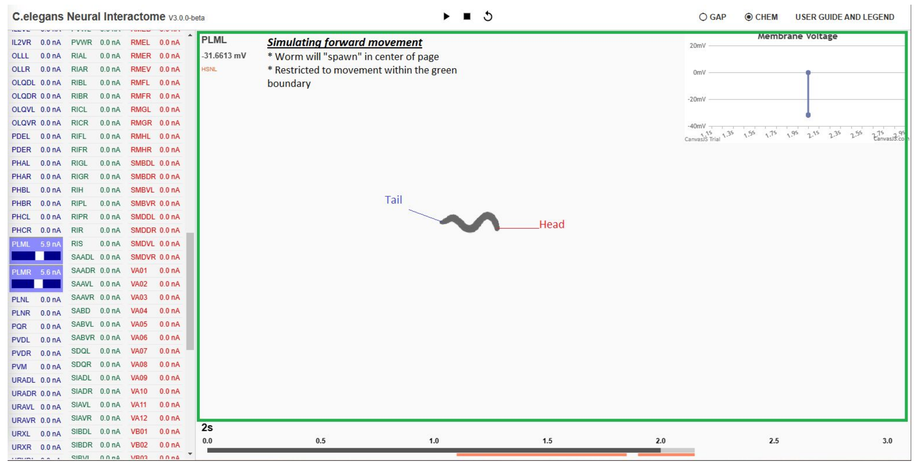
Program Architecture

- Browser interface in Javascript, connected to a Python background via Flask
- Built on commonly-used libraries for broad compatibility



Project Overview

- Fully functioning, user friendly 2D simulation platform
- Users are allowed full access to the C. Elegans neural network for manipulation
- Quick simulations speeds averaging 0.6 seconds to calculate nearly 10,000 body coordinates at a time.
- Smooth animations of 30 FPS
- Highly visible worm behavior



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Future Work & References

- Further increase to simulation speed
- Loading and running pre-designed experiment scenarios
- Hosting simulation platform on a domain

Kim, J., Leahy, W., & Shlizerman, E. (2019). "Neural Interactome: Interactive Simulation of a Neuronal System." Frontiers in Computational Neuroscience 13. https://doi.org/10.3389/fncom.2019.00008/full

Kim, J., Santos, J., Alkema, M., & Shlizerman, E. (2019). "Whole integration of neural connectomics, dynamics and bio-mechanics for identification of behavioral sensorimotor pathways in Caenorhabditis elegans." bioRxiv. https://doi.org/10.1101/724328

ELECTRICAL & COMPUTER ENGINEERING
UNIVERSITY of WASHINGTON

ADVISORS: ELI SHLIZERMAN, JIMIN KIM

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