TITLE

Real-Time Calcium Imaging Analysis and Stimulation Platform

AUTHORS

Raymond Chen[1], Anne Draelos Ph.D[1,2]., John Pearson Ph.D[1,2].

1. Center for Cognitive Neuroscience, Duke University, Durham, NC 27710
2. Department of Biostatistics and Bioinformatics, Duke University, Durham, NC 27710

ABSTRACT

Advancements in microscopy and calcium imaging techniques have allowed modern experiments to generate terabytes of data. This surge in data volume comes at the cost of increased processing time. However, recent improvements in preprocessing algorithms for imaging data, along with tools for characterizing neuron responses, have allowed researchers to envision a real-time imaging analysis platform to support adaptive experiments. Thus, using standard Python libraries and CaImAn, an open source calcium imaging processing library, we are developing an online, fully-integrated pipeline for calcium imaging analysis that facilitates closed-loop neural experiments. Our system utilizes modular components to execute and monitor activity involving data acquisition, processing, analysis, and visualization. These modules are run in parallel using Python's multiprocessing library. This provides concurrency such that data is sequential, but is processed in parallel. For centralized data storage, we are using Apache Arrow's Plasma In-Memory Object Store, which is independently accessible by modules. Furthermore, we employed Windows Subsystem for Linux to circumvent compatibility issues with Apache Arrow and Qt on the Microsoft Windows operating system. Our platform is designed to meet efficiency and stability requirements to ensure zero data loss and real-time analysis for imaging experiments.