PiVR Real-Time Behavioral Mode Classification

<u>Intro to PiVR</u>

PiVR is a virtual reality program for small animals. It has a robust closed-loop tracking system and post-hoc data analysis tools. It uses Raspberry Pi technology combined with 3D printing, with a tracking algorithm and machine interface written in Python (Tadres and Louis, 2020). It can be used to create virtual odor realities for small animals expressing a red-light gated ion channel (Chrimson) in a genetically targeted olfactory sensory neuron. It is used by the Louis Lab for Drosophila larvae virtual odor experiments.

The one thing PiVR is lacking is the ability to identify larval behavioral modes in real time. This limitation prevents the implementation of open-loop optogenetic stimulation paradigms, in which the Drosophila larva is stimulated during a specific behavioral mode. This real-time mode classification would help advance many projects within the lab, as well as be useful to others using PiVR. The project aims to update the software to include a robust real-time mode classification algorithm. Doing this will require looking at a large pool of existing behavioral data from PiVR to determine parameters and thresholds to build the algorithm with accuracy. It will also require researching methods implemented in other tracking softwares which have real-time mode classification algorithms.

<u>Louis Lab Coding Team</u>

The Louis Lab coding team is a subset of members in the lab, mostly consisting of undergraduates. We are currently working on creating a streamlined post-hoc data analysis pipeline for PiVR data, to be integrated by the whole lab. We are achieving this in 3 steps: 1) a module for filtering/cleaning raw data points, 2) a module for behavioral classifications, and 3) a module for statistical analysis using the results of 1) and 2). We are on step 2, creating a module for behavioral classifications. Ideally, once the coding team has successfully created algorithms that can robustly identify behavioral modes post-hoc, these algorithms can be used as a reference for doing so in real-time.

Potential Student Research Plan ** *Come to meetings prepared.*

Week	Students
Week 1	- One on one meeting: Introductions
Week 2	- Complete readings - (https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3000712) - (https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1004606) - PiVR installation - Anaconda installation - One on one meeting: discuss reading, setup PiVR and anaconda installation together - Attend meeting: Louis Lab coding team intro
Week 3	- Complete readings - (https://pivr.readthedocs.io/en/latest/) - Manual mode classifications using PiVR - Practice using Python - One on one: discuss reading, compare manual classifications - Attend meeting: Louis Lab coding team
Week 4	- Complete readings - https://www.sciencedirect.com/science/article/pii/S0960982217316044?via%3Dihub - Read up on clustering algorithms - One on one meeting: discuss progress with learning Python, questions about clustering algorithms - Practice using Python
Week 5	- Read PiVR source code - Help identify where to add algorithm to source code
Week 6	- Help with virgin collection of drosophila flies
Week 7	- Help with experimentation
Week 8	- Identify holes in algorithm
Week 9	- One on one: discuss progress, what went well, what didn't go well, what improvements can be made + what we will we work on next quarter

Expectations:

1. Readings/literature review

2. Weekly meetings with mentor/monthly meetings with mentor + PI

3. Staying on task and organized:

- Taking notes during meetings
- Creating to-do lists
- Establishing personal goals and keep them in mind
- Ask questions!!