



WTEM – Worm Tracking Epifluorescence Microscope

MANDI YAMADA, STEVE MENDOZA, Tim Sherry, Blake Madruga, Katsushi Arisaka

UCLA, *Elegant Mind Club* @ Department of Physics and Astronomy



<http://www.elegantmind.org>

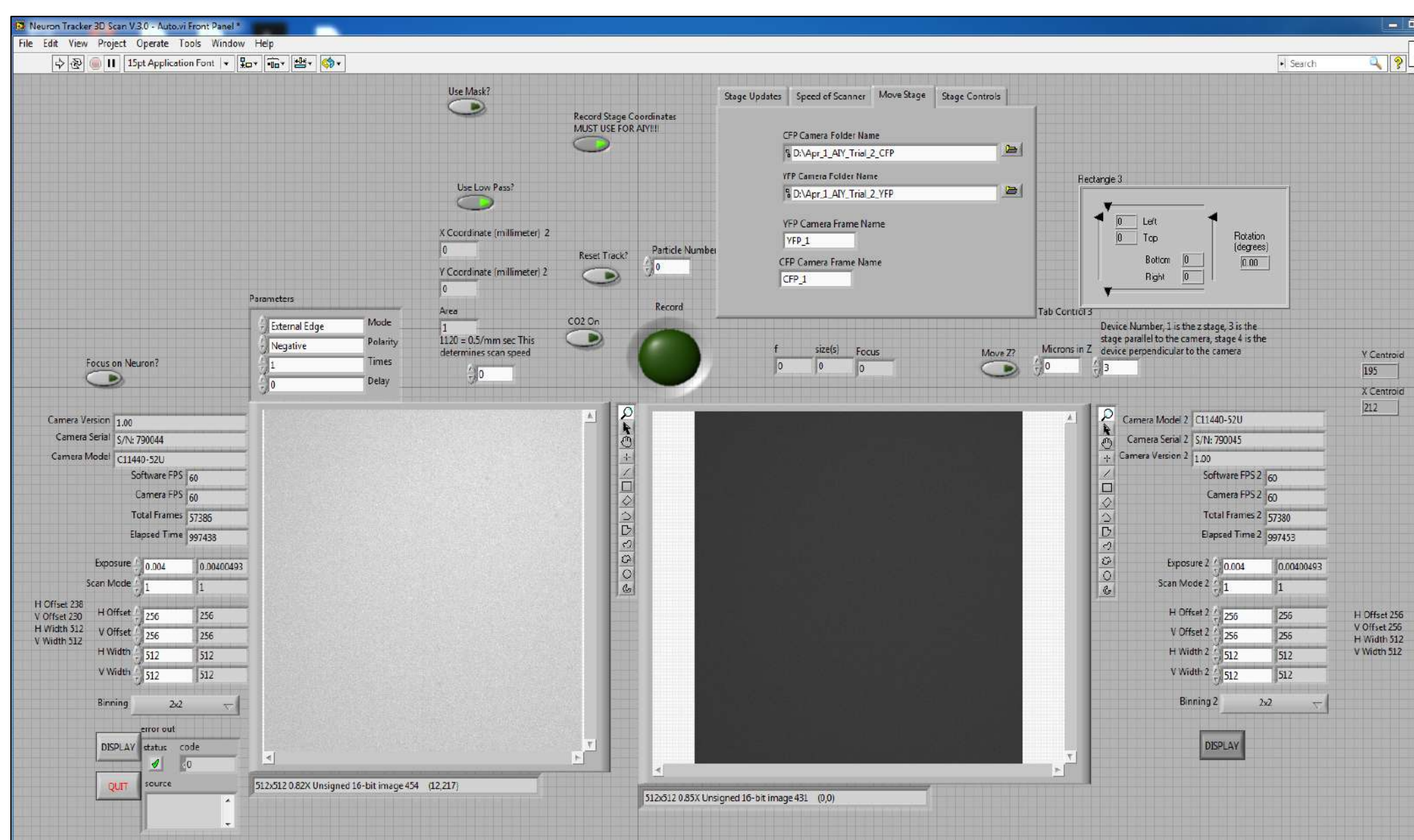
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ABSTRACT

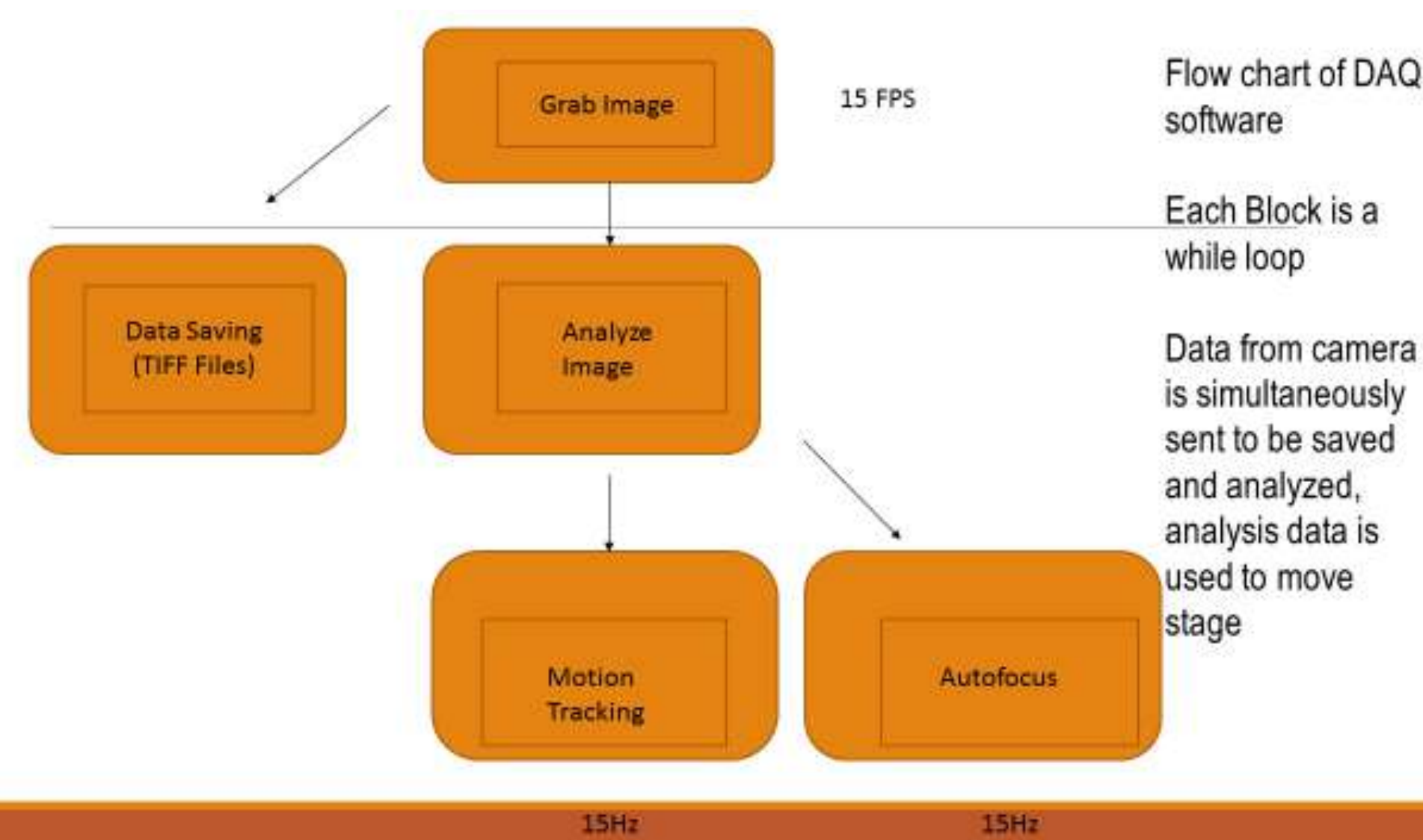
Following animals in real time is an essential part of finding out how animals behave. Our lab studies the motion of a small worm known as *C. elegans* while following them in real time, as well as measuring their neural activity. As opposed to other worm tracking systems, our microscope moves, while the surface in which *C. elegans* crawls on is stationary. The platform allows us to look at the worms neurons while they are freely moving. The current configuration has three cameras, two for each of the YFP and CFP channels, which are GFP variants that allow us to see neurons, and a dark field image showing the worm body, under a 10x magnification. Being able to track freely moving worms under various stimulations such as temperature, allows for us to observe *C. elegans* regardless of the various environments and allows for more flexible behavioral stimulation hardware. To test our microscope, we run a thermotaxis experiment, to study their navigation under a temperature gradient, tracking a worm under a stationary temperature platform. We image one neuron that has been shown to be active when *C. elegans* sense temperature changes. We find that there is a 0.8 second delay between the temperature change and the neuronal activity change. Our methodology could also apply to other behavioral experiments where an external stimulus would be hard to move via a motorized stage, such as an electotaxis experiment, where we apply an electric field to the worms.

INTRODUCTION

- Worm Tracking is a useful method to get high resolution images
- It is also used to get neuronal data even when the worm is moving
- So far, *C. elegans* is one of the few animals that can be tracked in this manner.
- Our microscope has been used for a variety of purposes and experiments such as temperature and electric field tracking



Automated tracking program to track neurons. This software was written using LabView and allows us to follow the worm while it is moving.

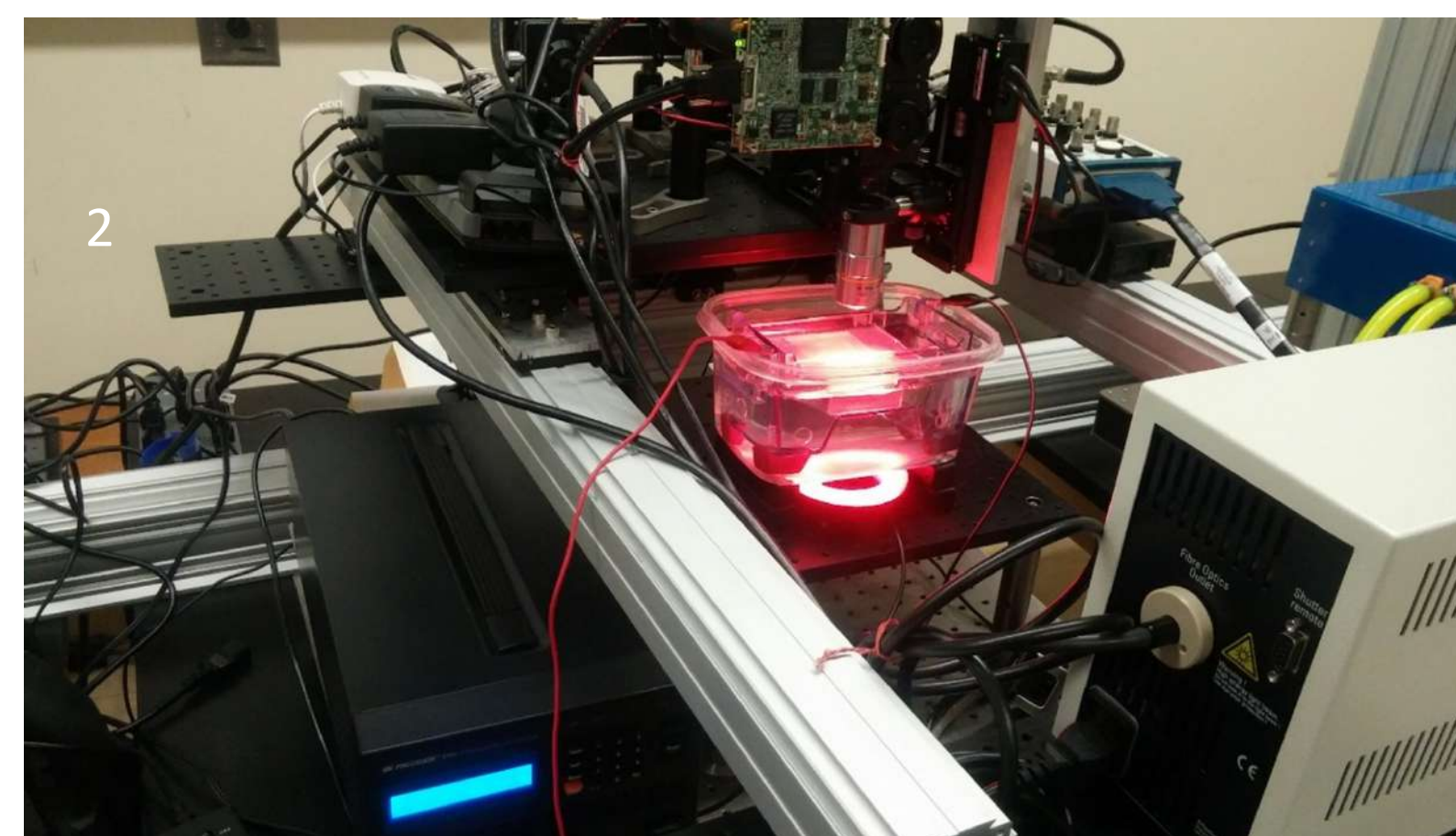


Algorithm used to do worm tracking, We take an image, then use the image data to move the stages in order to accurately track the worm.

SETUP and DATA

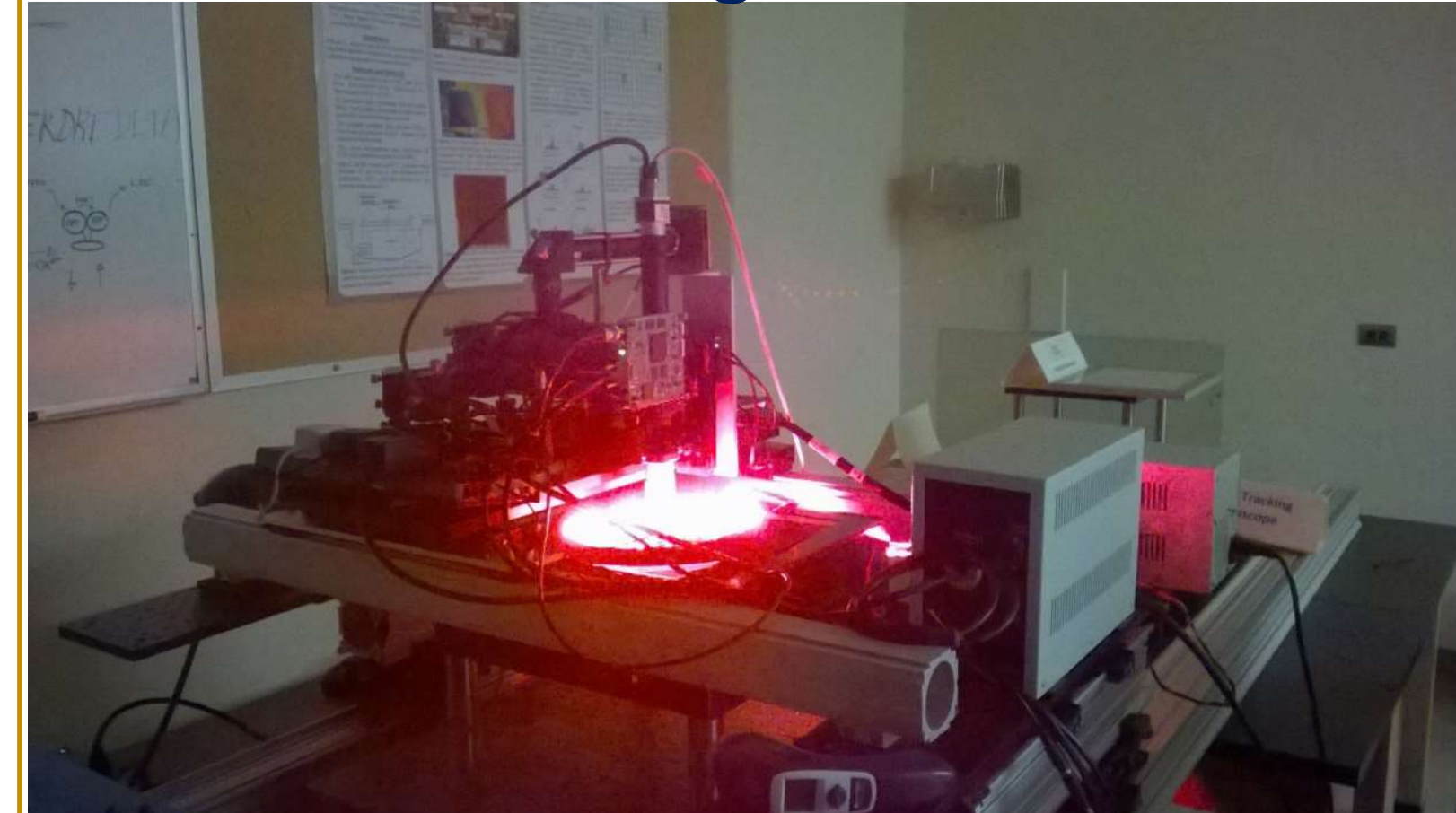
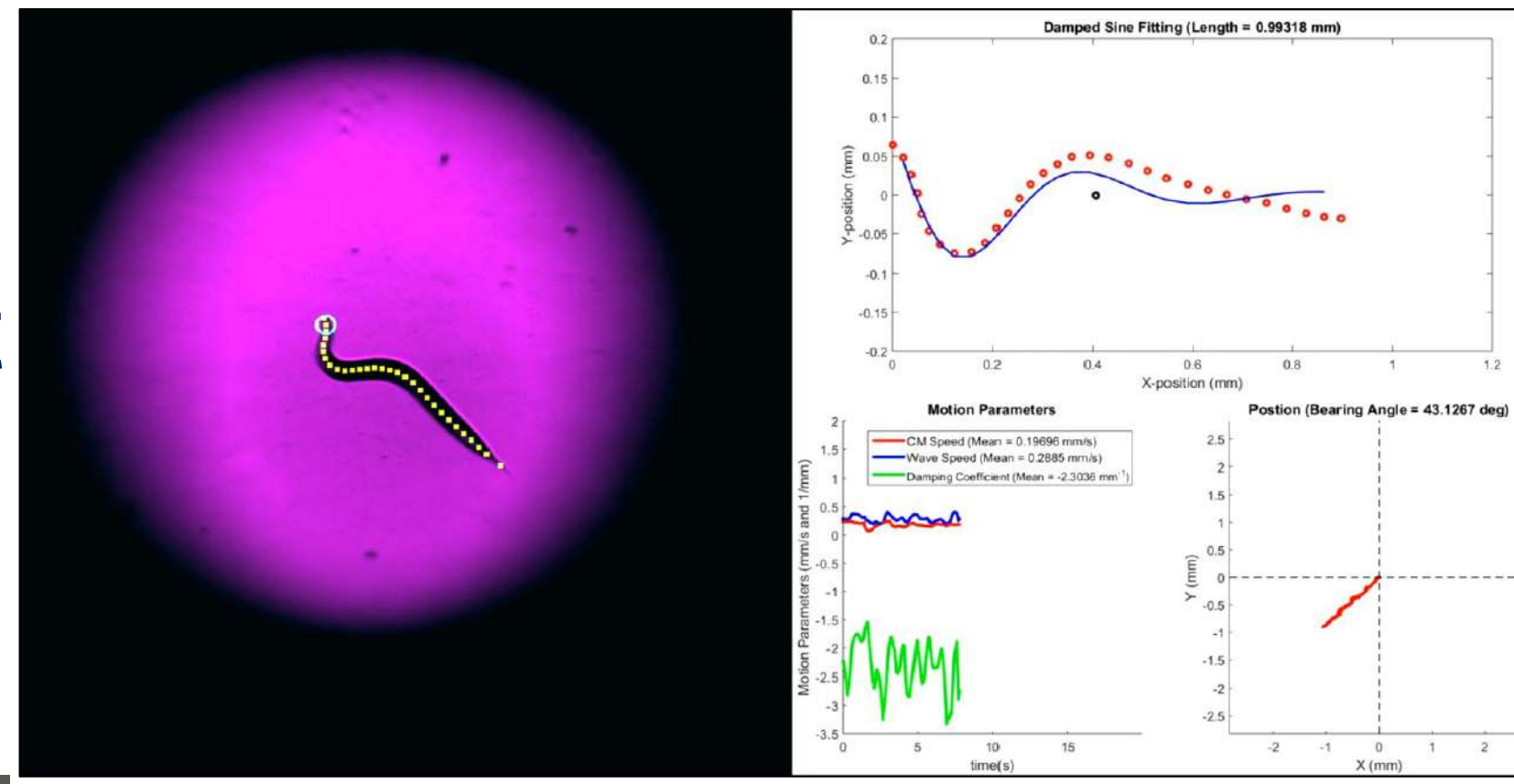


Microscope setup in which the microscope can slide and move from one experiment to the next to facilitate worm tracking. The microscope can take data from the various temperature plates around to take temperature experiment data.



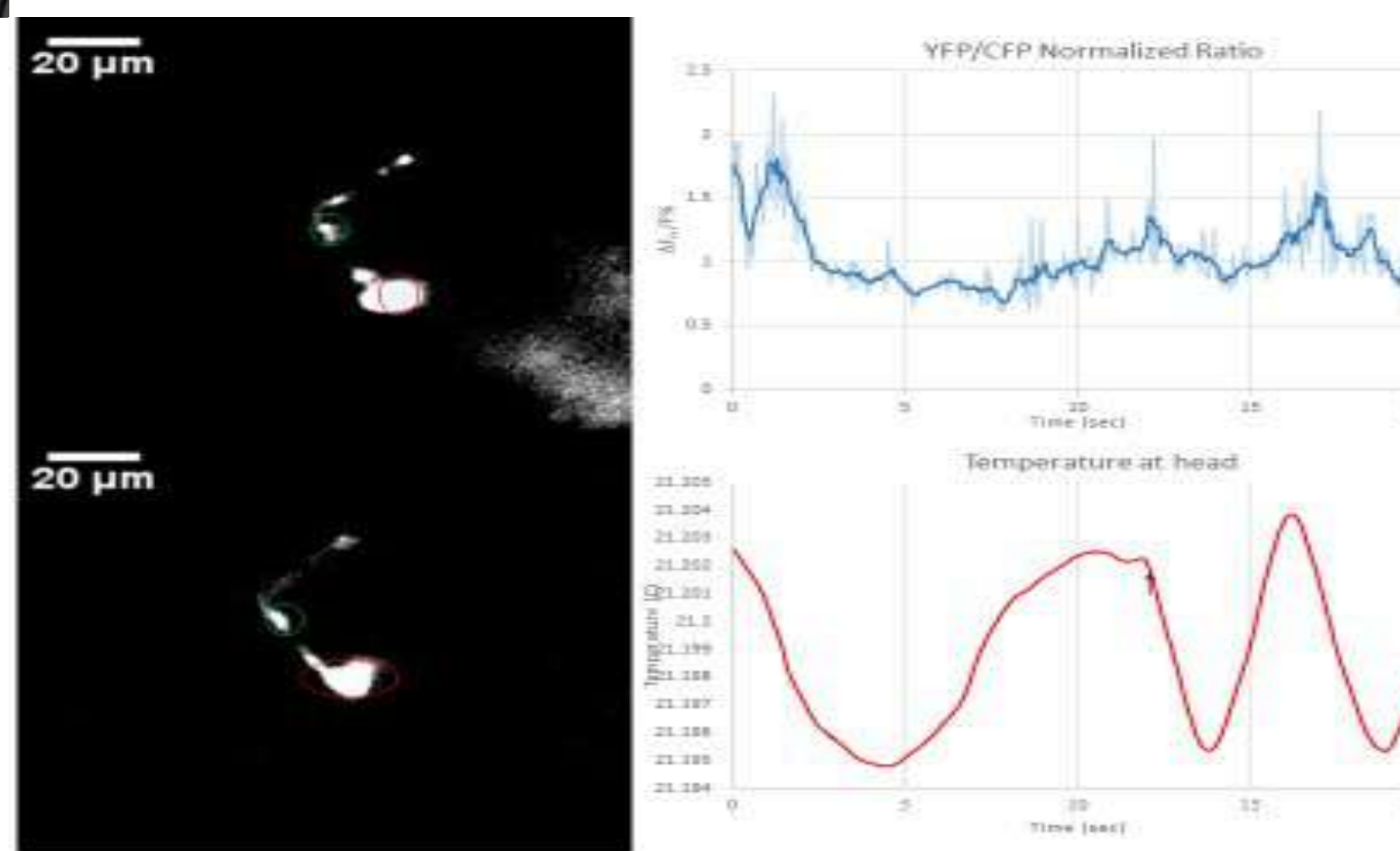
Microscope setup over an electric field experiment. This experiment involves subjecting worms to electric fields from 4-12 V/cm

Data taken from a typical run taken at 8V/cm. We can take detailed tracking data at around 30 fps, then we analyze the data using high resolution images.



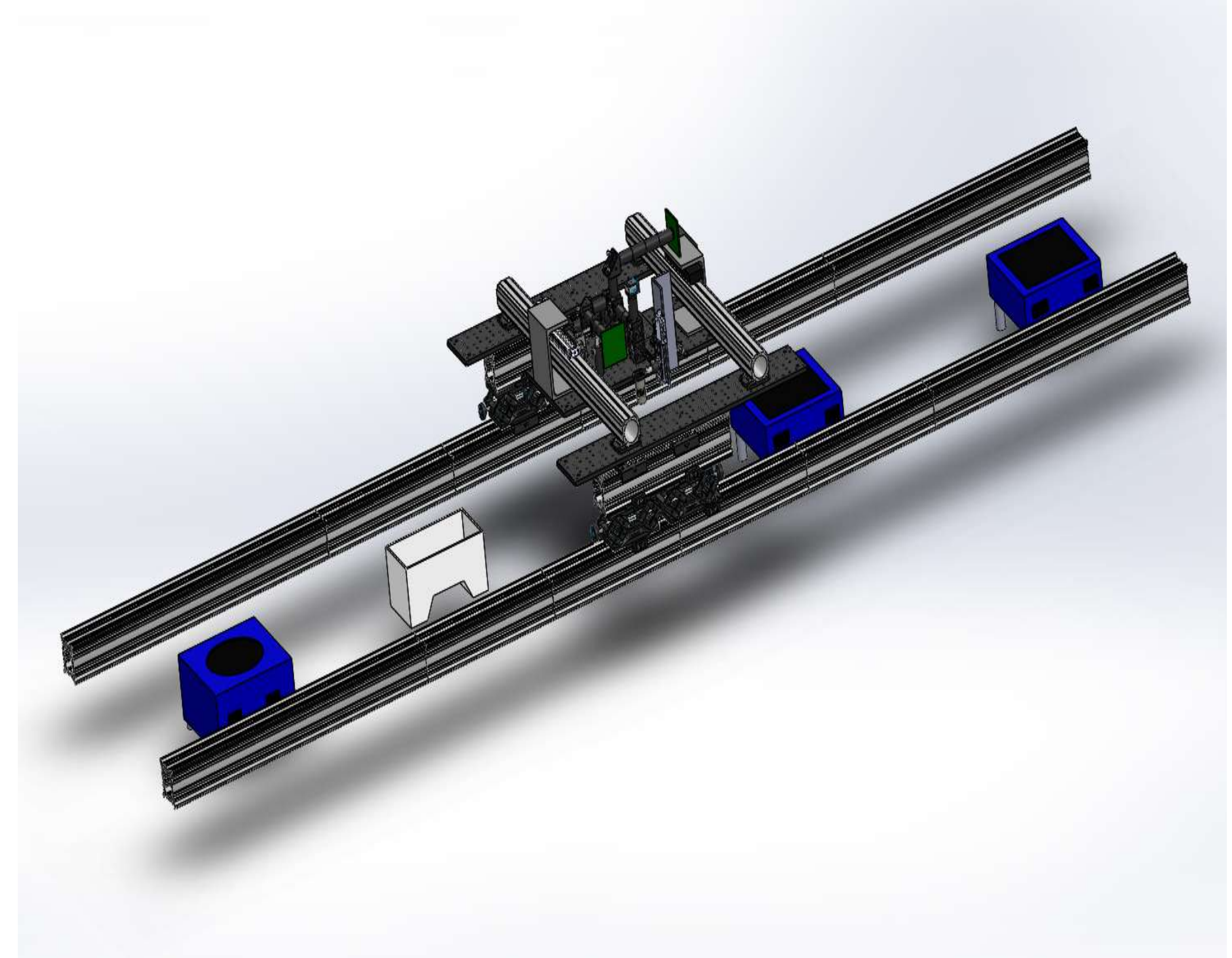
Microscope setup over a temperature plate. This is a linear gradient that can be anywhere from 0.2 C/cm to 0.6 C/cm, to study behavior such as isothermal tracking.

Neuron tracking data using the neuron AIY using the temperature plate setup. Using this setup we can track worms as they move along a large area while they search a good temperature.

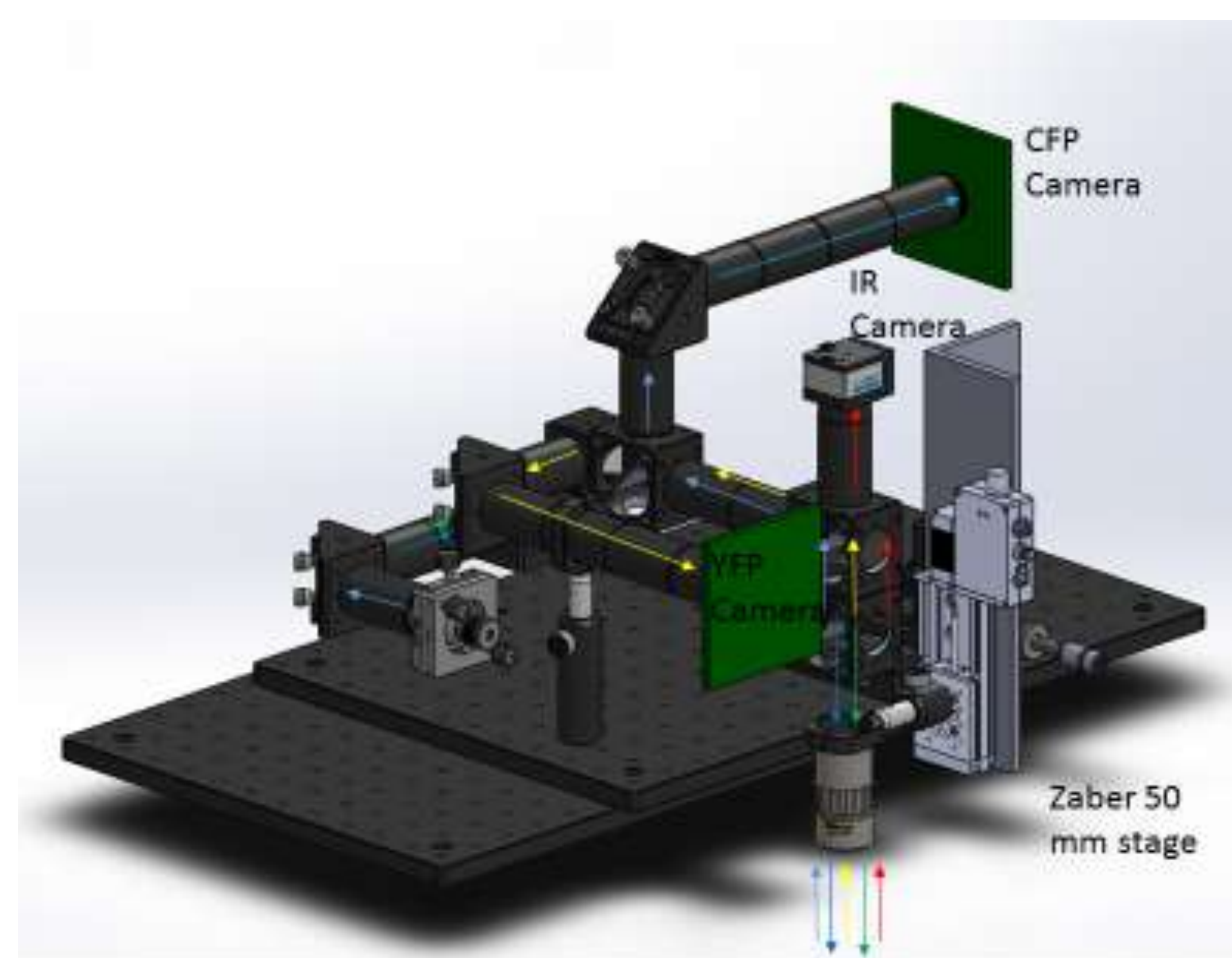


MICROSCOPE DIAGRAM

Program used for controlling the microscope, and some sample data analysis of an experiment using the microscope.



Cartoon of the microscope setup. Colors denote the wavelength that is present in the specified pathway



Side view of the worm tracking microscope with labeled parts.

REFERENCES

- MATLAB, Mathworks
- LabView, National Instruments
- Husson, S. J. et al. Keeping track of worm trackers (September 10, 2012), WormBook, ed. The *C. elegans* Research Community WormBook, doi/10.1895/wormbook.1.156.1, <http://www.wormbook.org>.

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