

The Design and Application of a Three-Dimensional Flying Prey Simulator

Max L. Balter¹

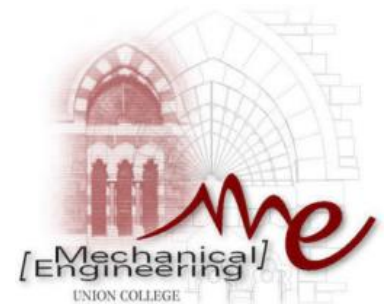
Advisors: David Hodgson¹, Ashok Ramasubramanian¹, and
Robert Olberg²



Union College - Schenectady, NY

¹Mechanical Engineering Department

²Biology Department



Outline

- Biology background
- Motivation
- Design
- Construction
- Testing

Objective

- Investigate dragonfly neuronal responses in prey interception

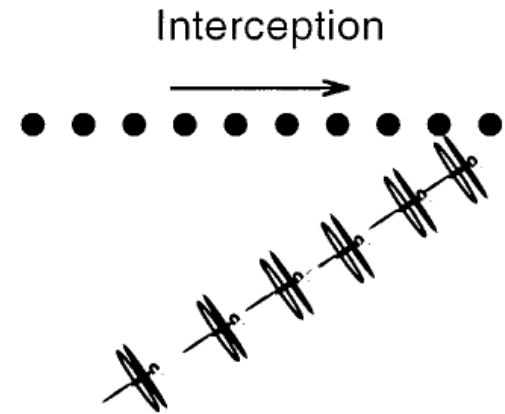


Olberg et al., Comp Physiol 2005.

- Understand how dragonfly neurons encode information about object movement in 3-D

Introduction

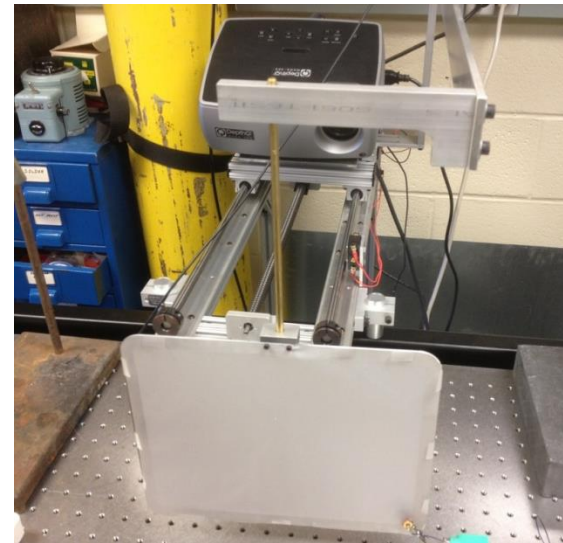
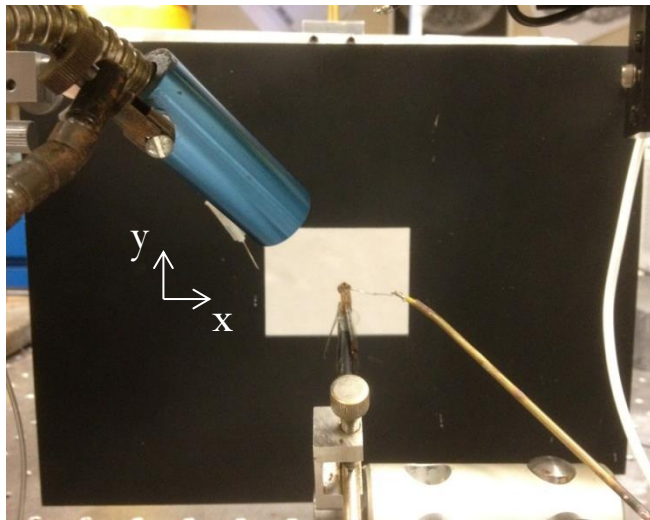
- Highly efficient aerial predators
- Requires rapid visual processing and information transmission
- Evolution of large neurons in the control pathway
- Target-selective descending neurons (TSDNs)



Olberg et al., Comp Physiol 2005.

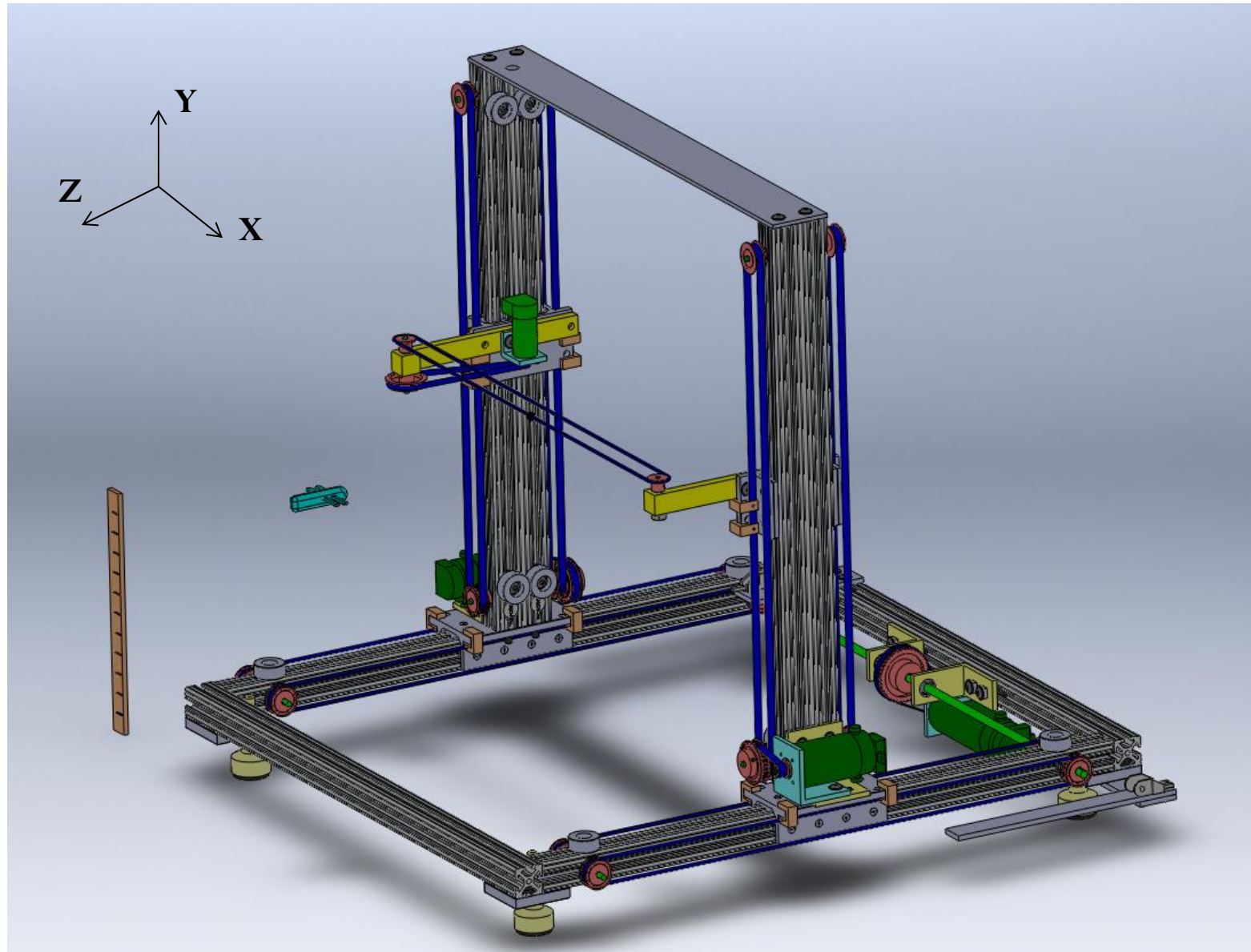
Previous Studies

- Dragonfly visual neurons restricted to 2-D
 - X direction (right-left) and Y direction (up-down)



- Flying prey move in 3-D and little is known about how the visual neurons encode the third (depth dimension)

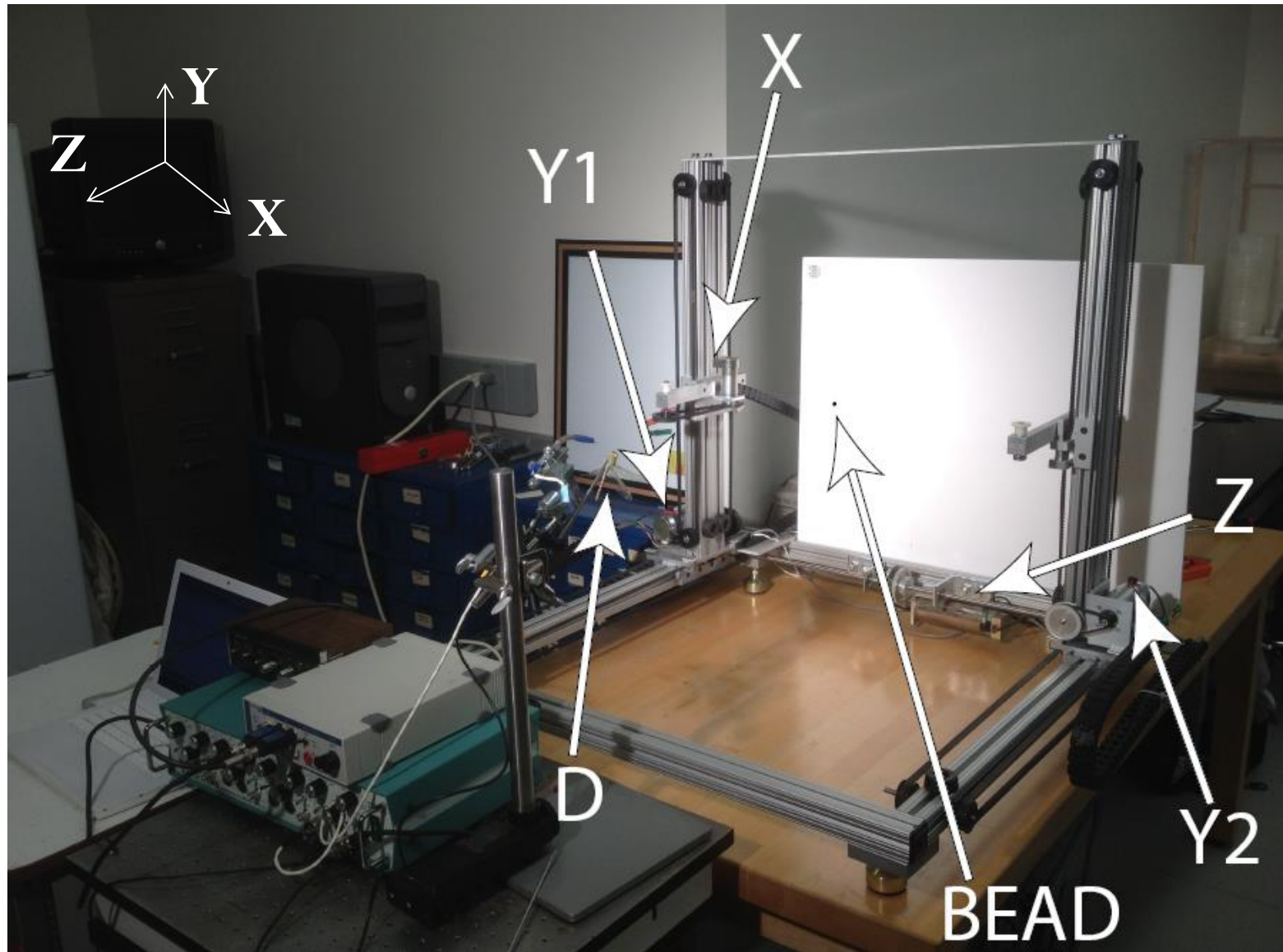
Design Requirements



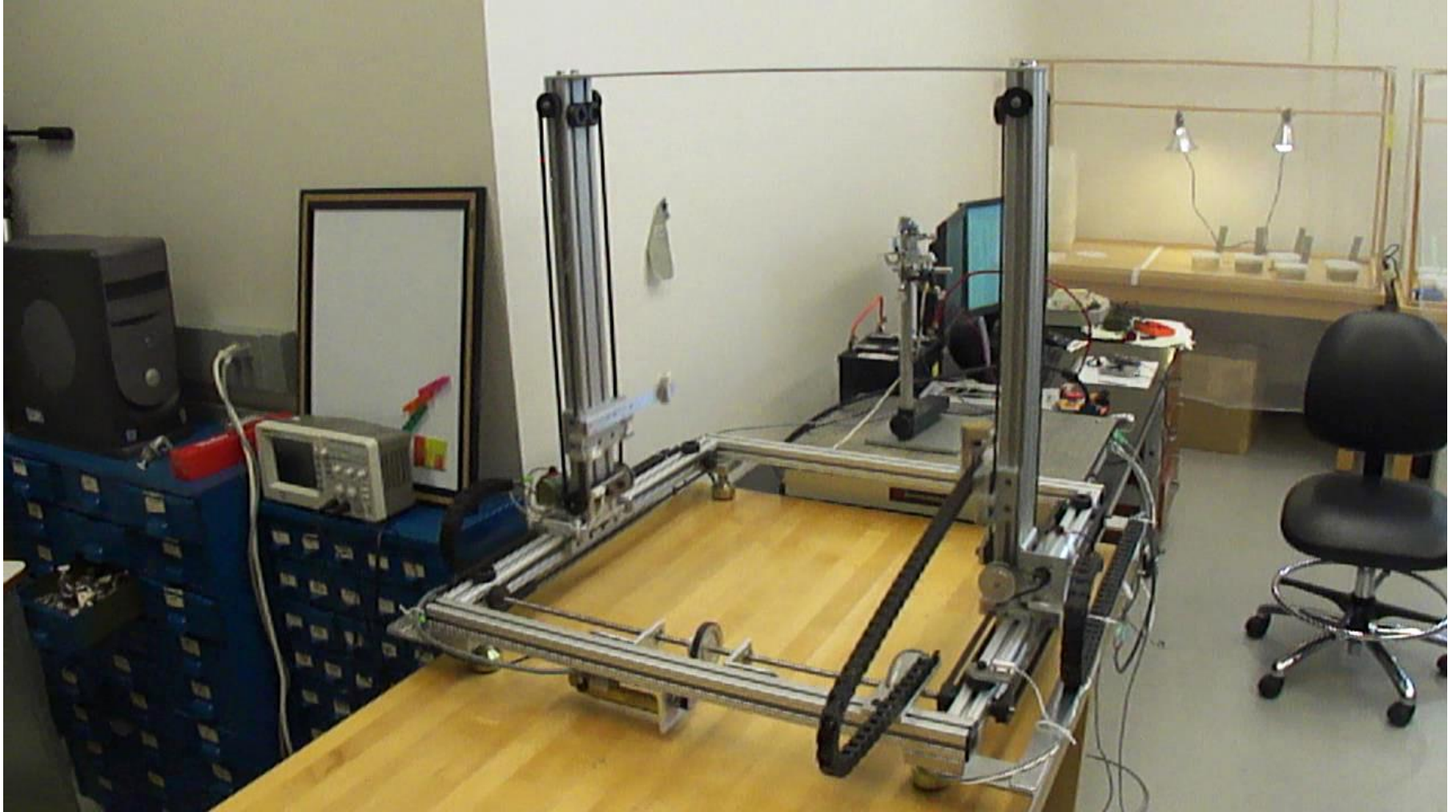
Methods

- Structural framework
- Open loop control
- Closed loop control
- Neurobiological experiments

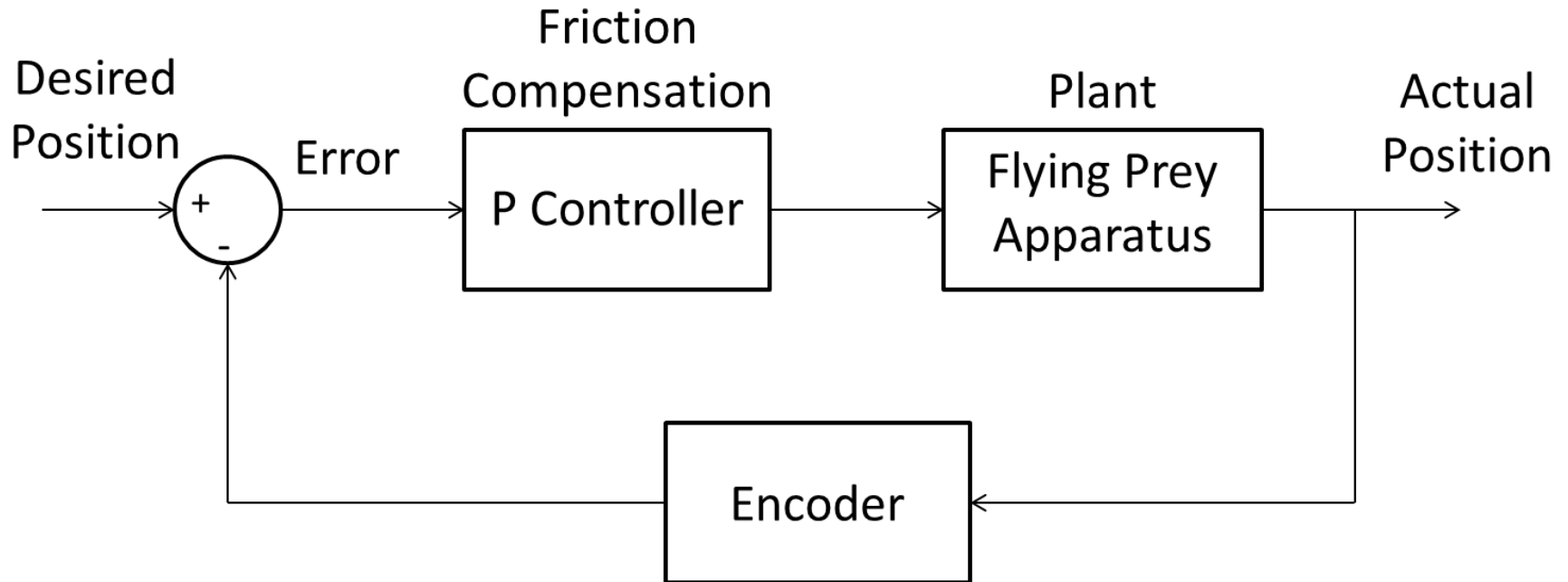
Flying Prey Simulator



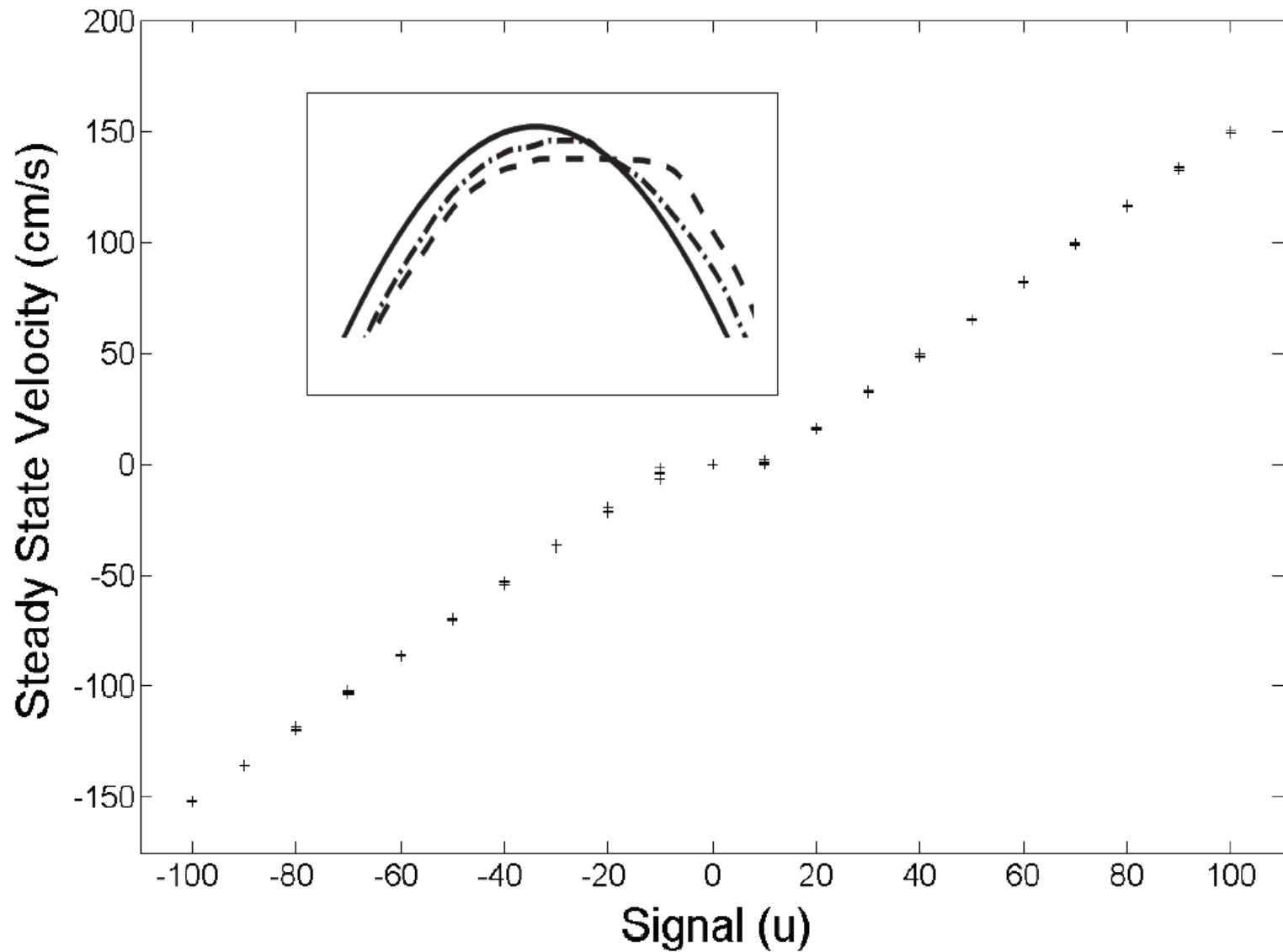
3D Motion



Closed Loop System

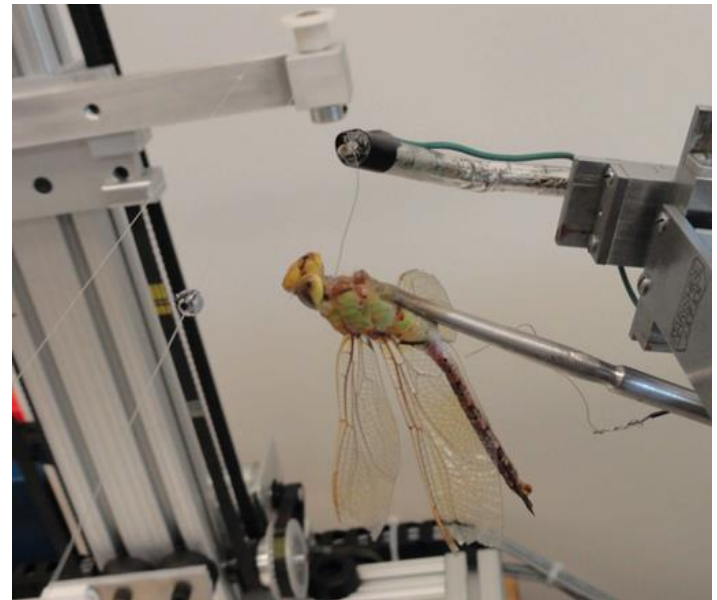
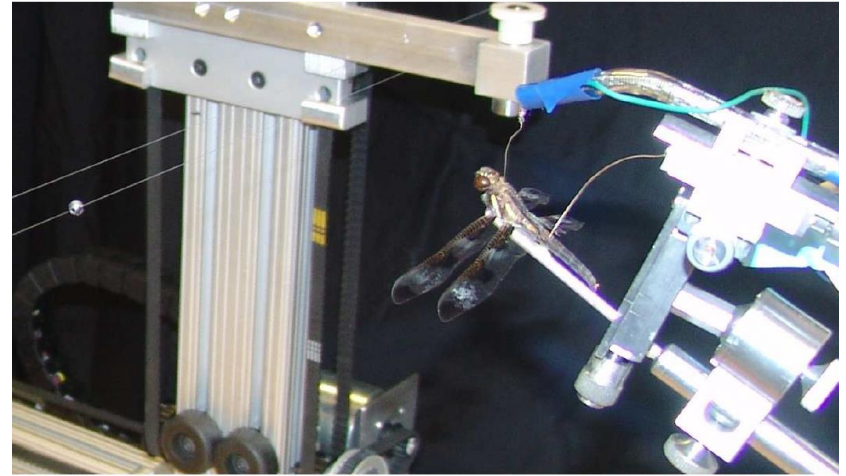


Friction Cancellation

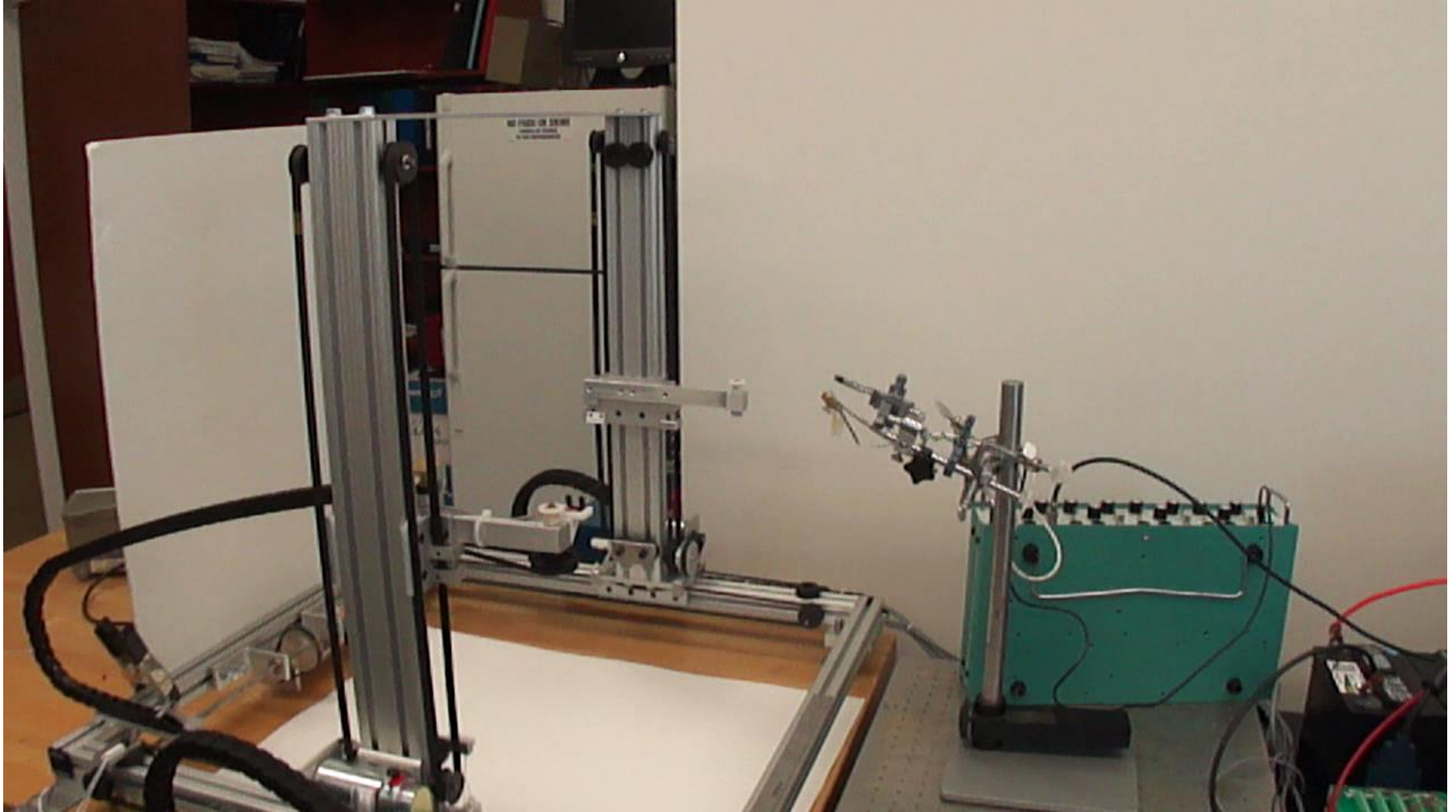


Dragonfly Test Setup

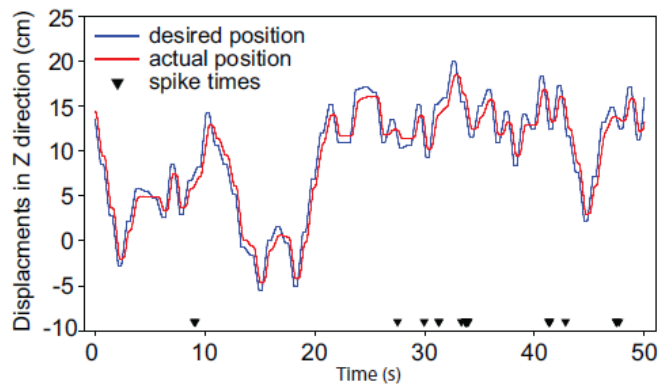
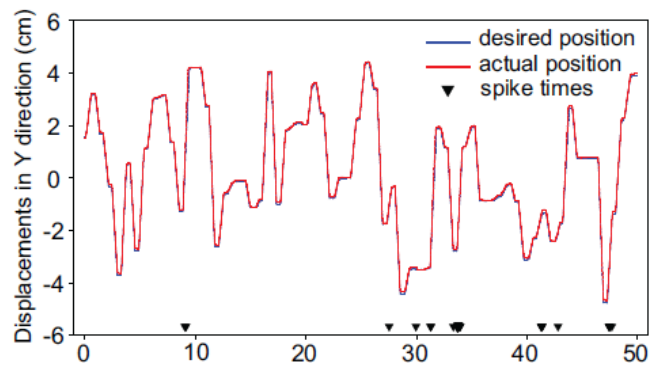
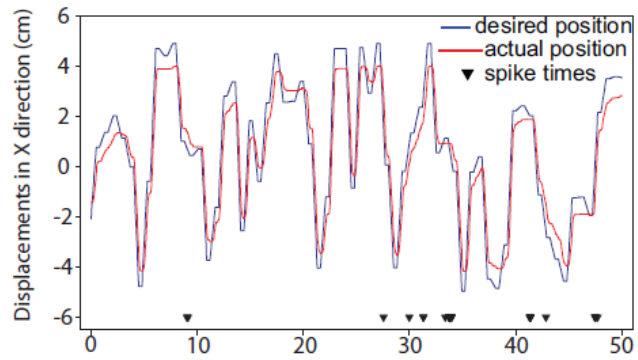
- Dragonfly (*Anax Junius*) mounted with wax to a rigid bar
- Hook electrode fashioned from bare 100 μm silver wire
- Bead centered on the acute region of the dorsal compound eye



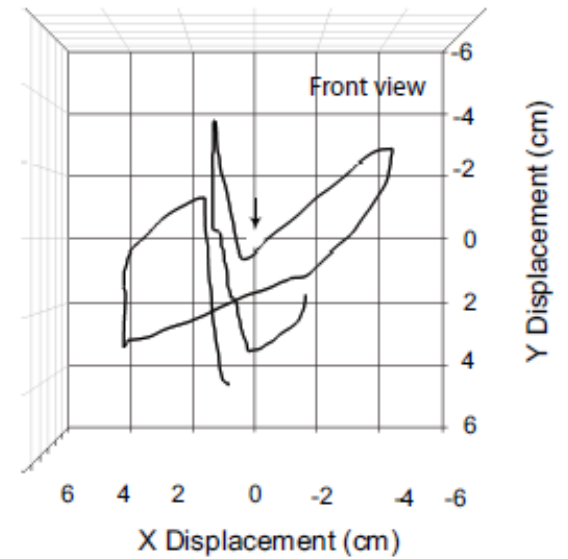
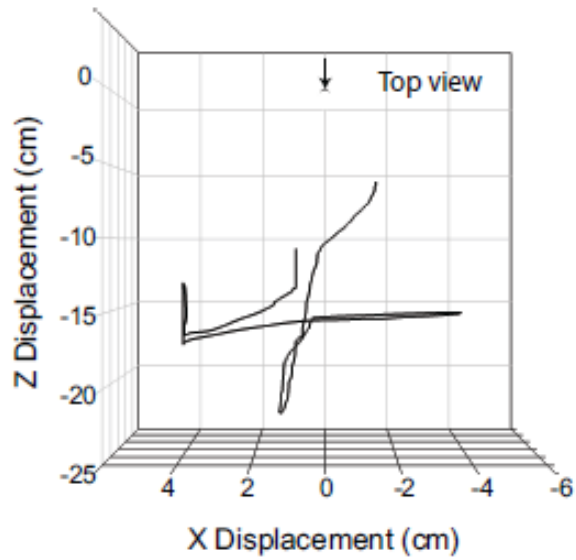
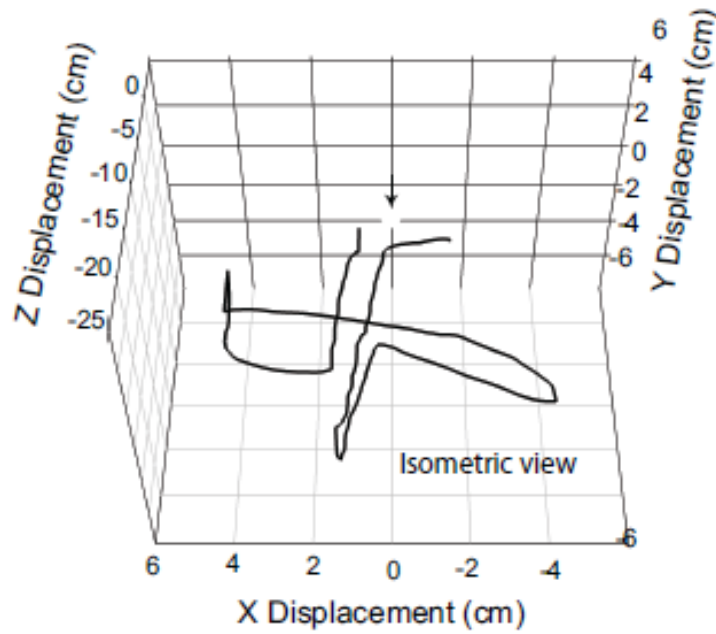
Dragonfly Test



Results



Results



Conclusions

- Remarkable level of repeatability
- Computer controlled bead trajectories
- Interception of flying insects is a fast, complex, and highly reliable behavior

Acknowledgments

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