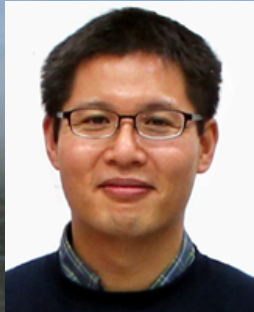
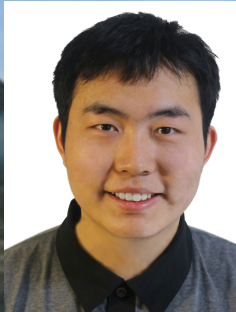


Human-friendly Miniature Autonomous Blimp



Sunjin Cho



Qiuyang Tao



Tony Lin



Tianfu Wu



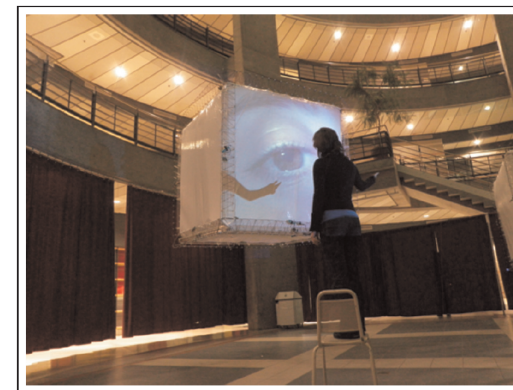
Wugang Meng

Fumin Zhang
Hong Kong University of Science &
Technology
Georgia Institute of Technology

Airships and Blimps



Skye (Burri, 2013)



Cubic (St-Onge, 2015)

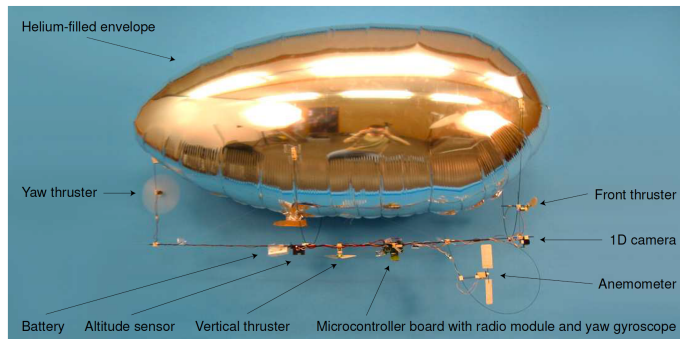


Small Indoor Robotic Blimps



Georgia Tech Miniature Autonomous Blimp (2014)

Semi-major axis length 1.1m (Muller, 2013)

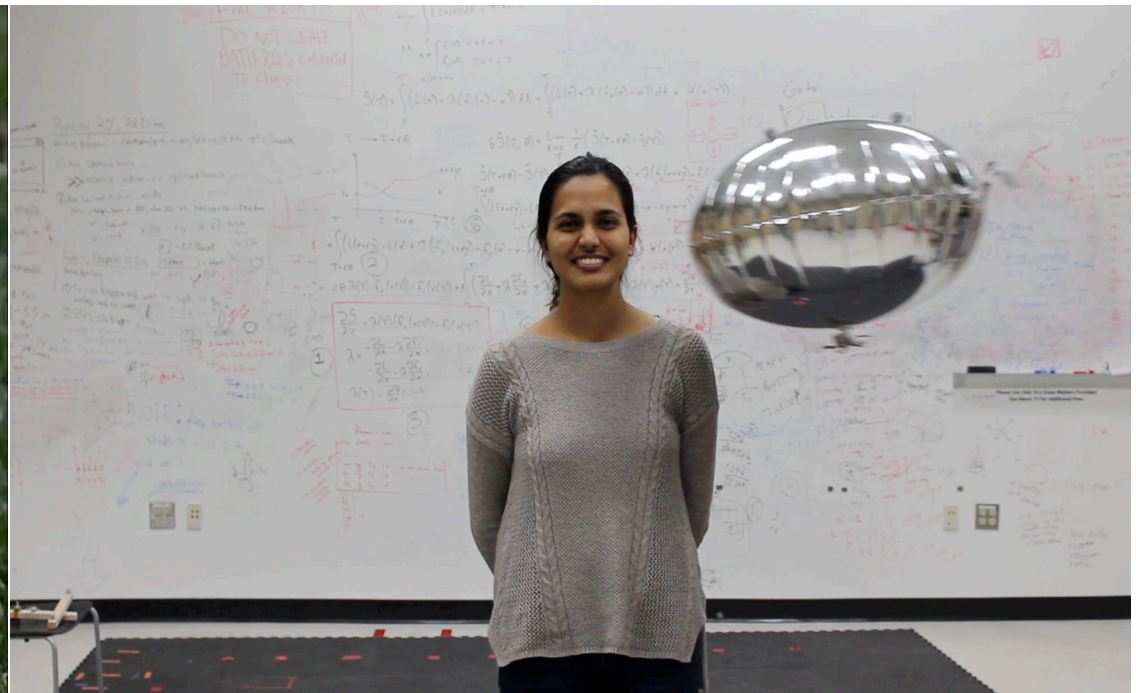


Semi-major axis length 0.5m (Zufferey, 2006)



Semi-major axis length 0.36m

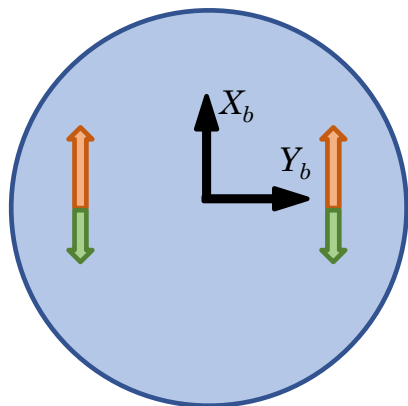
Why Blimps - Safety



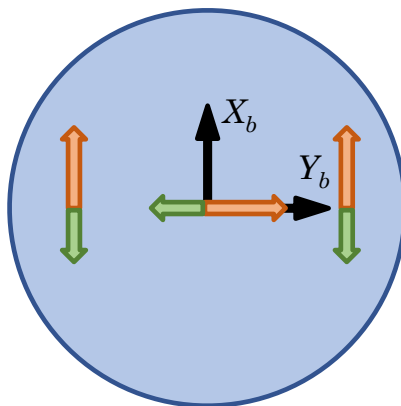
Video Curtesy: Leptidrone, <https://youtu.be/TFR2OkH9Gto>

Three Generations of Blimp Design

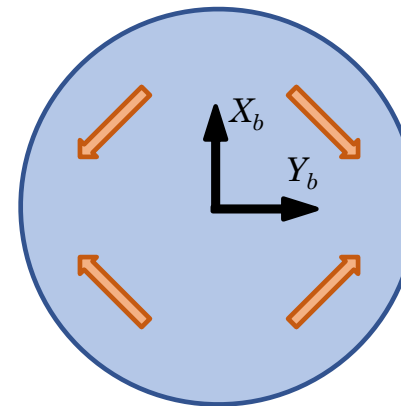
V1.0




V1.5

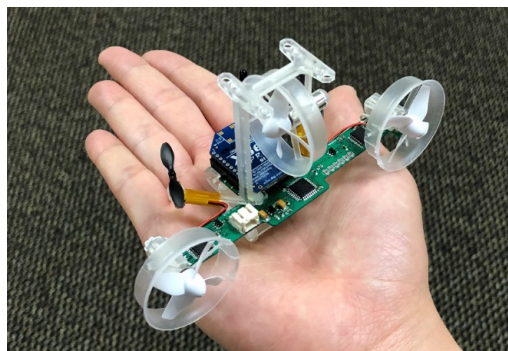
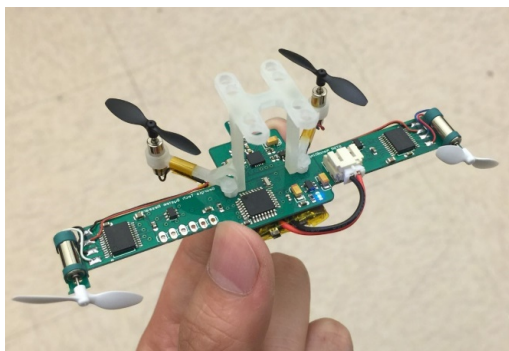


V2.0



 Forward thrust
 Reverse thrust

 Top view of the envelope

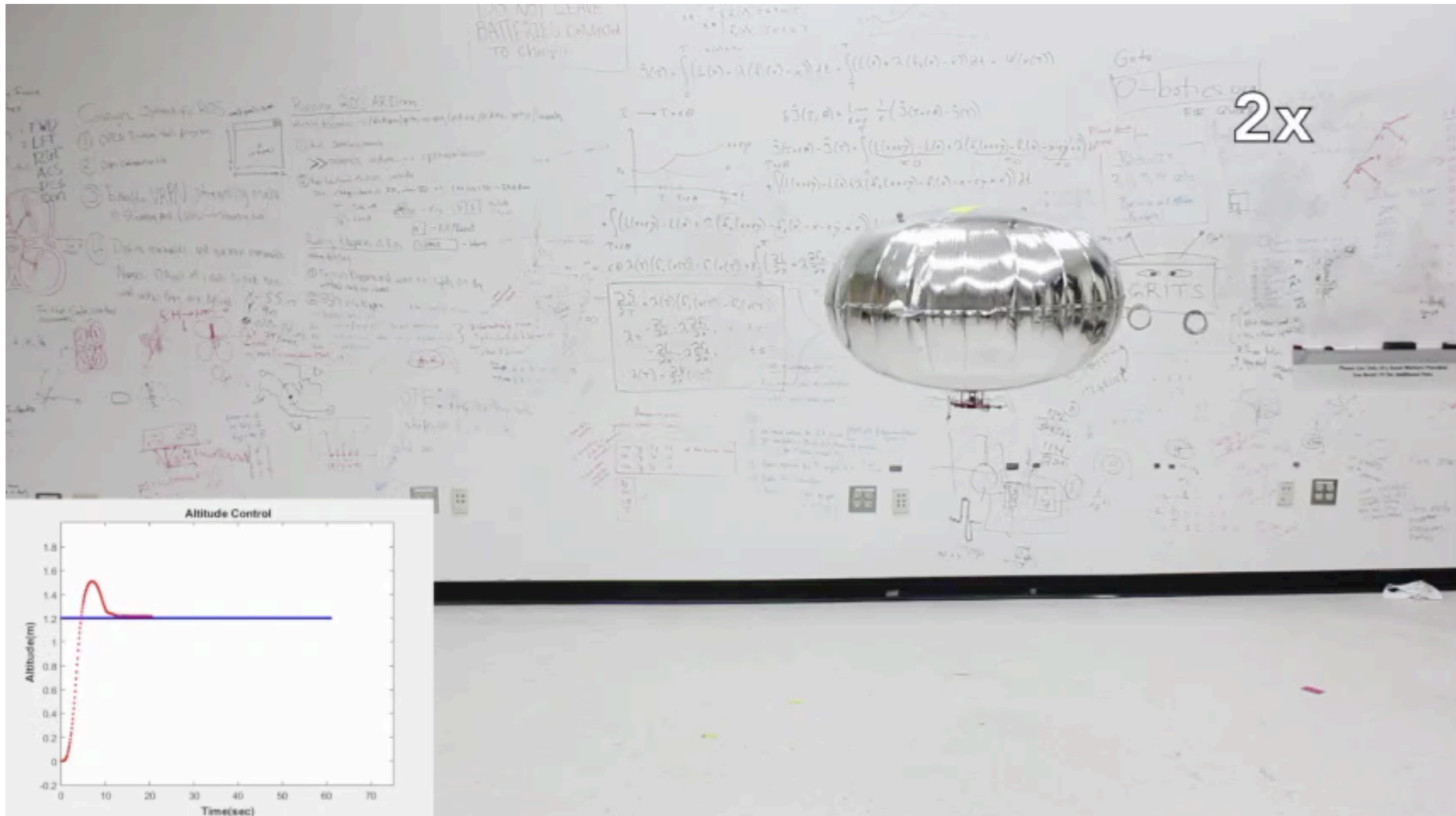


- Nonholonomic
- Bi-Dir. Motors
- Asym. Actuation

- Holonomic
- Bi-Dir. Motors
- Asym. Actuation

- Holonomic
- Uni-Dir. Motors
- Symm. Actuation

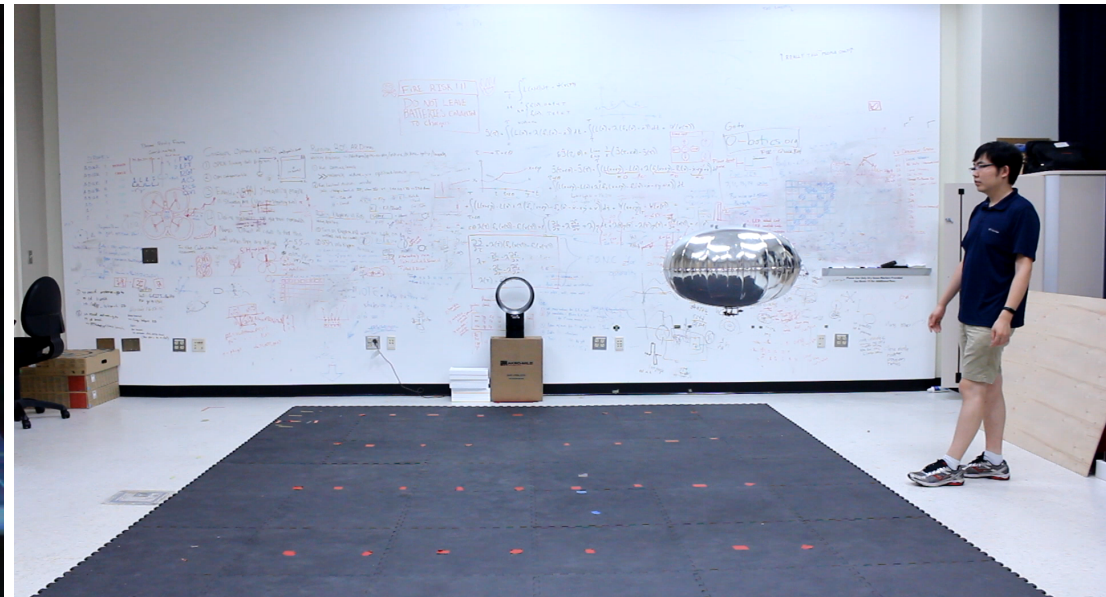
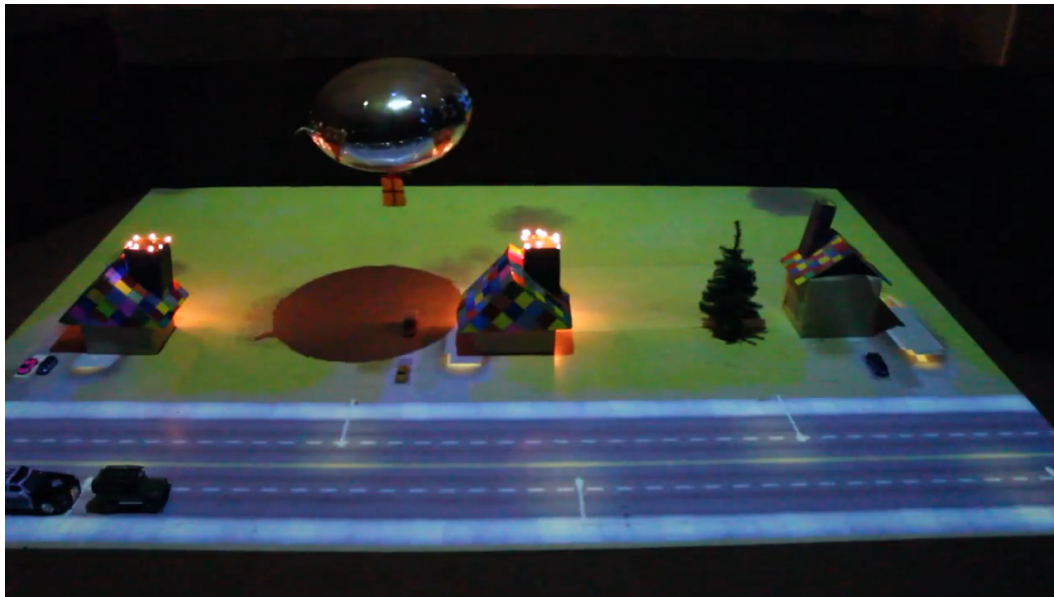
Controller Performance



Swing Oscillation of MABs

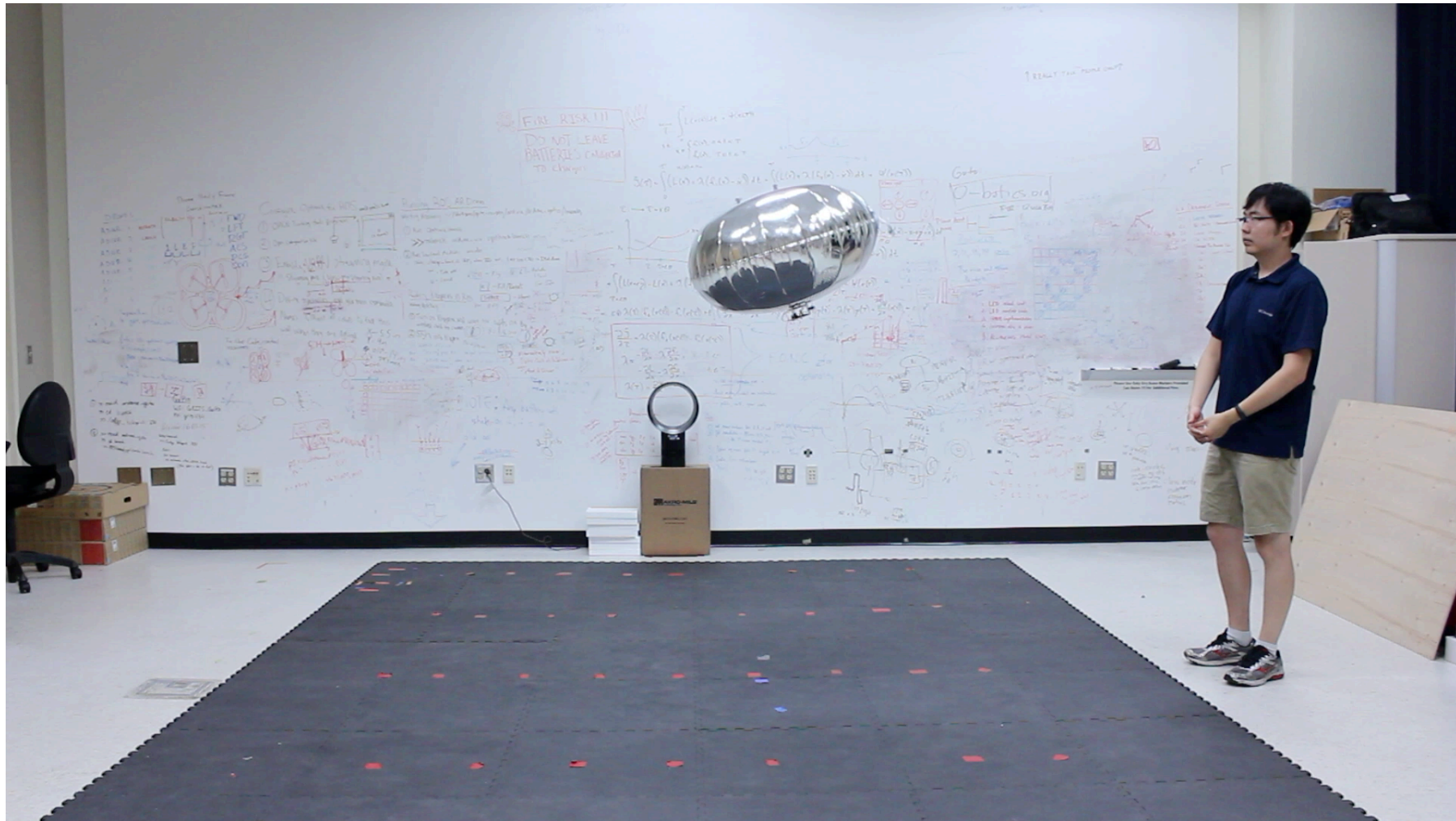
Common issue among indoor blimps. Less stable flight

- Wavy image
- Inaccurate sensor measurement

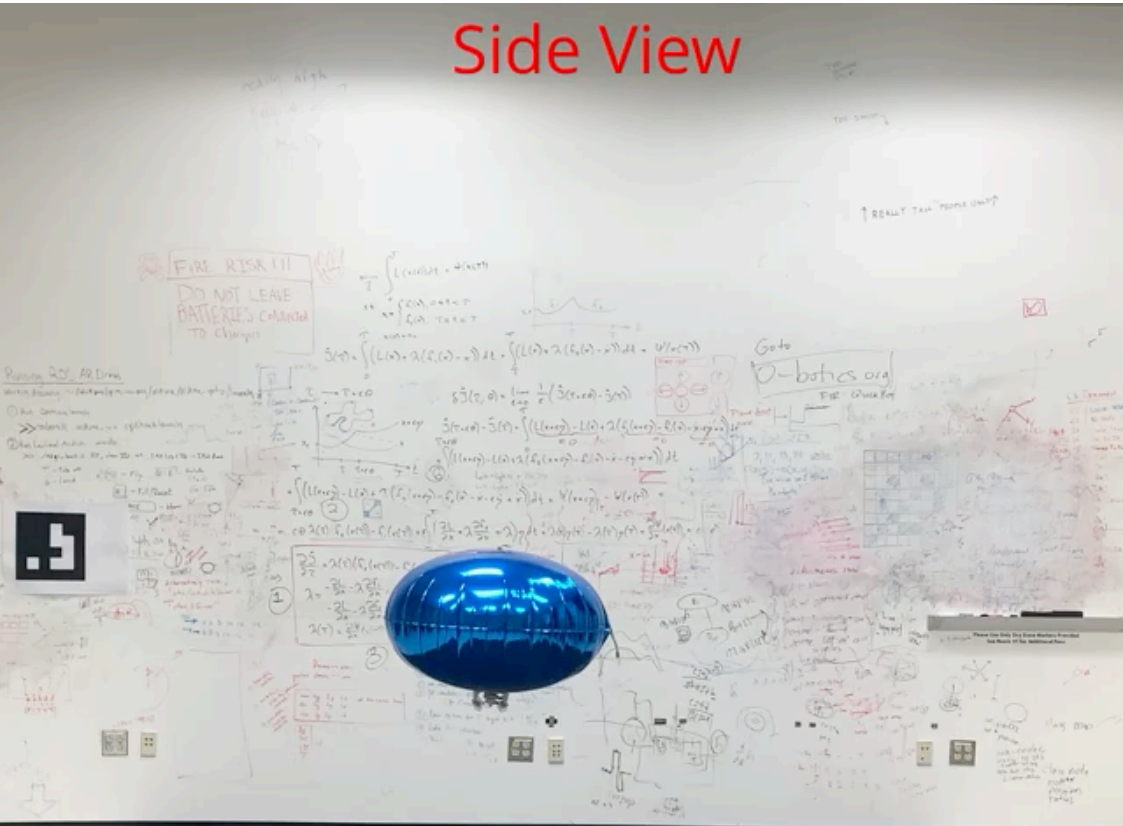


Air Damping Coeff. & Inertia

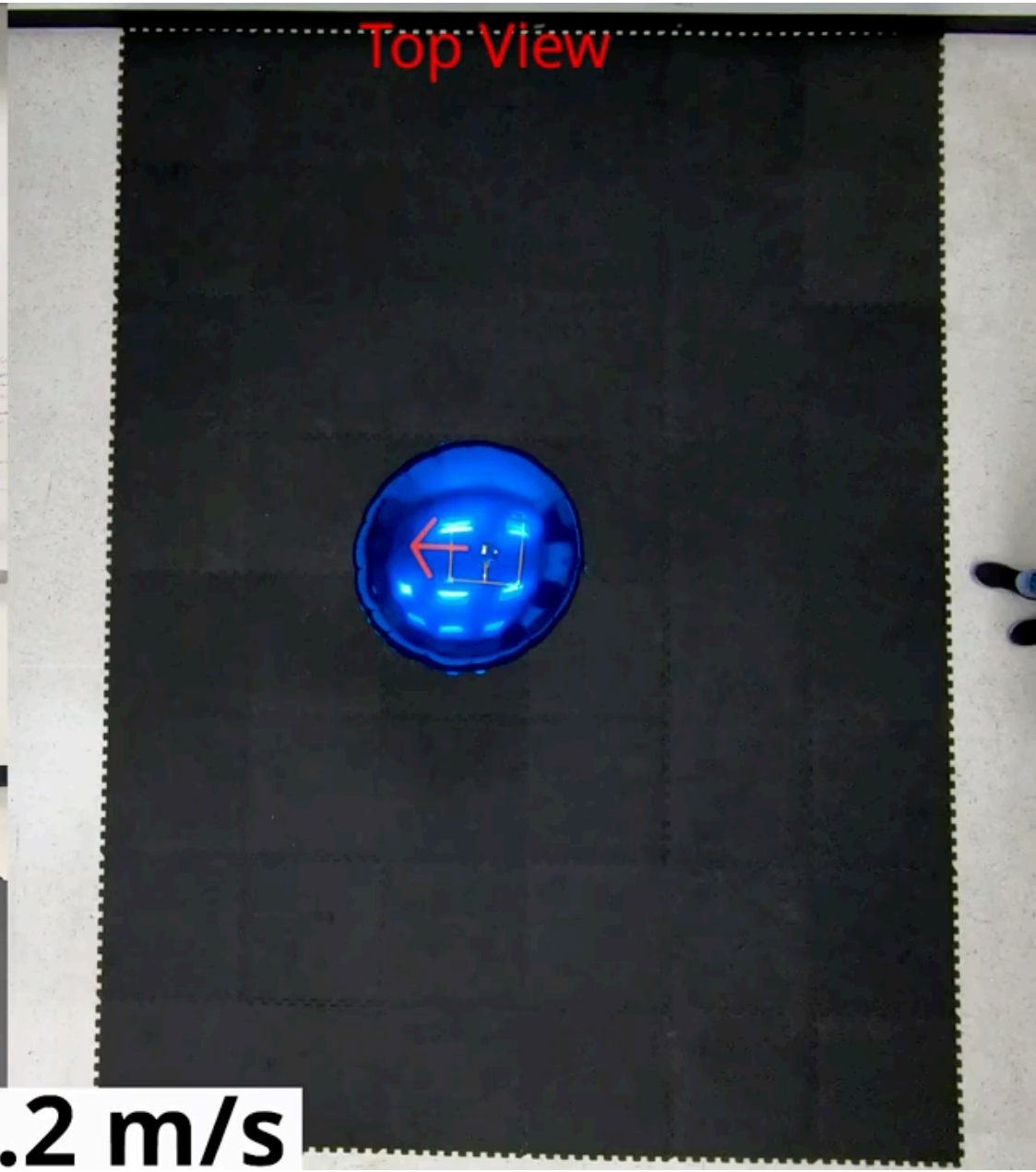
Pitch angle is logged by optical motion capture system (OptiTrack).



Side View



Top View

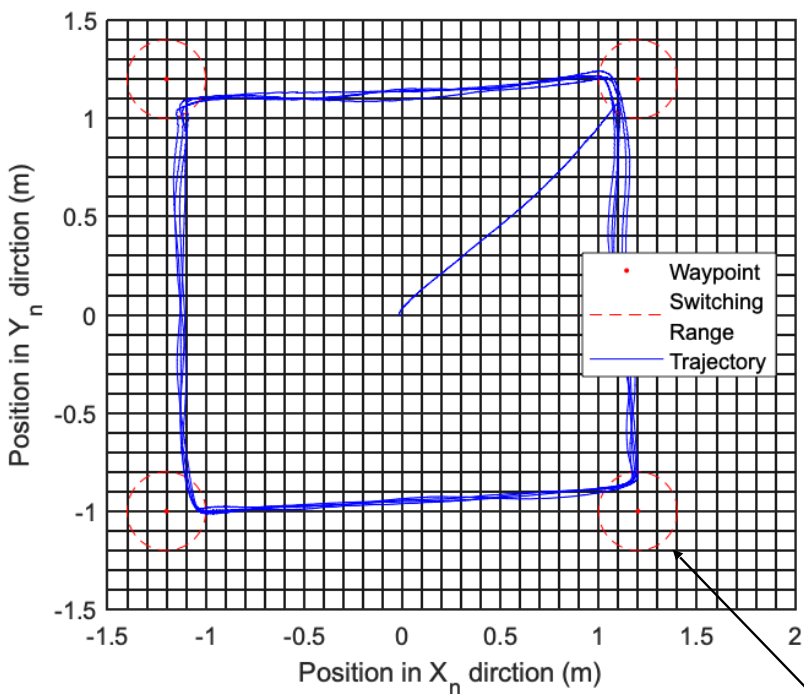


$V_x = 0.2 \text{ m/s}$

Waypoint Navigation Trajectory

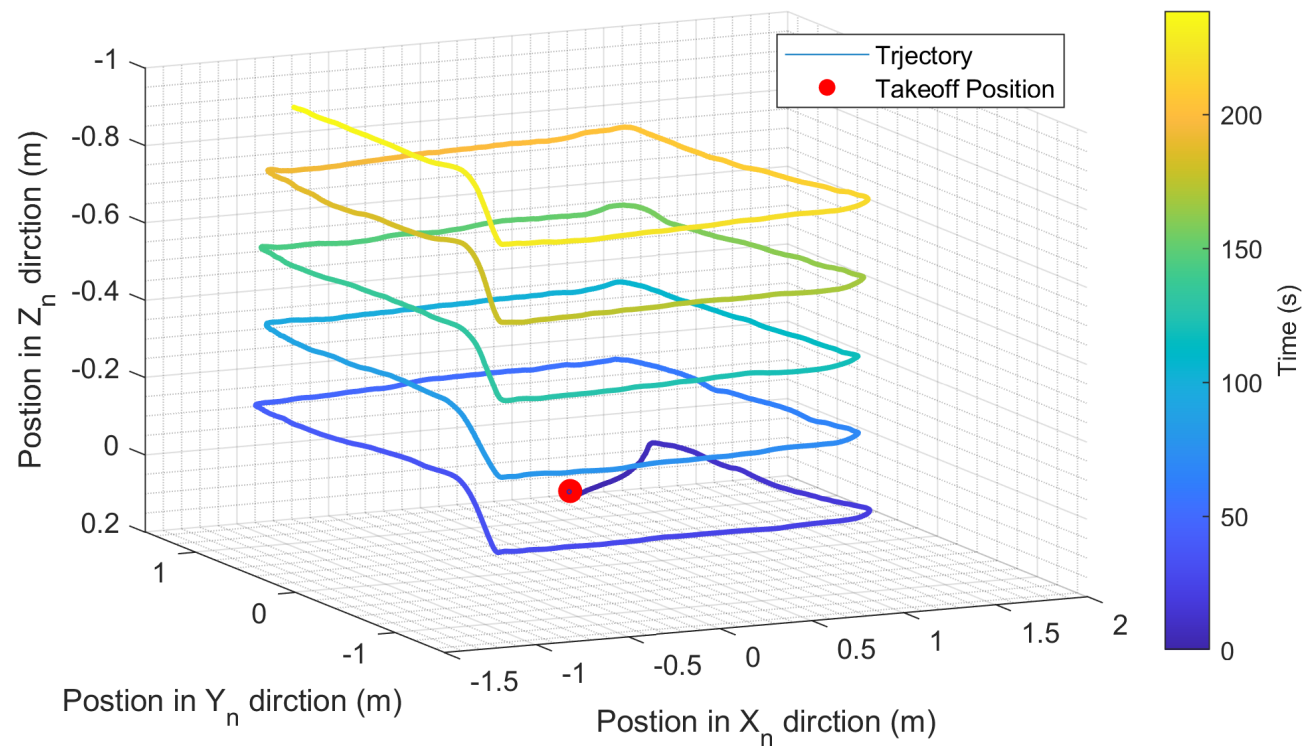


Trajectory Top View



Waypoint switching radius 0.2m

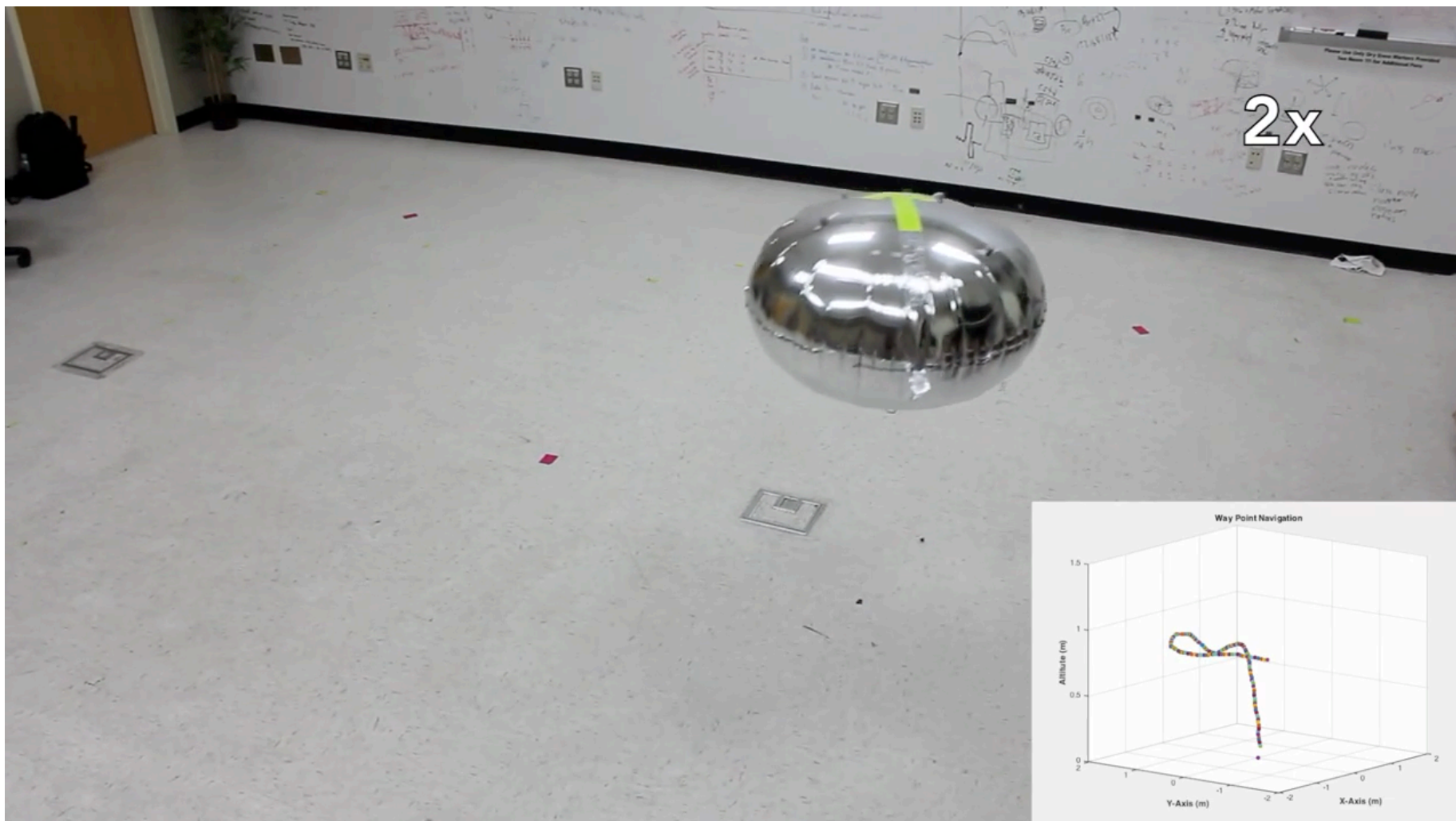
Trajectory 3D View



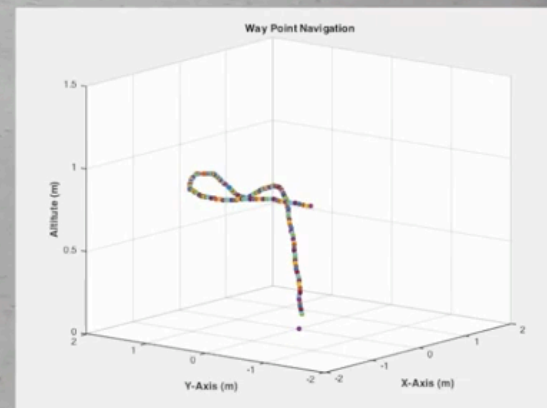
Trying to Flip



Light Field Mapping



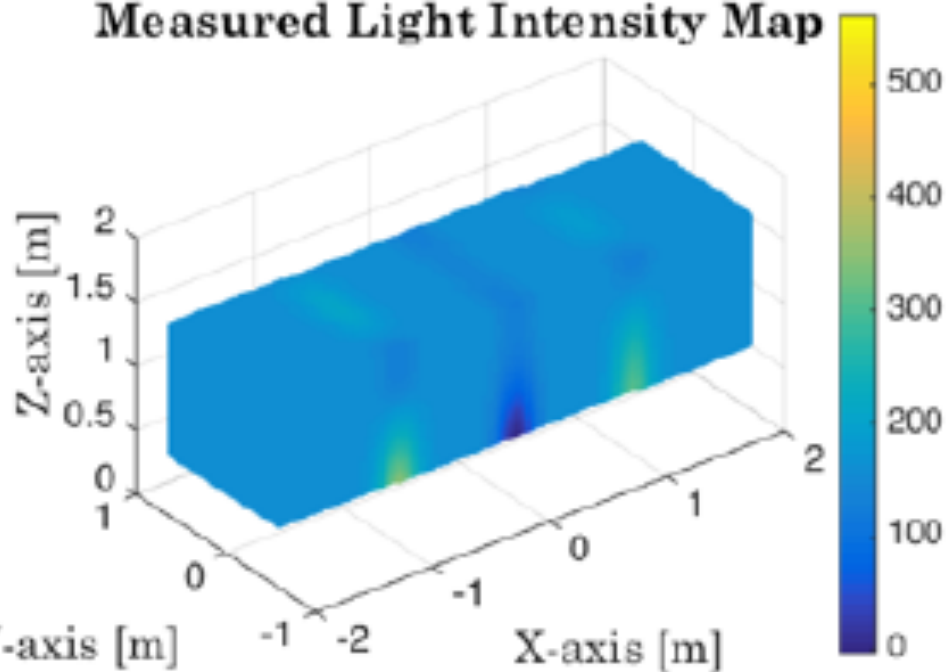
2x



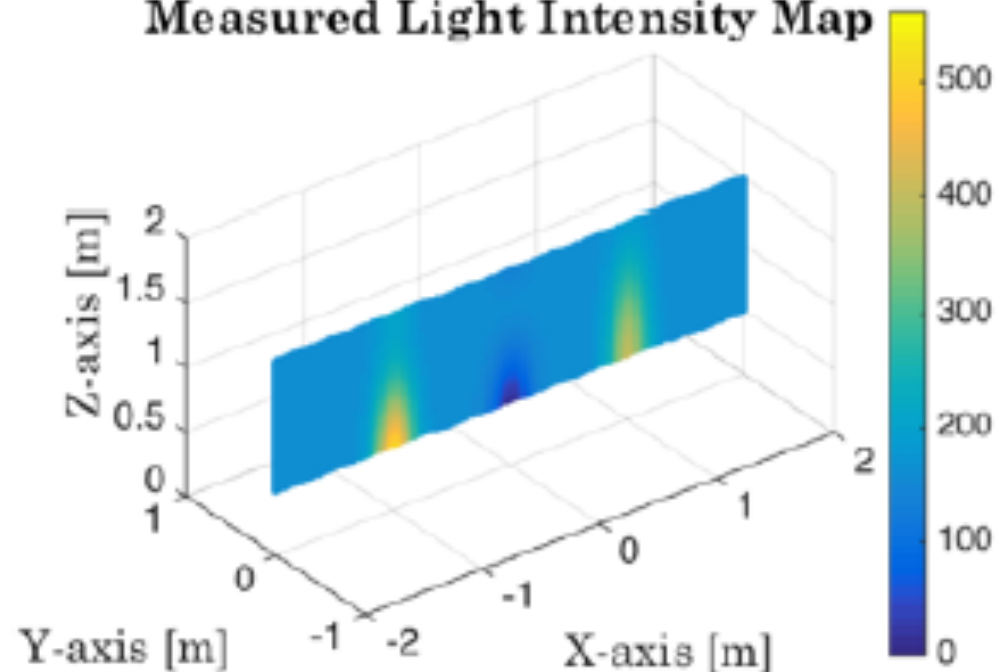
Light Field Mapping Result



Measured Light Intensity Map



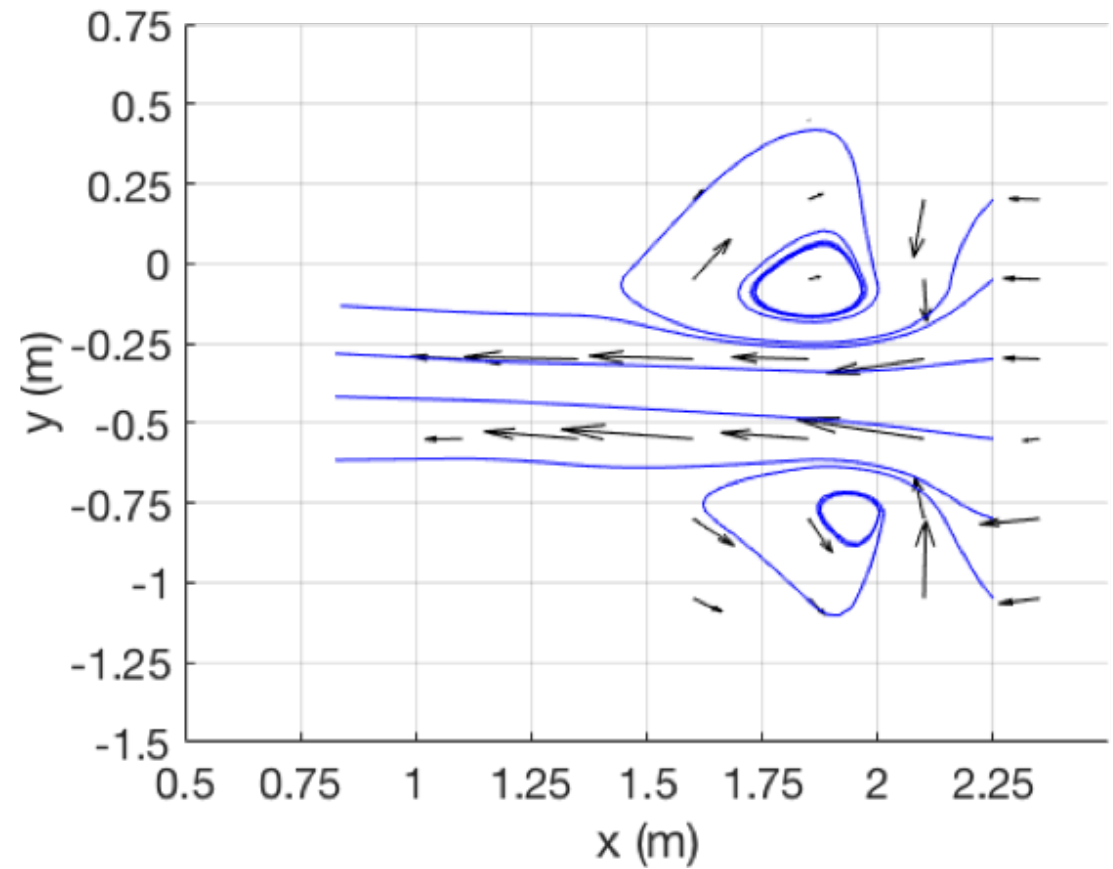
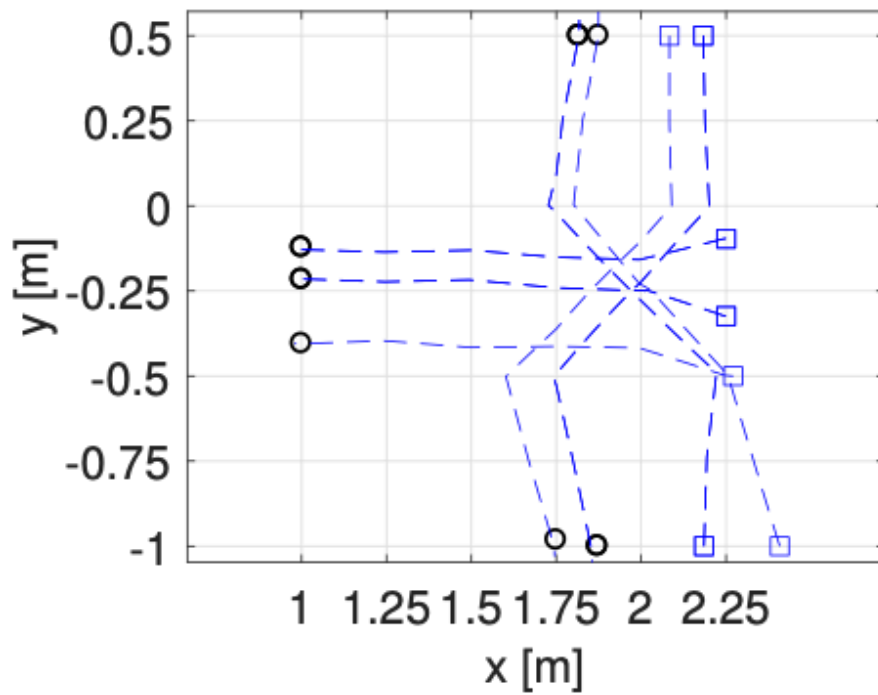
Measured Light Intensity Map



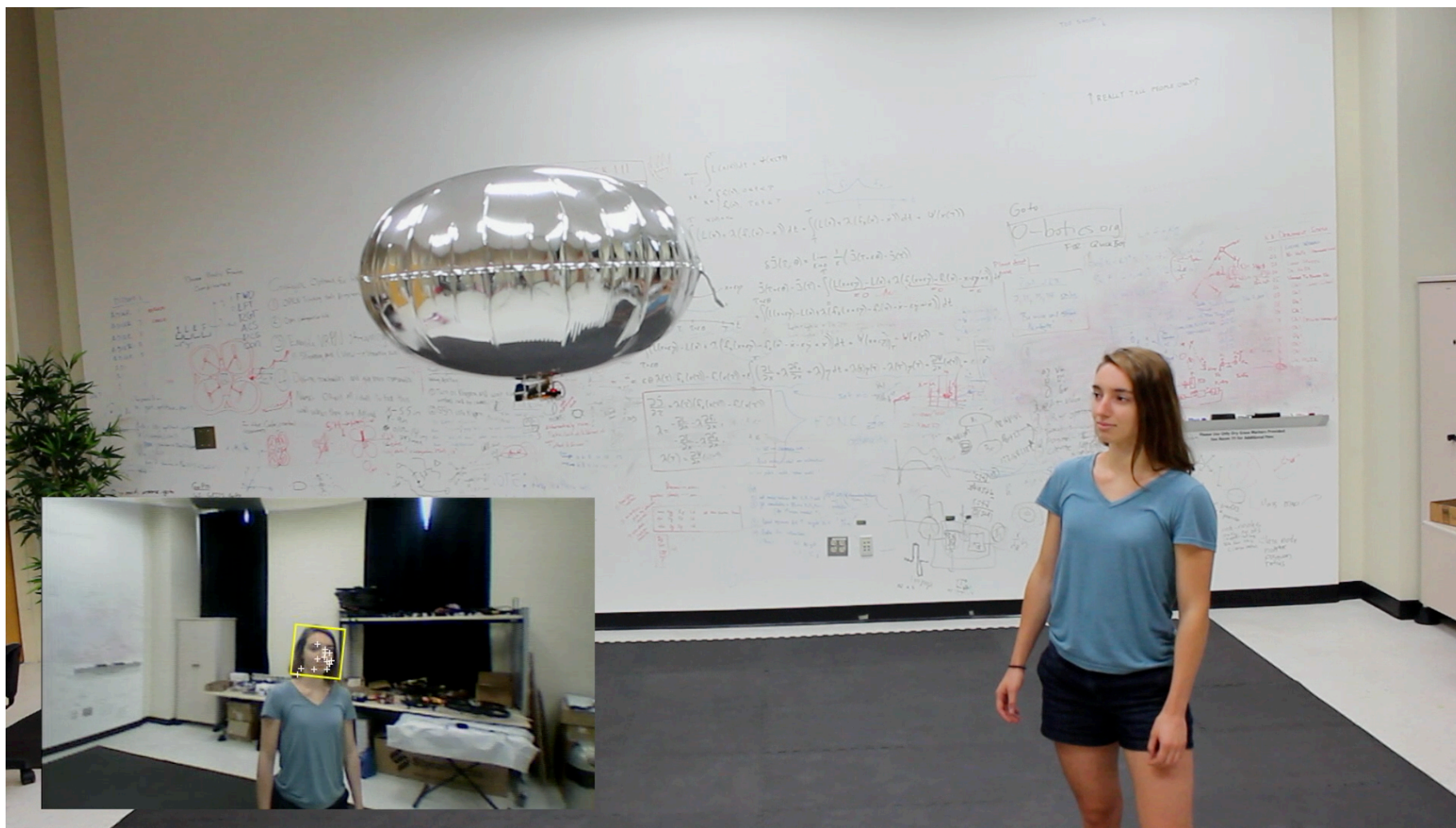
Wind Field Mapping



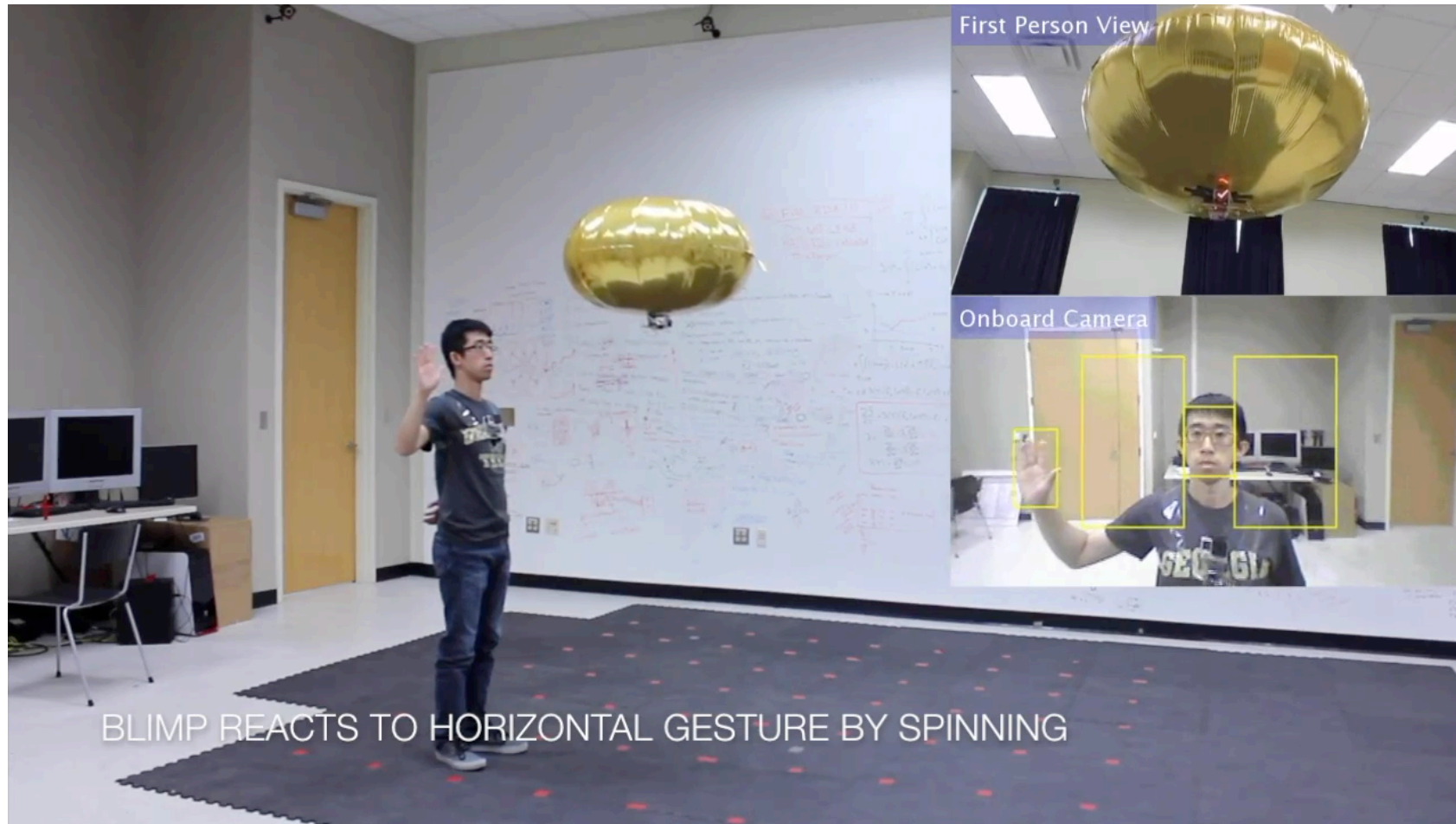
Wind Field Map



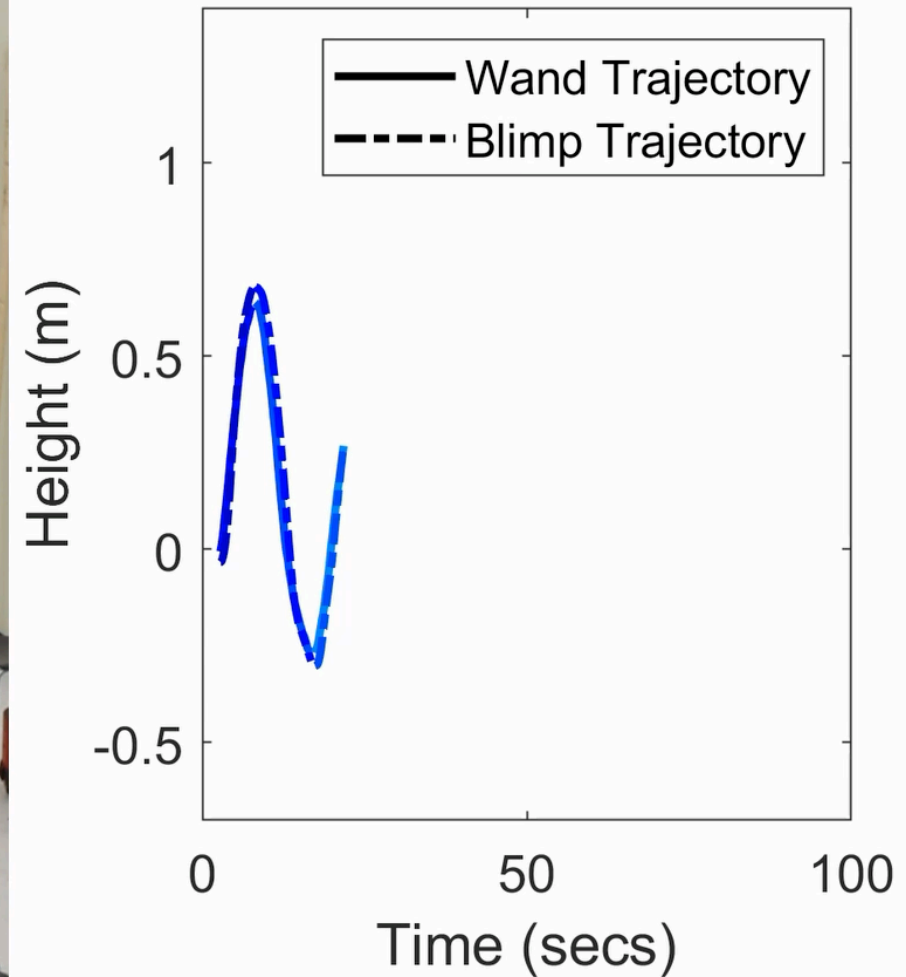
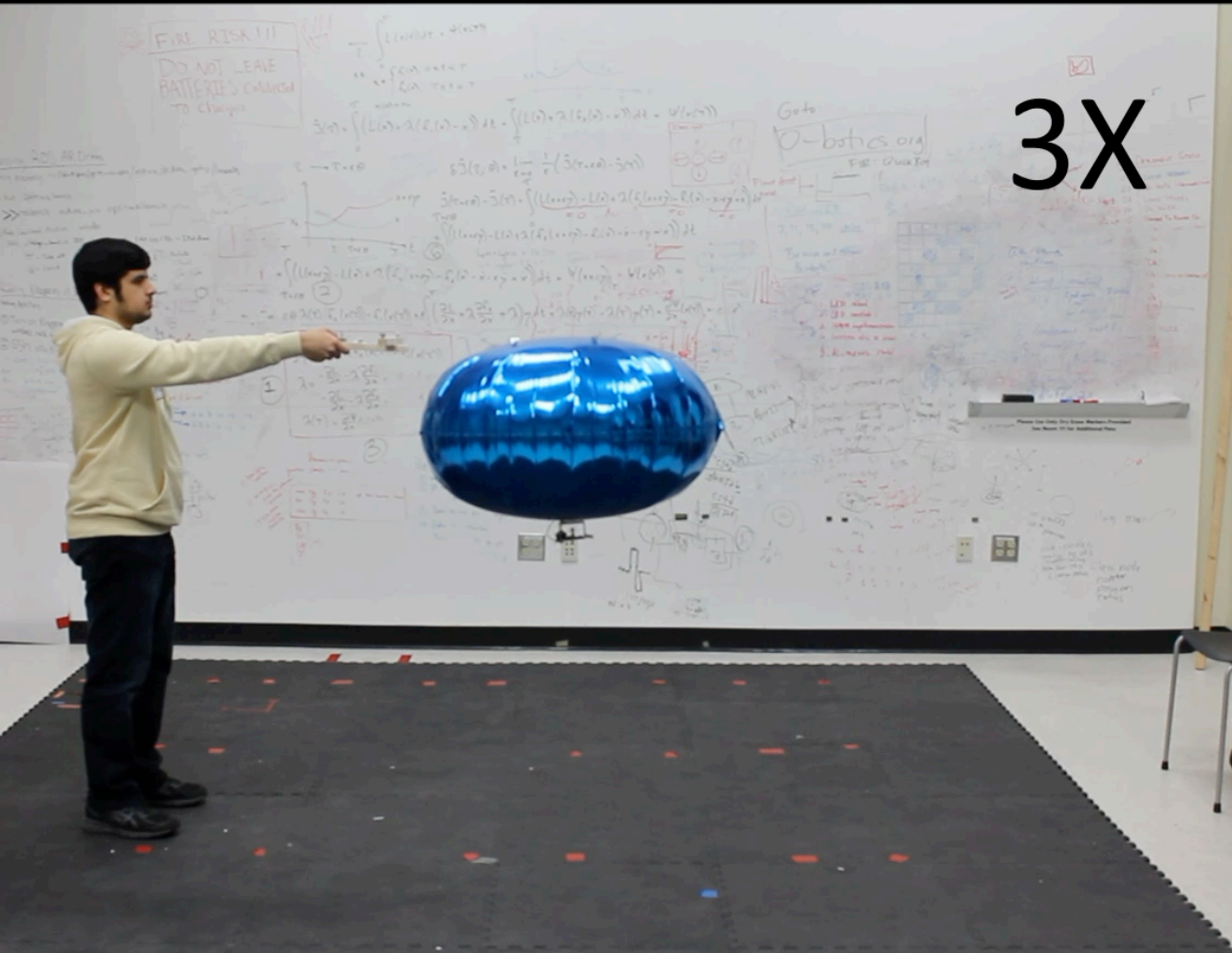
Human-Blimp Interaction



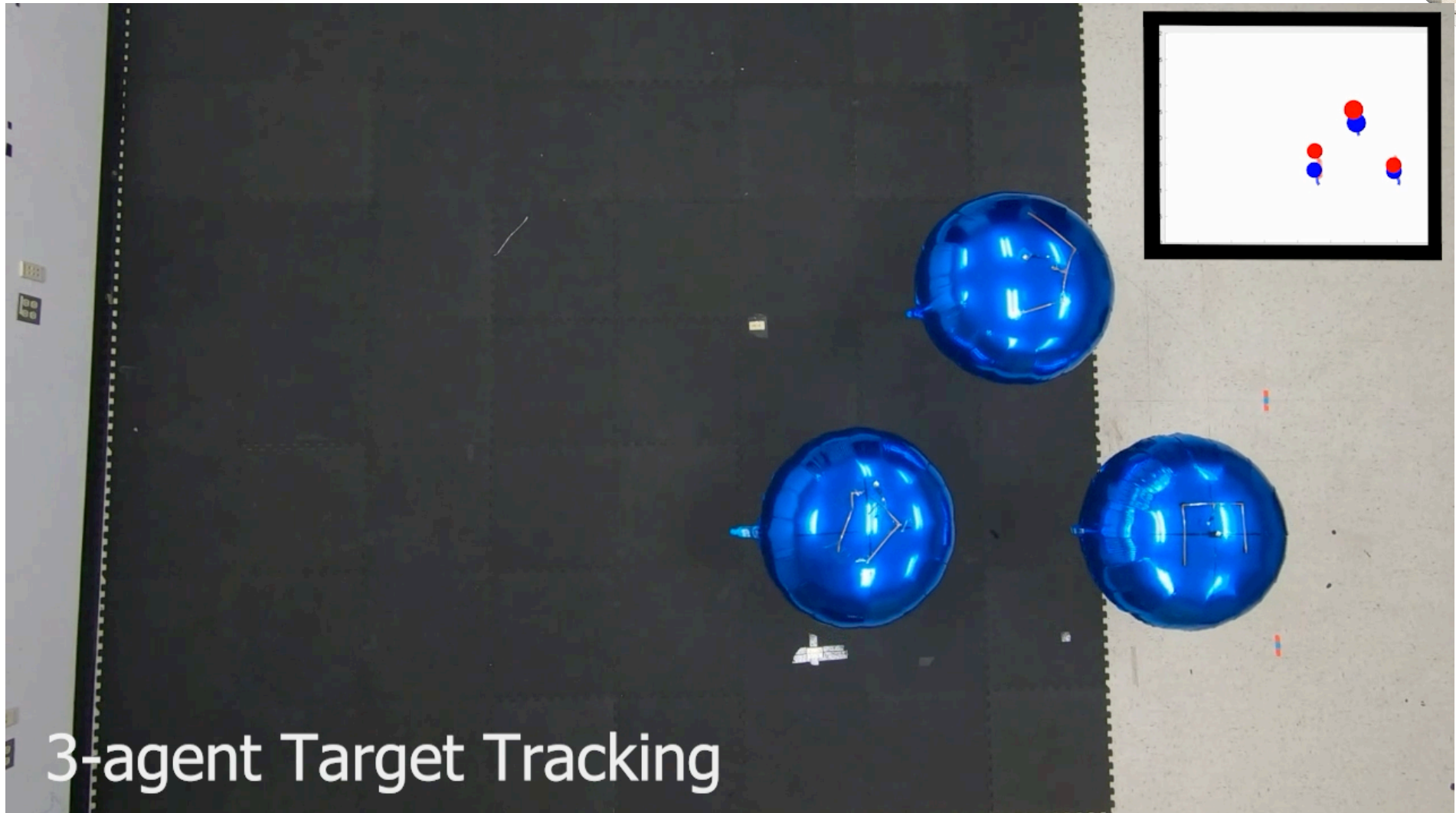
Human Robot Interaction



Video Courtesy: Yao et al., Natural Human and Blimp Interaction via Simultaneous Face and Hand Gesture Recognition, <https://youtu.be/C2liCWrlH4>



Swarming

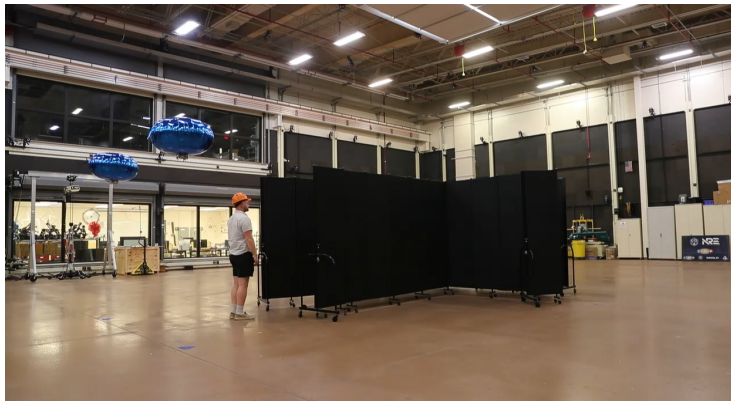


3-agent Target Tracking

Multi-Blimp View Planning

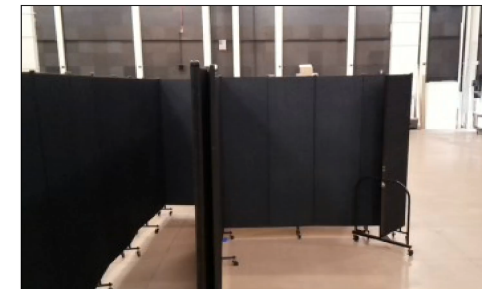
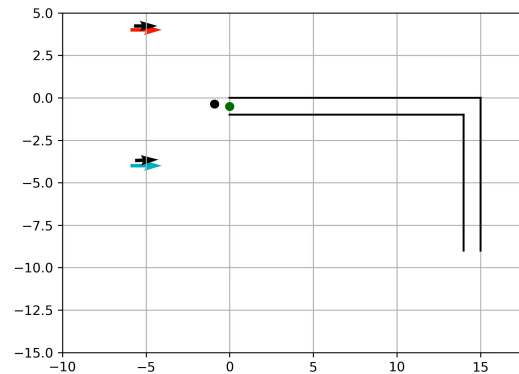
Objective: Plan a view tracking path so that the target is always viewed by at least one blimp

3rd Person
Perspective



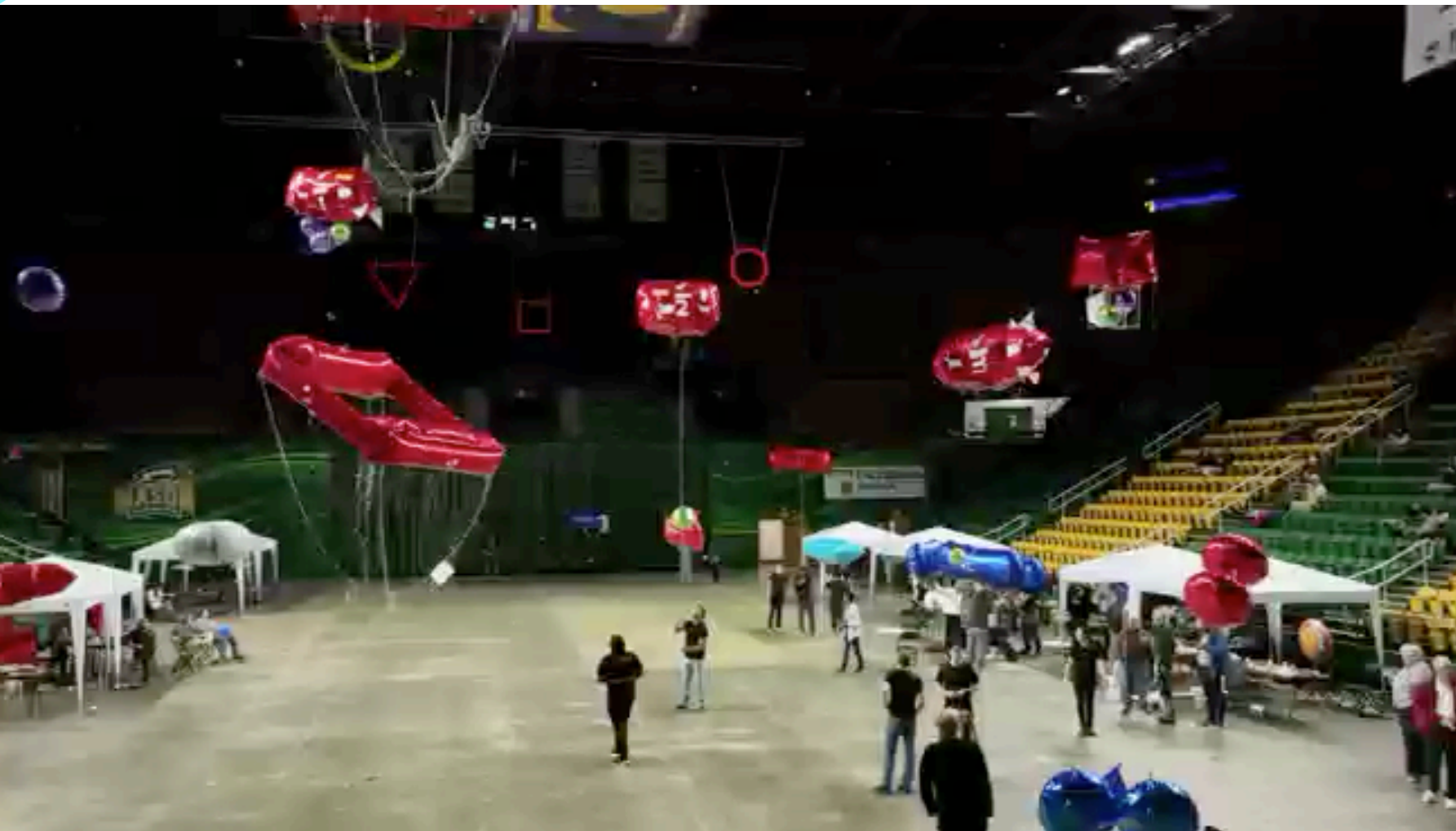
Blimp 1
Camera

Vicon visualized
data



Blimp 2
Camera

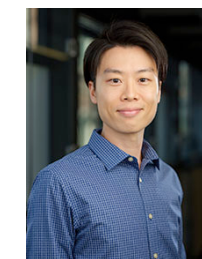
ONR Autonomous Blimp Competition



Ningshi Yao



Cameron
Nowzari



Daigo
Shishika

Blimp w/o HCI Sys

17:19



Blimp w/ HCI Sys

18:60



Acknowledgement

The research work is supported by ONR grants N00014-14-1-0635 and N00014-16-1-2667, and NRL grant N0017317-1-G001.

