Time-optimal Flying a VTOL Drone

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Topic and Motivation

- Minimum-time flight for VTOL-Drone
- Push platform to its limits
- Use Cases:
    - Rescue
    - Delivery
    - Transportation

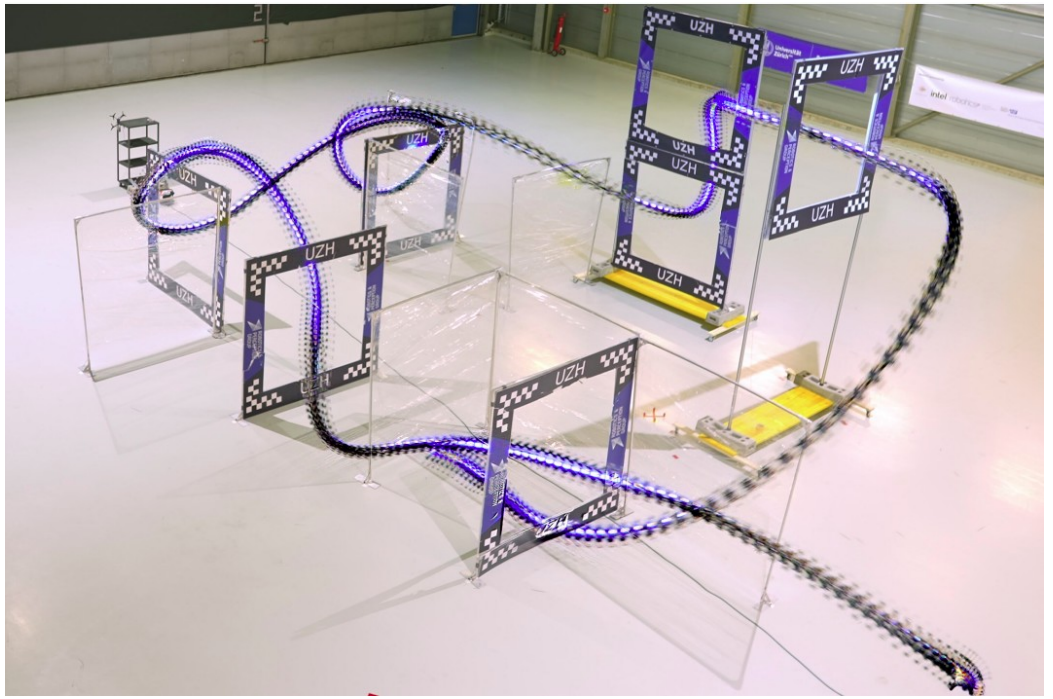
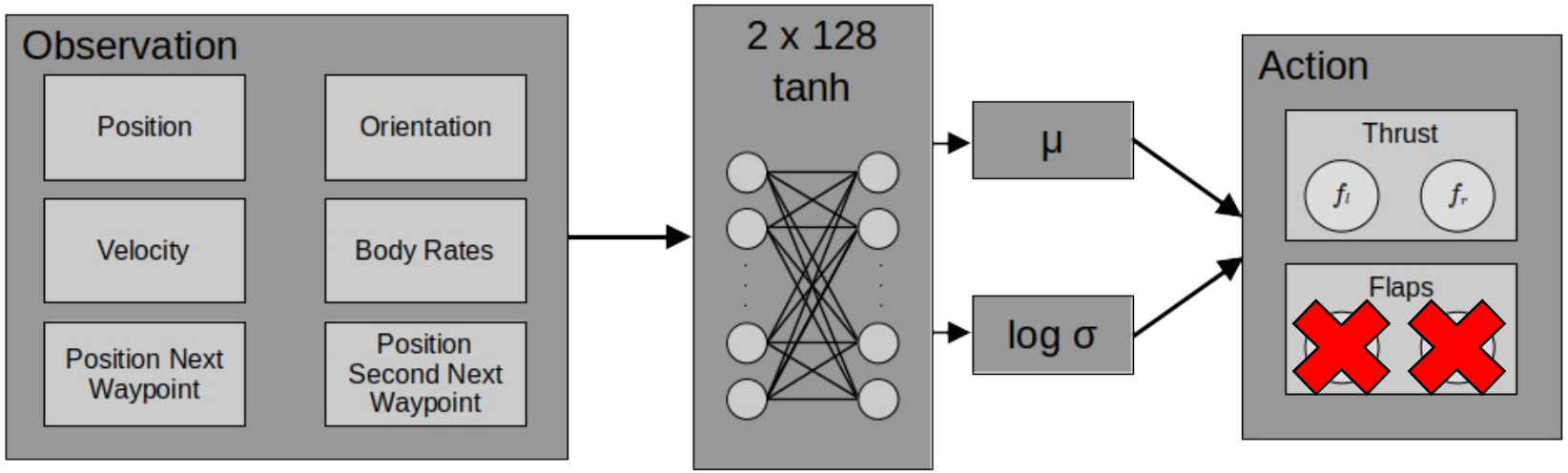
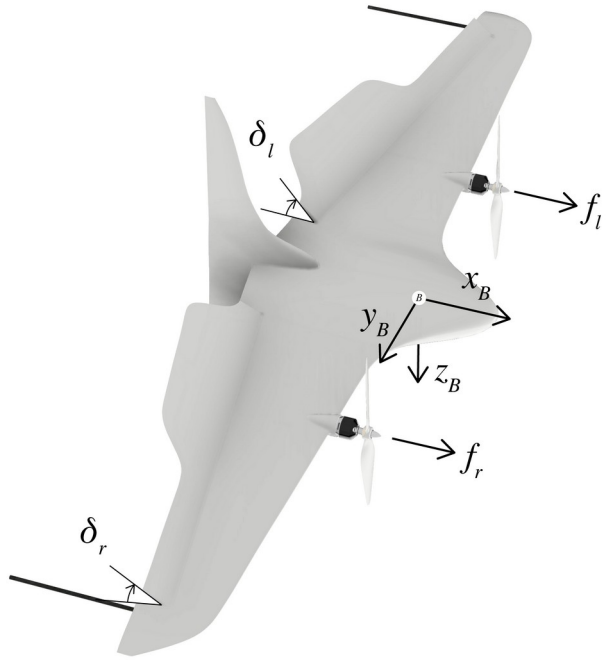


Fig. 1: Quadrotor races through a race track in the real world.

Our Approach

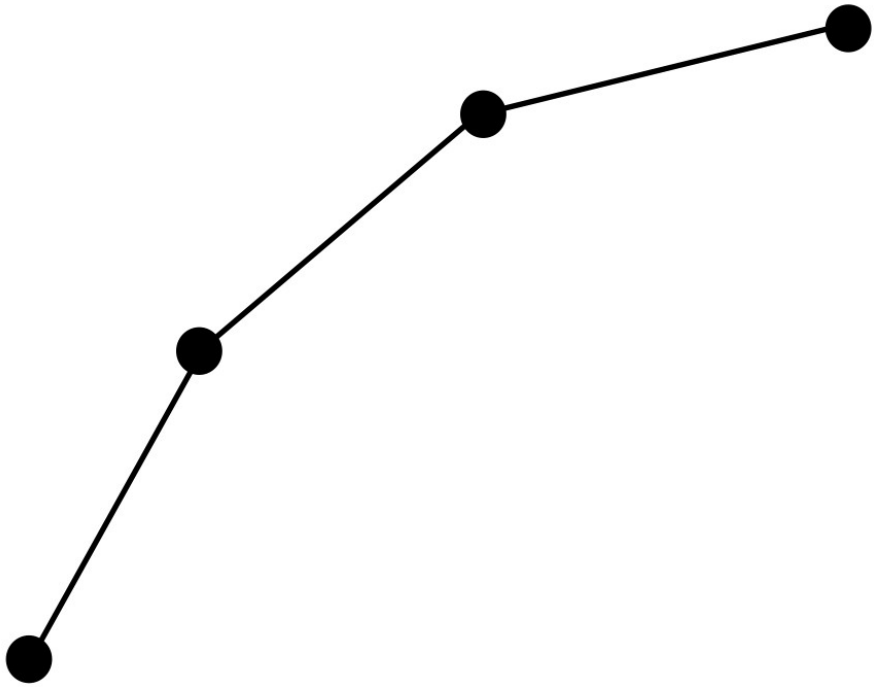
- Actor Critic
- Adam Optimizer





What has been done so far

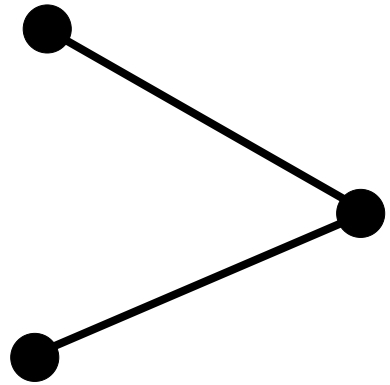
- Problem reduced to 2D
- Steer towards single points
- Fly along small random trajectories



Reward Function

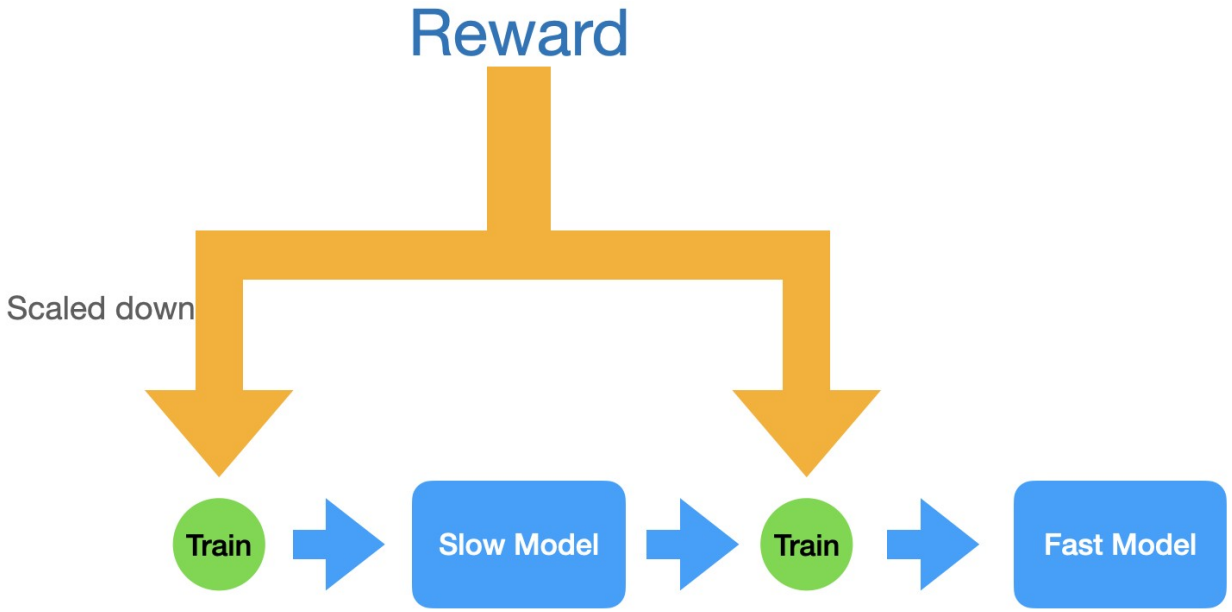
$$r(t) = k_p \cdot \Delta progress(t) + k_s \cdot progress(t) + k_{wp} \cdot r_{wp} - k_\omega \cdot \|\omega\| - fall$$

- Encourage line progression
- Encourage reaching points
- Penalize spinning
- Penalize inactivity

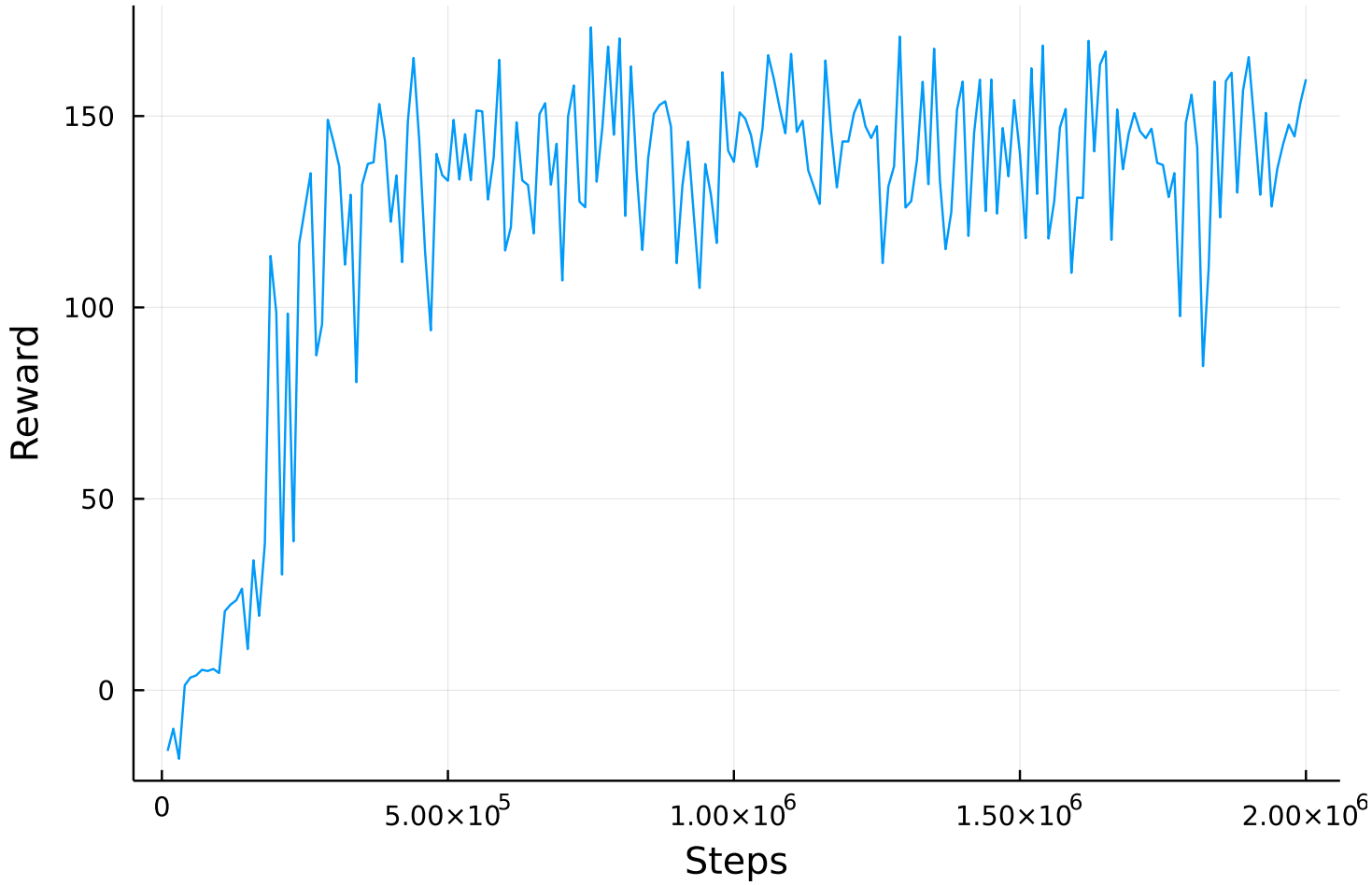


Training Strategy

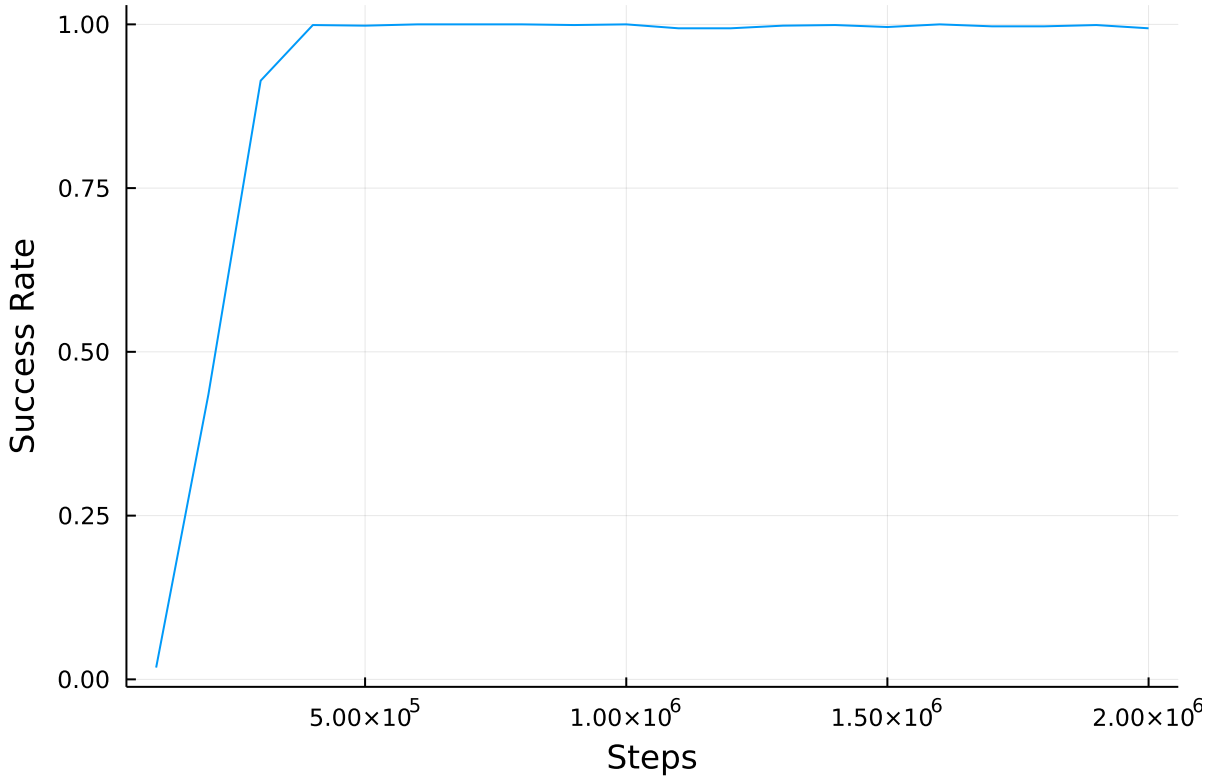
- Two Phases: Slow and Fast
- Slow: Learn to follow path
- Fast: Time optimality

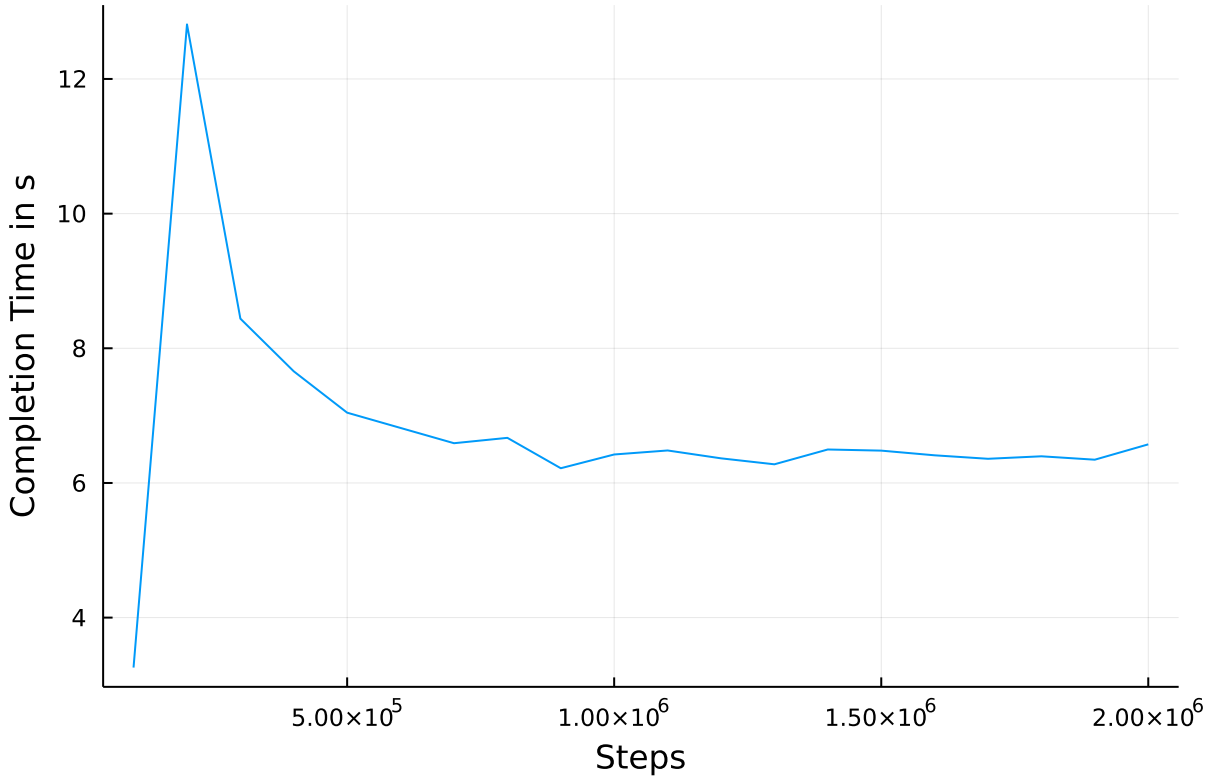


SLOW PLOTS

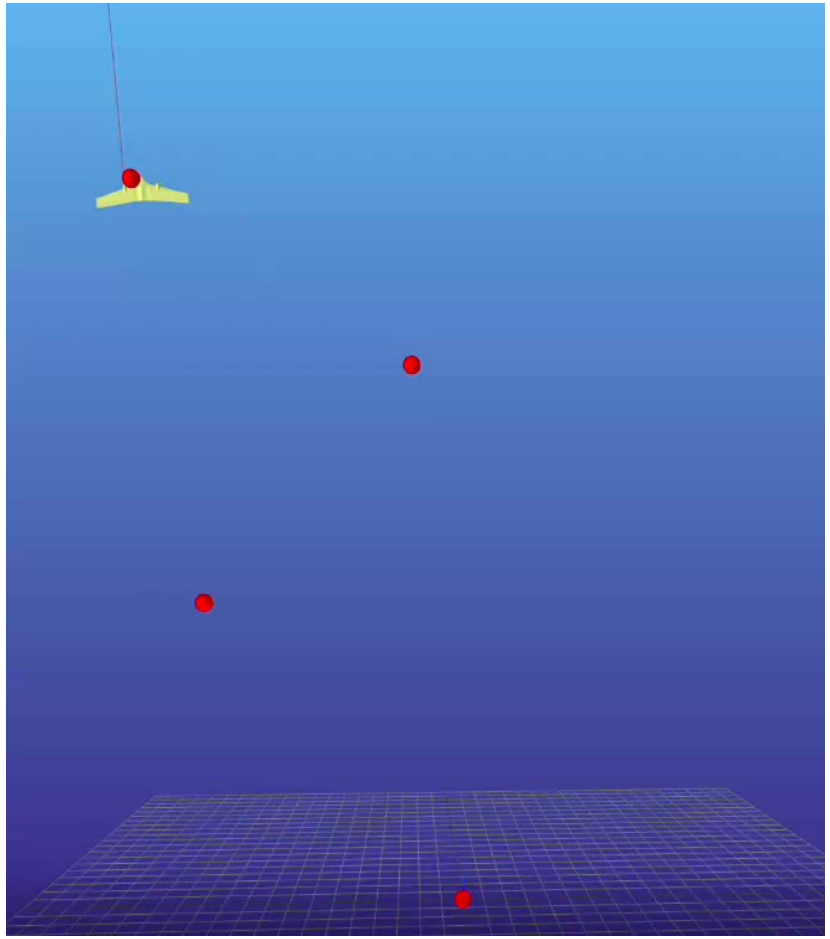


SLOW PLOTS

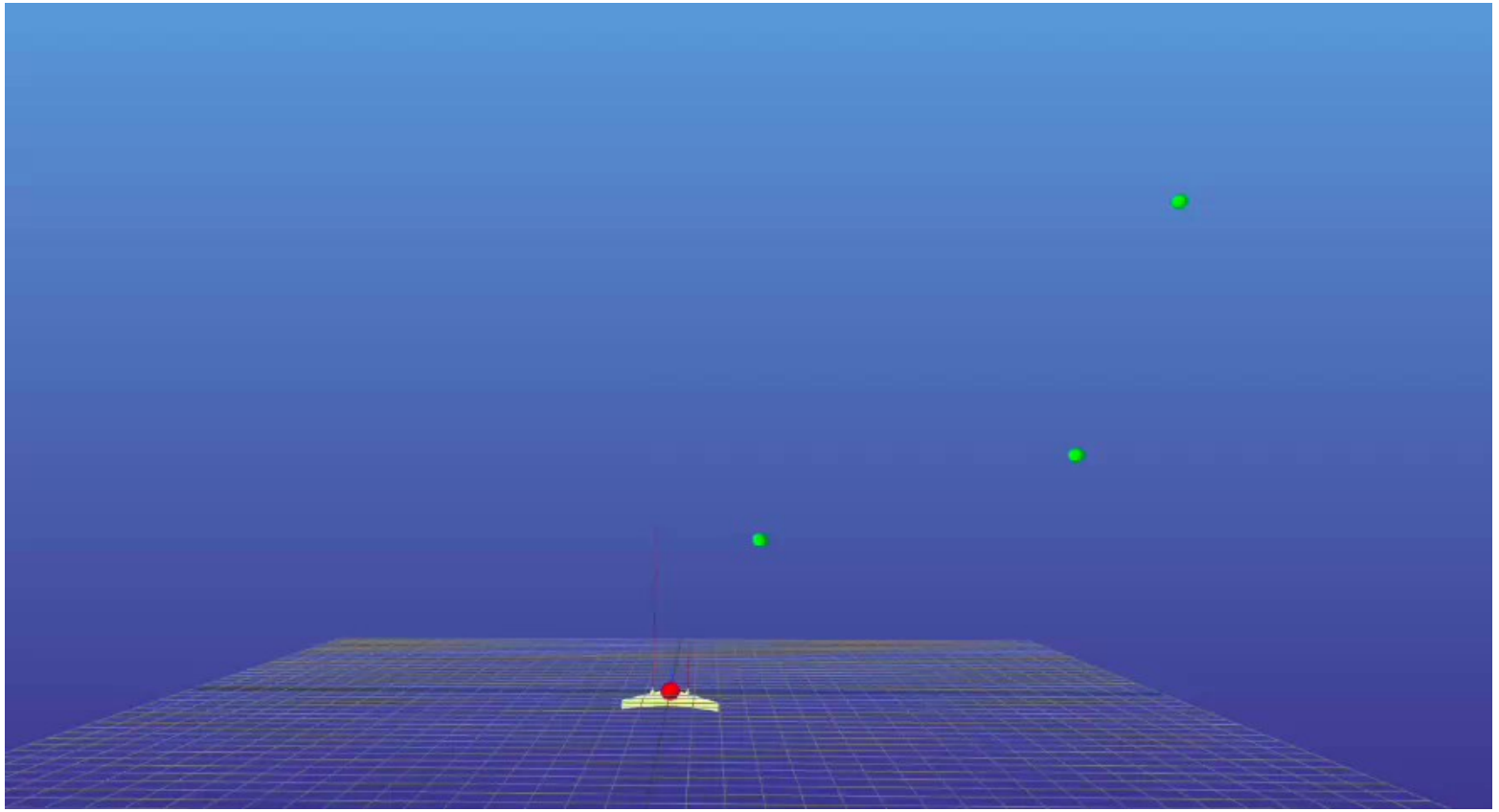

1.00
0.75
0.50
0.25
0.00
Success Rate
5.00×10^5
1.00×10^6
1.50×10^6
2.00×10^6
Steps


12
10
8
6
4
Completion Time in s
5.00×10^5
1.00×10^6
1.50×10^6
2.00×10^6
Steps

SLOW VIDEO



FAST VIDEO



Next Steps