Agile Trajectory Generation for Tensile Perching with Aerial Robots

Progress Update

- Practical Experiments
  - After meeting with Atar last week - with drones available - switch to ROS2, latest version of Gazebo
  - Demo
  - Wednesday + Thursday - Based around converting the controller to ROS2
  - Friday Experiments
    - Came across a lot of techical issues
    - Added in an additional safety mechnaism allowing Atar to take control via a remote control when needed.
    - By Friday evening we managed to run some trajectories and achieved a full successful manuever on the first run at full speed.

Report

Introduction

- Description of Problem + Manuever
- Main Contributions

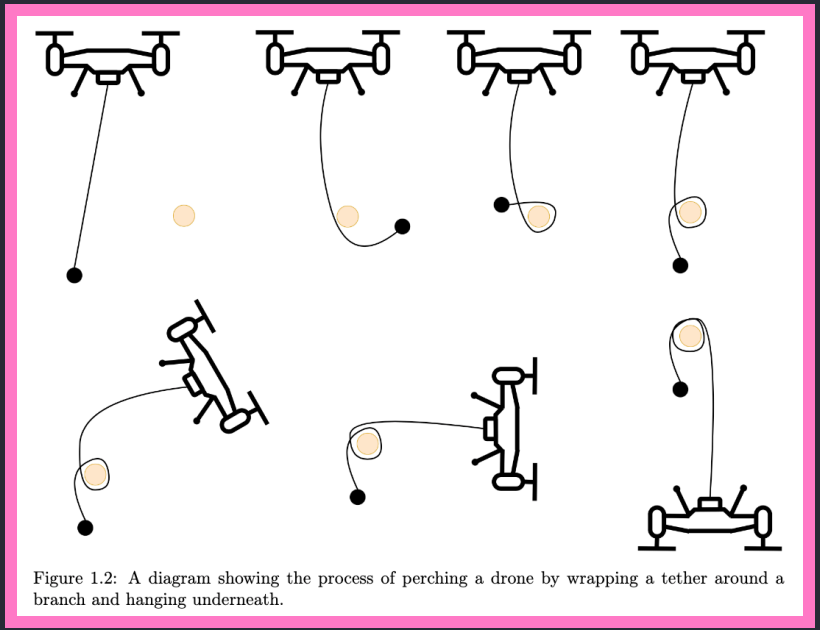


Figure 1.2: A diagram showing the process of perching a drone by wrapping a tether around a branch and hanging underneath.

Background + Literature

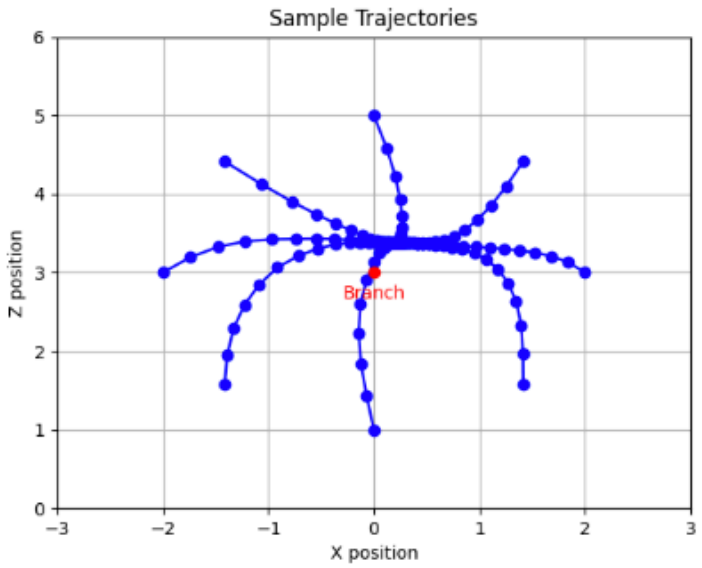
- A question at the end.

Environment

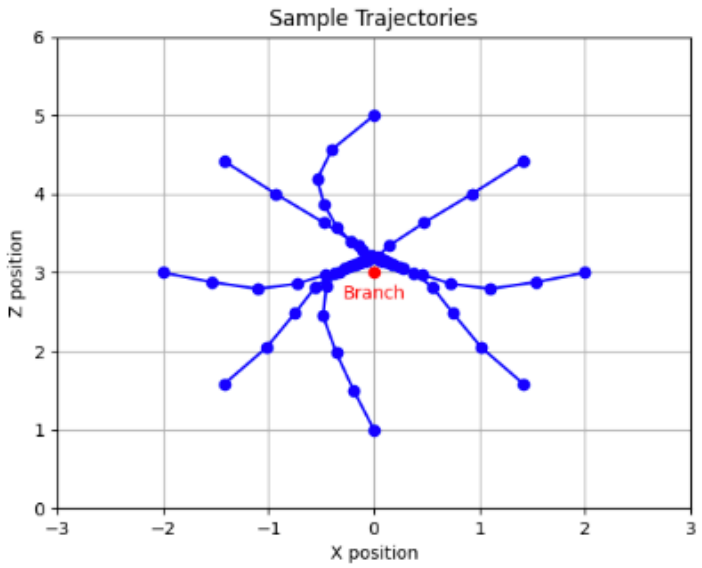
- Scenario
- PyBullet Environment
  - Visualisations
- Approximate Tether Modelling
  - Explanation and Evaluation
    - Evaluation will consist of x, y, z graphs of the tether model positions and several runs of the practically observed position to show that the approximate tether model is similar enough.

Training System

- System Design - Integration between training, PyBullet, Gazebo, Real controller.
- Training Wrappers: Waypoints, Dimensions, Symmetry, Starting Points
  - As an example here's the plots from the symmetry wrapper section:

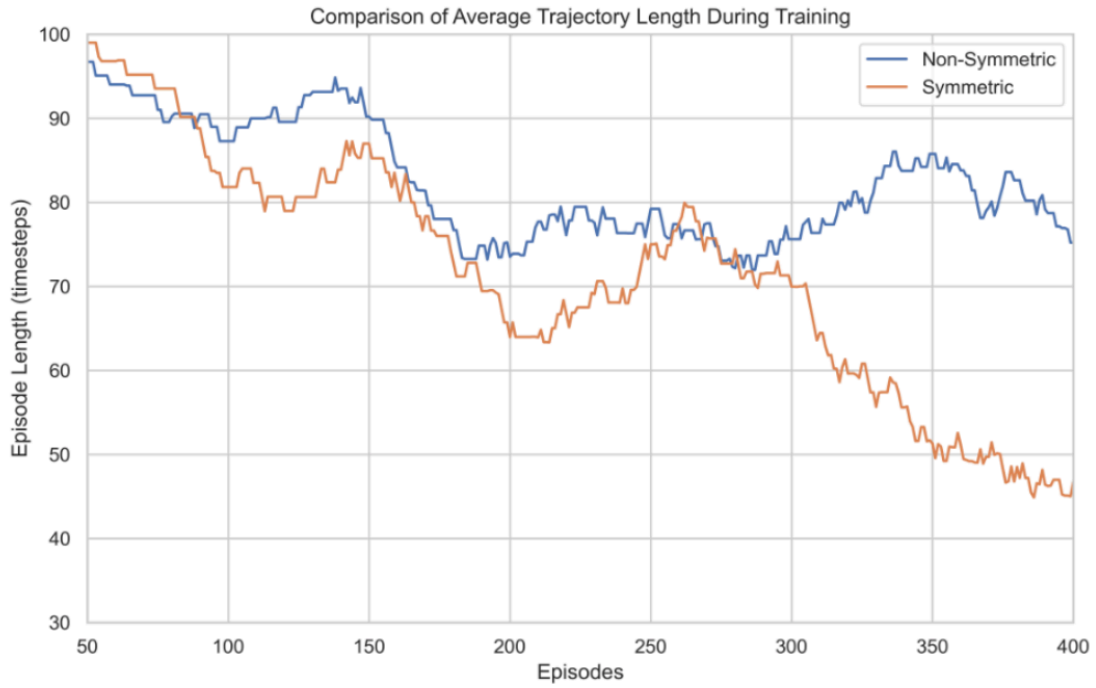


(a) Diagram showing xz plots of trajectories from various starting positions around the drone before the introduction of the symmetric wrapper.



(b) Diagram showing xz plots of trajectories from various starting positions around the drone after the introduction of the symmetric wrapper.

Figure 4.6: Comparison of sample trajectories before (a) and after (b) introducing the symmetric wrapper.



(b) Diagram showing the average length of an episode for an environment with symmetry and a non-symmetrical environment

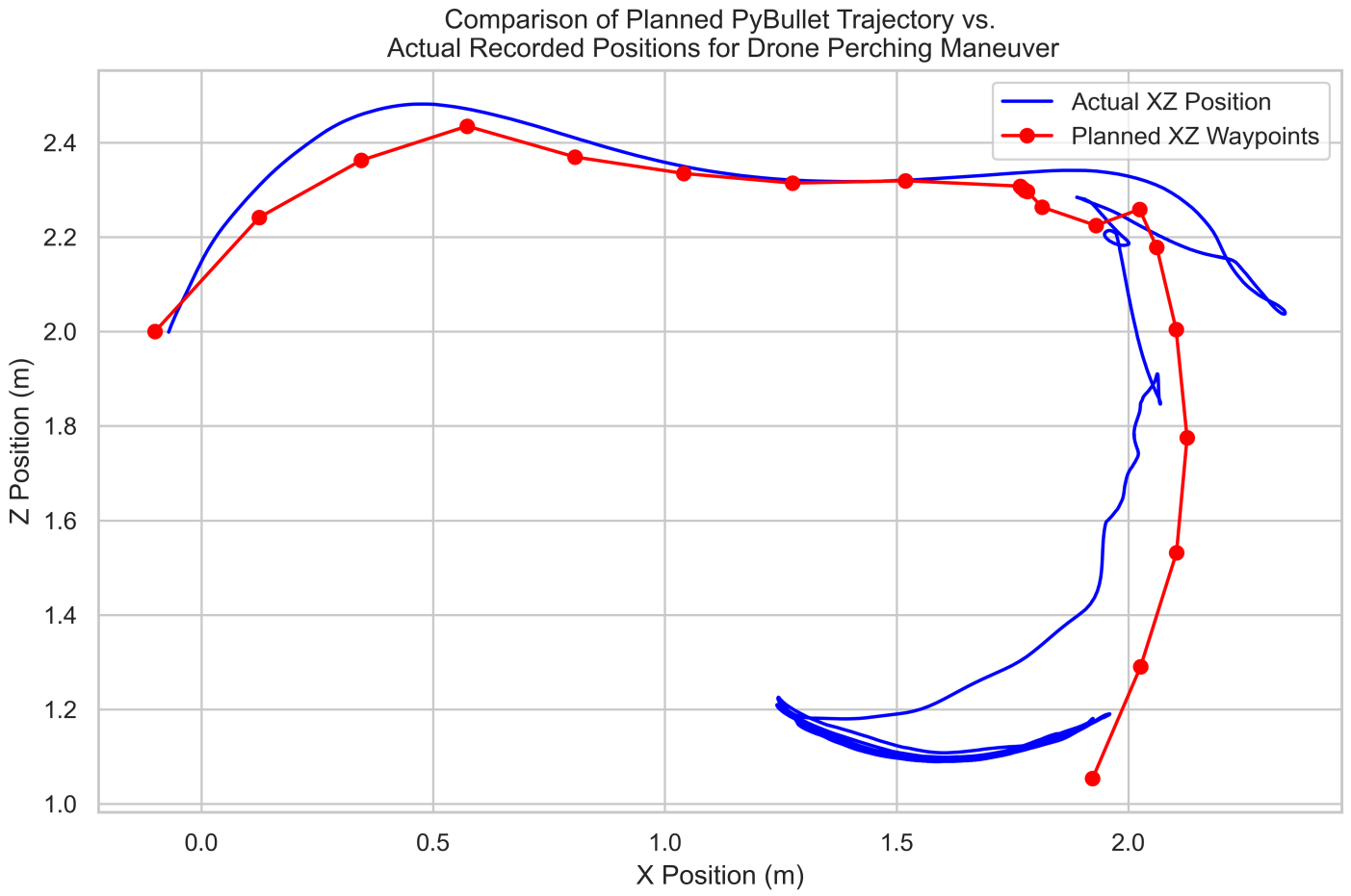
- Rewards
- Algorithms
  - Sampling between demonstrations and own experiences.
  - Evaluation on the number of demonstrations required - Compare performance between SAC, Ours with 1 demo, Ours with 5 demos.

Drone Controller

- Discuss the 2 modes: Trajectory Files
- Practical Demonstrations

Trajectory Analysis

- Comparison of PyBullet and Gazebo
- Comparison of Planned Trajectory and Practical Demonstrations
- Speed
- Adaptability to trajectory issues
- Number of Test Trajectories needed for learning


Comparison of Planned PyBullet Trajectory vs.
Actual Recorded Positions for Drone Perching Maneuver
Actual XZ Position
Planned XZ Waypoints
Z Position (m)
X Position (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.0
0.5
1.0
1.5
2.0

Overall Progress

- Roughly a day behind where I had planned to be last week - almost finished with a first draft - Tomorrow.
  - Plots

Questions

- Appendix: User Guide or Just READMEs in repos.
- Simulation Improvements: Is that for report? Outlook section?
- Literature: Added some new literature compared to interim that I’ve ended up using. 1.5 page of literature that I haven’t used any techniques from. Is this worth keeping as a future interest? Or is it worth removing this?