

# Deep Field 2023

3/07 to 15/07 - Stuttgart

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# Objectives

- Set up an UAV environment using Gazebo + ROS + PX4 control
- Implement an RL agent to solve simple tasks
- Implement different action and reward strategies
- Increase tasks complexity
- Set up parallel environments to train simultaneously

# Week 1 - Environment set up

- Gazebo environment with empty world and iris UAV
- PX4 Software-in-the-Loop with ROS connection through MAVROS

## 1<sup>a</sup> Problem: Reset PX4 EFK

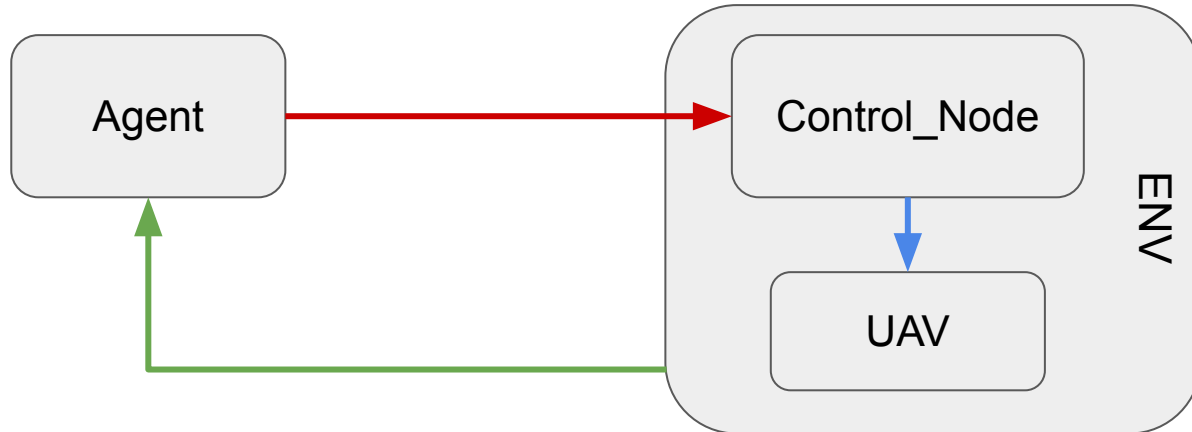
- PX4 doesn't have implemented a reset for the estimators
- Gazebo reset\_world leads to big jumps in EKF

## Solution:

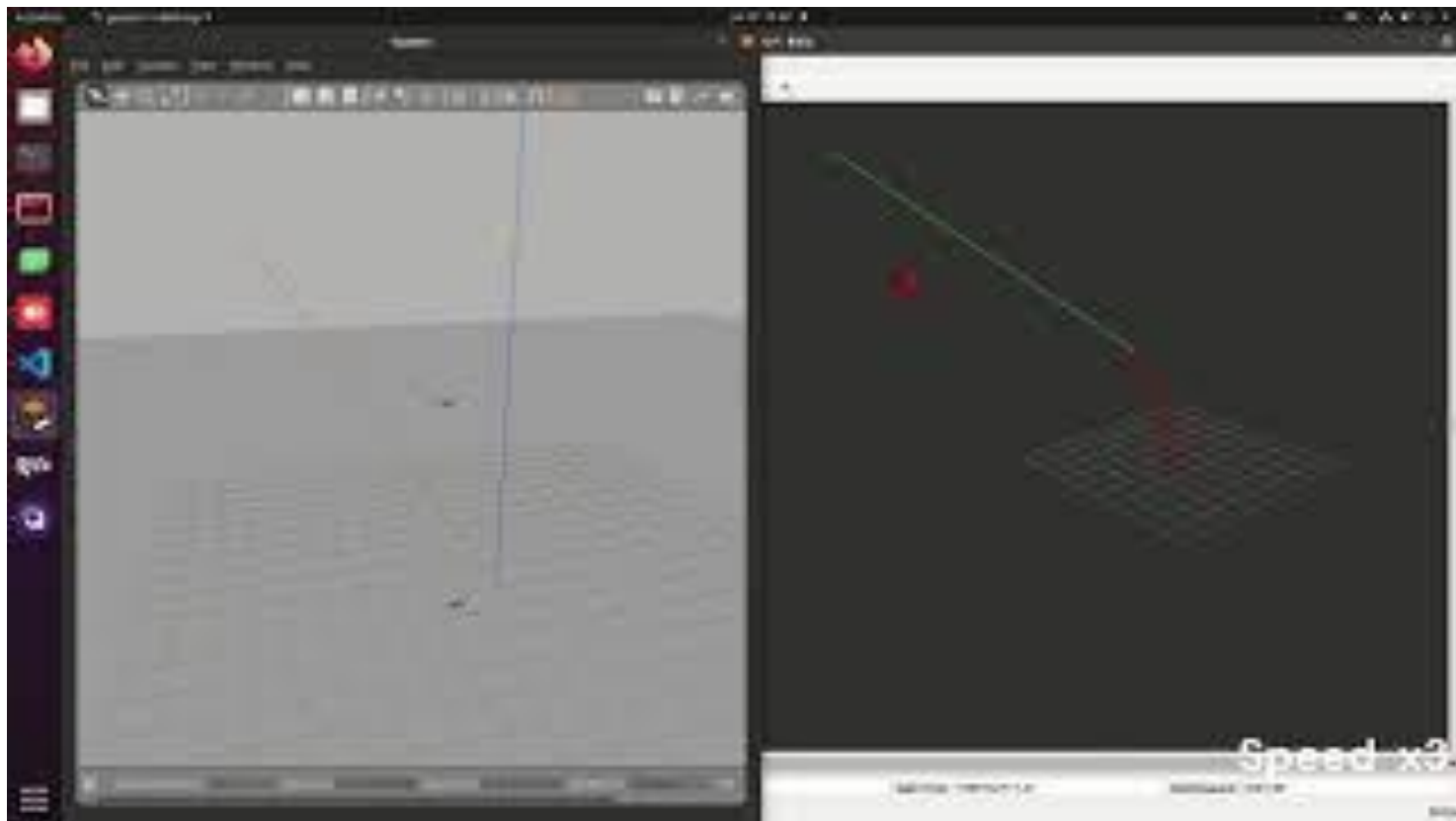
- Use the gazebo/model\_state pose + random noise in the observation
- Velocity offboard commands based on this pose

# Week 1 - Achievements

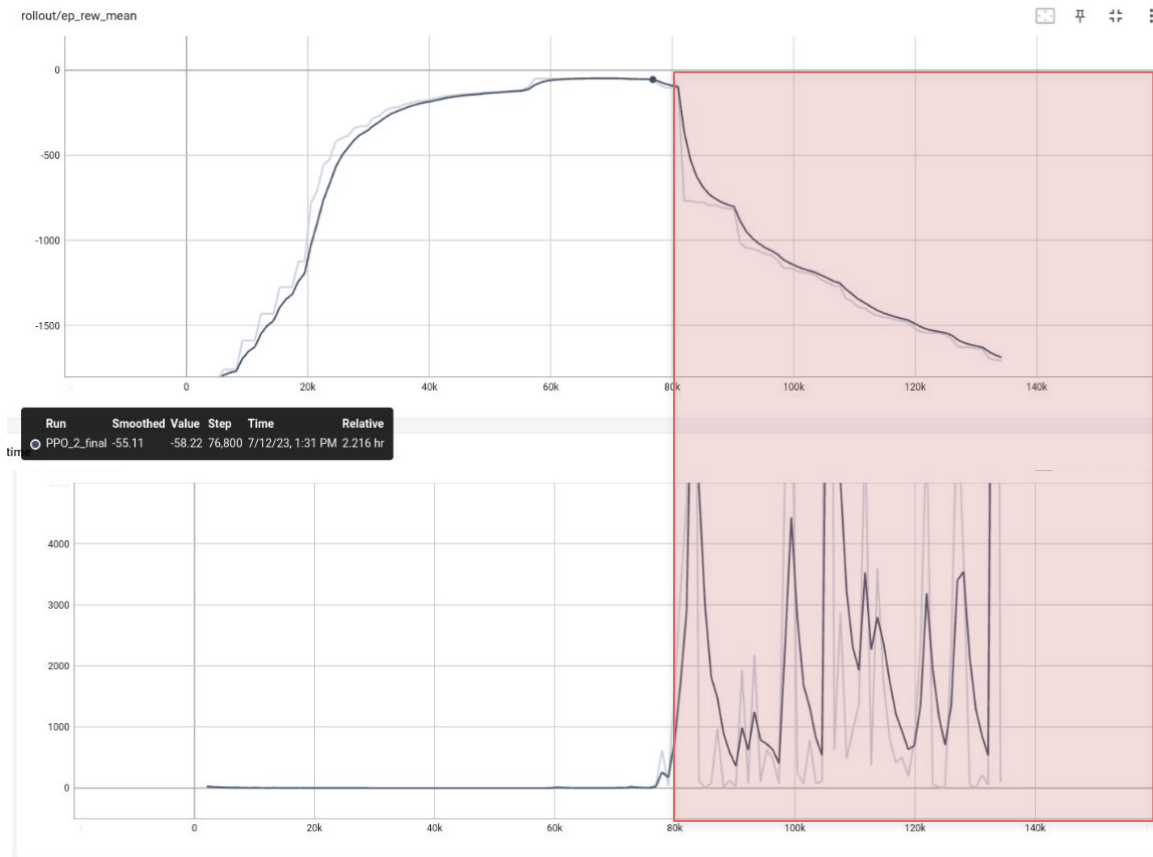
- Stable baseline 3 implementation with PPO to reach a waypoint
- Linear/Quadratic Bézier curve action space (10 Hz —)
- High frequency velocity control based on the generated path (50 Hz —)
- Observation space with UAV pose and goal relative distance (10 Hz —)



## Week 2 - First Implementation results



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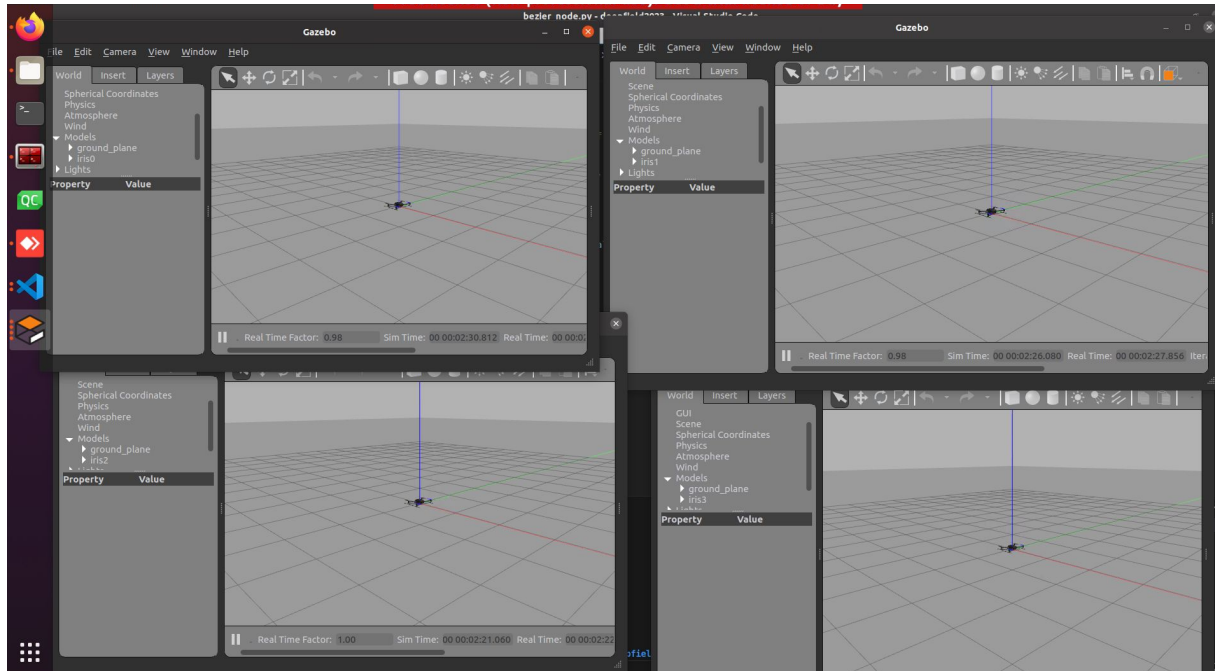


## Reset malfunction overtime

- error accumulation in PID
- jumps in velocity estimation
- stop function not working

# Week 2 - Parallelization

- Independent ROS\_MASTER and GAZEBO\_MASTER
- Scripts to launch and kill multiple screens for ROS/GAZEBO\_MASTER, CONTROL\_NODE



# To-Do - Reset solutions

## PX4 SITL:

- Disarm Kill - Arm - Takeoff sequence could reset the estimators
- Try to disable failsafe
- Fix STOP bug to force the 0 velocity and reduce the Integrator error when UAV jumps to origin
- Develop a reset function in PX4 firmware
- Evaluate the time of killing and relaunch PX4 process (isn't killing a ROS node)
- Increase reset Bounding Box
- Implement safety verifications after reset and block agent until OK

## Pascal Rotor simulator:

- Evaluate Rotor Simulator (Gazebo + ROS) for UAV velocity control
- Train the agent with this ROS package and include noise in the actions and observations
- Test the agent in the Rotor Simulator
- Test the agent in PX4 SITL
- Compare differences



# To-Do

- Set up environment, control node and agent for multiprocessing learning (turtle sim example)
- Increase gazebo real time factor to increase speed
- Feedback vehicles velocity
- Implement accumulative action for smoother actions changes
- Try to include Long-Short Term Memory to the agents (PPO+LSTM)
- **Future:** Implement Ray's agents (better performance agents) after a getting a stable environment