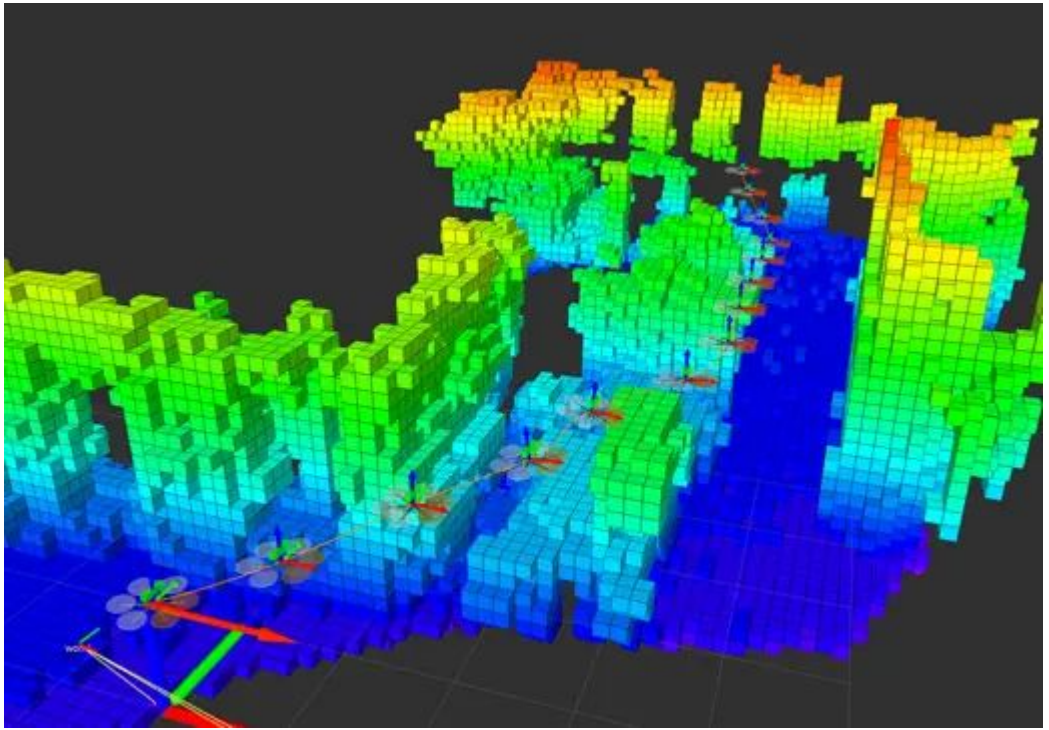
CPS 2024

Multiagent SITL SLAM

Simultaneous Localization And Mapping

WHAT IS?

is a method used for autonomous vehicles that lets you build a map and localize your vehicle in that map at the same time. SLAM algorithms allow the vehicle to map out unknown environments.



USEFUL LINKS:

UAV ROS Cartographer: https://github.com/larics/uav_ros_cartographer

ROS

WHAT IS?

The **Robot Operating System** (ROS) is a set of software libraries and tools that help you build robot applications. From drivers to state-of-the-art algorithms, and with powerful developer tools, ROS has what you need for your next robotics project. And it's all open source.

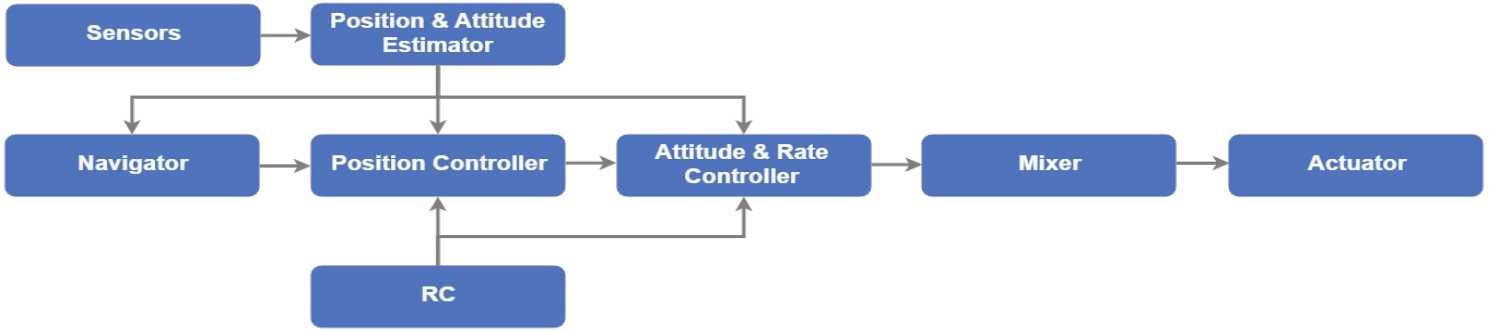
USEFUL LINKS:

ROS: https://www.ros.org/

PX4 Autopilot

WHAT IS?

PX4 is open source autopilot flight stack build on Nuttx OS. It consists of two main layers: the **flight stack**, a collection of guidance, navigation and control algorithms for autonomous drones and the **middleware** that consists primarily of device drivers for embedded sensors, communication with the external world (companion computer, GCS, etc.) and the **uORB** publish-subscribe message bus.



- **Flexible** and **powerful flight modes** and **safety features**.
- Robust and deep **integration** with **companion computers and robotics APIs (ROS 2, MAVSDK)**
- All functionality is **divided** into exchangeable and reusable **components**
- **Communication** is done by **asynchronous** message passing.

PX4 Autopilot

The interaction with the ground control station (GCS) is handled through the "business logic" applications including the **commander** (general command & control, e.g. arming), the **navigator** (accepts missions and turns them into lower-level navigation primitives) and the **mavlink application**, which accepts MAVLink packets and converts them into the onboard **uORB** data structures.

You can use **QGroundControl** to load (flash) PX4 onto the vehicle control hardware, you can setup the vehicle, change different parameters, get real-time flight information and create and execute fully autonomous missions.

USEFUL LINKS:

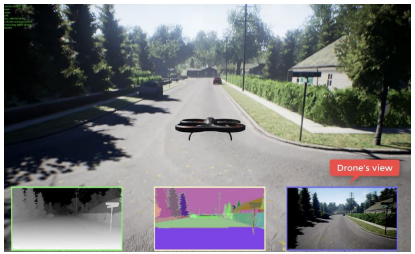
PX4 Autopilot: https://px4.io/

SITL: https://docs.px4.io/main/en/simulation/

Simulators

AirSim

- Photorealistic
- Not deterministic
- 2 UAV models ready-to-use

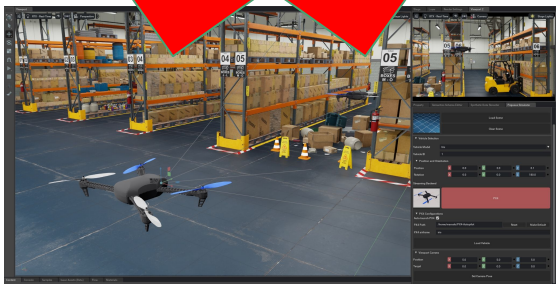


Gazebo

- Light (work locally)
- Suitable for those who want to learn more about control

Isaac Sim

- Photorealistic
- Suitable for those who wa[illegible]t to learn [illegible]ore a[illegible]
- Too[illegible]a PC



USEFUL LINKS:

AirSim: https://microsoft.github.io/AirSim/ Gazebo: **https://gazebosim.org/home**

Isaac Sim: **https://developer.nvidia.com/isaac-sim**

Workplane & Guidelines

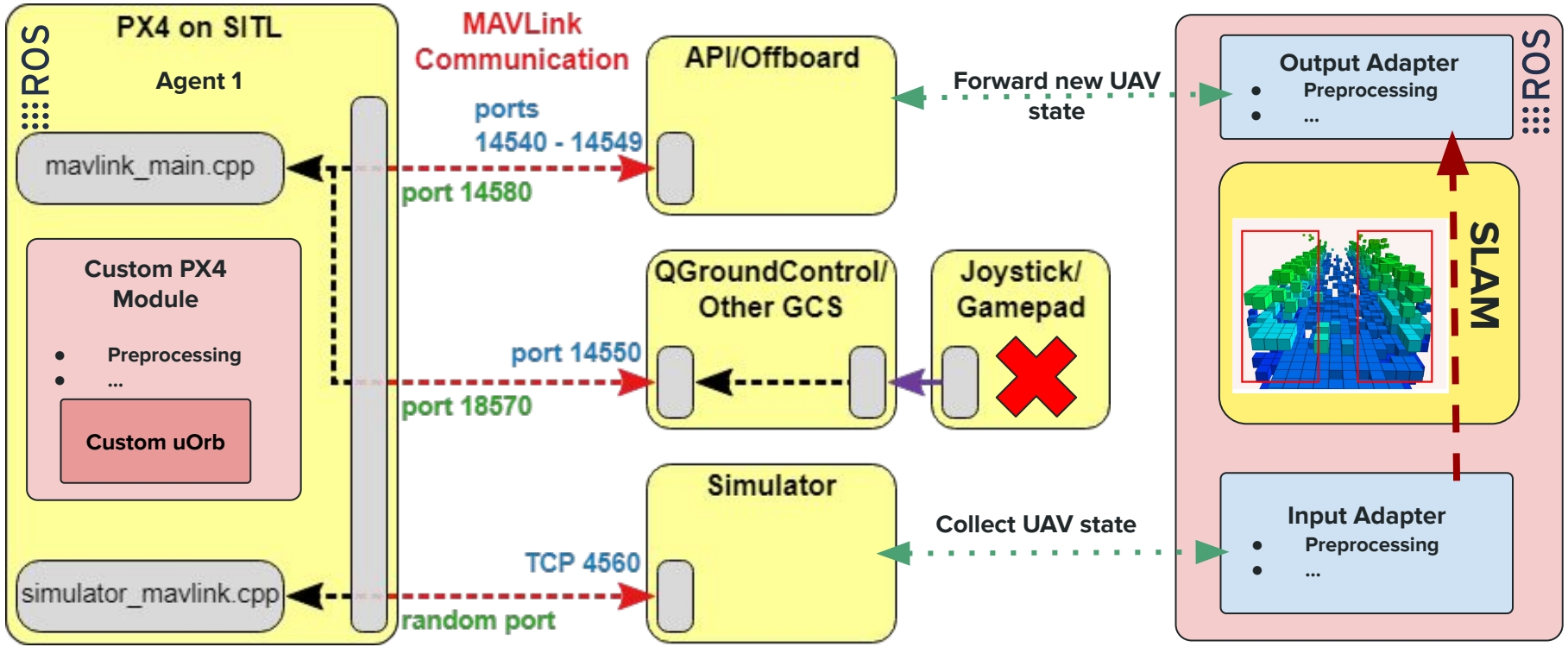
WORKPLANE

1. Study of the SLAM algorithm
2. Study of PX4 and ROS and first pM&8RJRa#2Jz6Papplications
3. First SITL with simulator chosen and a few movements
4. SITL with PX4 Autopilot
5. Integration of SLAM algorithm
6. Preparation of the environment
7. Validation, testing and debugging

GUIDELINES

- Informal weekly meeting (only in the weeks in which you work) in which you explain (also with the help of slides) what has been done and what has been understood.
- Access to lab technologies by reservation.
- Final documentation which explains step by step how to replicate the work done (launched commands, software versions, ...)
- Personal team group in which to ask for support (BE CAREFUL WHAT YOU ASK FOR)

Hypothetical result



THIS DIAGRAM IS FOR EXPLANATORY PURPOSE ONLY, THE RESULT MAY VARY LITTLE!!!