Natalia Sempere Sánchez
IR2136 - Robots Aeris i Submarins (2024-25)

LAB01 : SITL & ARDUPILOT

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1) OBJECTIVES

- Introduce the use of Ardupilot's SITL for simulating autonomous vehicles.
- Configure and run a simulation environment to test configurations and commands for a drone or rover.
- Familiarize with complementary tools like Mission Planner or QGroundControl to monitor and control the simulation.

2) REQUIRED MATERIALS

- A computer running Linux (Ubuntu) or Windows with WSL enabled.
- Pre-installed software :
    - Python (version 3.8 or higher)
    - Ardupilot SITL tools : ardupilot and sim_vehicle.py
    - Mission control software : Mission Planner (Windows) or QGroundControl.
- Internet Connection

3) ACTIVITIES

ACTIVITY 1: SETTING UP THE ENVIRONMENT

1) Clone the Ardupilot repository :

```
Unset
git clone https://github.com/ArduPilot/ardupilot.git
cd ardupilot
git submodule update --init --recursive
```

2) Install dependencies : Run the installation script for Ubuntu :

```
Unset

./Tools/environment_install/install-prereqs-ubuntu.sh -y
```

3) Source the configurations :

```
Unset

. ~/.profile
```

4) Compile SITL: Navigate to the Ardupilot folder and compile:

```
Unset
cd ArduCopter  (in ardupilot)
sim_vehicle.py -w

// si tarda mucho, hay que pararlo y poner
sudo /etc/init.d/clamav-daemon stop
```

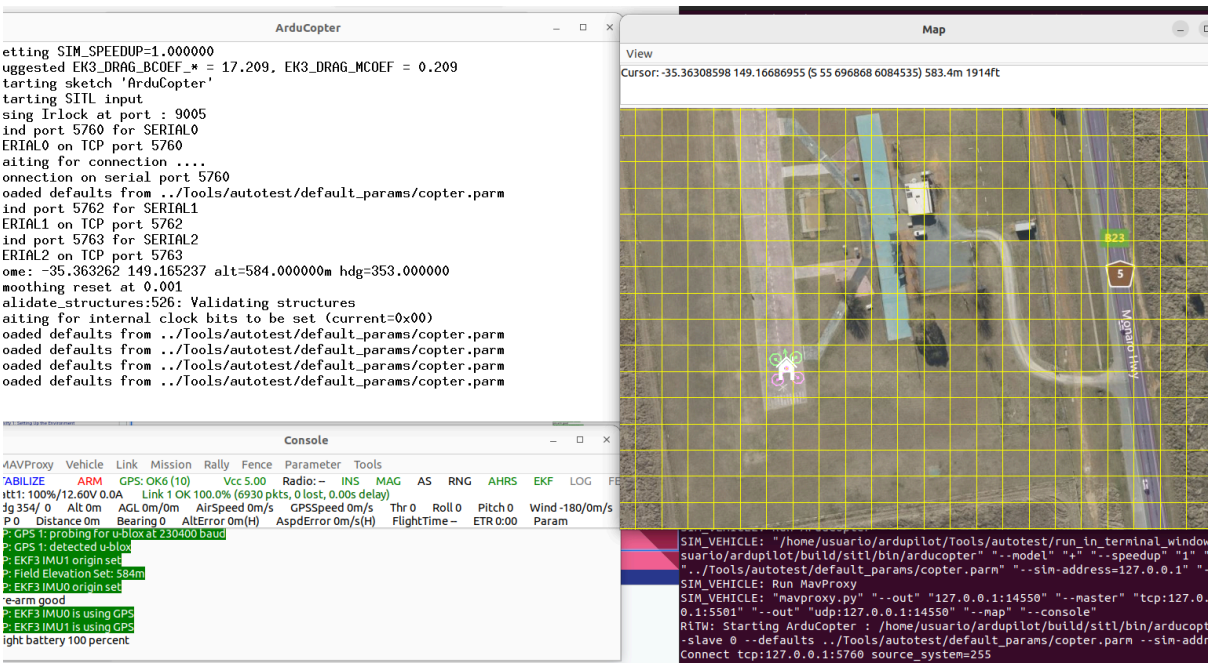
ACTIVITY 2: STARTING THE SIMULATION

1) Basic SITL execution: To simulate a drone, run:

```
Unset
sim_vehicle.py -v ArduCopter --map --console
--out=udp:127.0.0.1:14550
```

This will open:

- A console with flight information.
- A map to monitor the drone's position.



2) Change vehicle model: To simulate a different vehicle (e.g., a rover):

```
Unset
sim_vehicle.py -v Rover --map --console --out=udp:127.0.0.1:14550
```

ACTIVITY 3 : CONNECTING WITH QGROUNDCONTROL

1) Step 1: Install QGroundControl

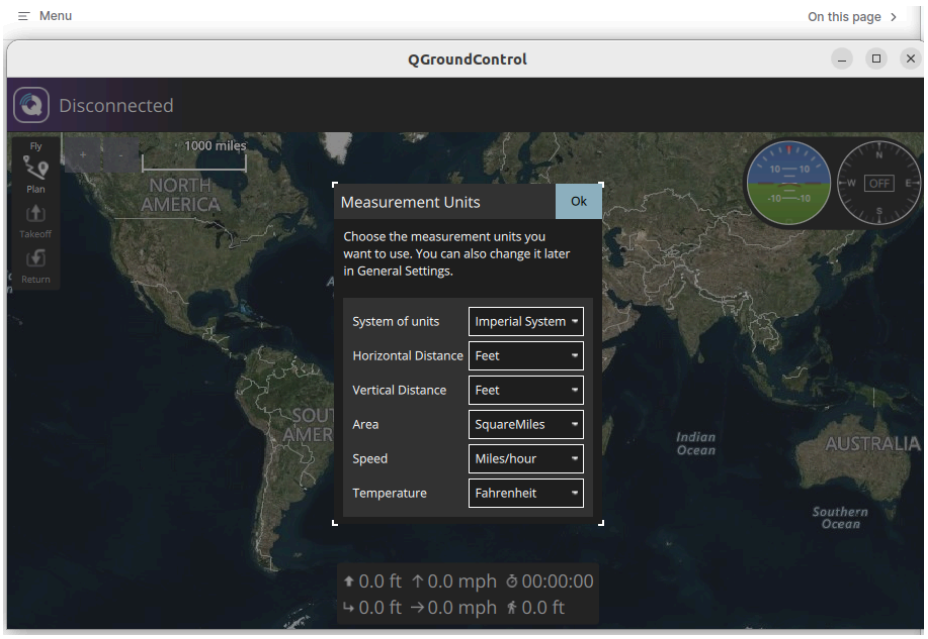
- Download QGroundControl (https://qgroundcontrol.com/):
- On Linux, you might need to make the downloaded file executable:

```
Unset
   chmod +x ./QGroundControl.AppImage
```

2) Step 2 : Launch QGroundControl

```
Unset
// Cambiar de directorio donde guardes QGroundControl.AppImage

./QGroundControl.AppImage
```



Familiarize yourself with the interface:

- **Map view:** Displays the vehicle's position and waypoints.
- **Vehicle status bar:** Shows connection status, battery, and other telemetry data.
- **Plan view**: Used for creating and uploading missions.
- **Telemetry panel:** Monitors real-time data like altitude, speed, and mode.

3) Step 3: Connect SITL to QGroundControl

```
Unset
cd ardupilot
cd ArduCopter

sim_vehicle.py -v ArduCopter --map --console
--out=udp:127.0.0.1:14550

//SITL opens a connection on udp:127.0.0.1:14550 by default.
```

Verify connection settings in QGroundControl:

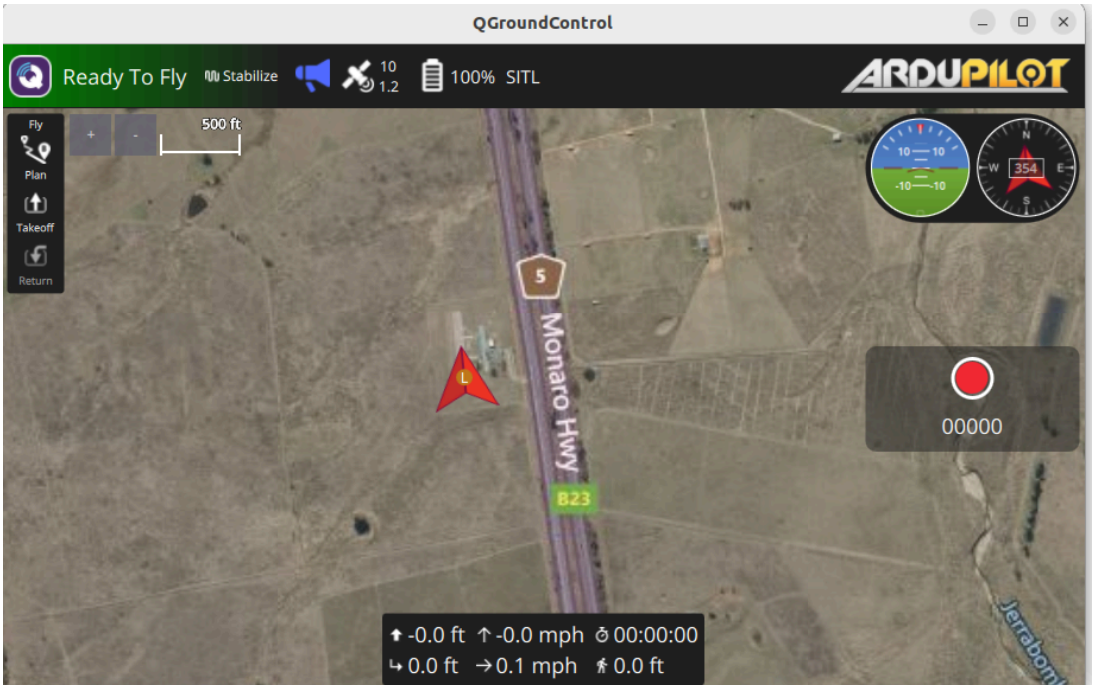
- Go to **Application Settings** (gear icon in the top toolbar).
- Navigate to the **Comm Links** section.
- Ensure the connection uses **UDP with the default SITL port 14550.**

Connect QGroundControl to SITL:

Once the SITL simulation is running, QGroundControl should automatically detect the vehicle and display it on the map.

If not, manually configure the communication:

- Go to **Application Settings** → **Comm Links** → **Add**.
- Enter:
  - **Name**: "SITL"
  - **Type**: UDP
  - **Port**: 14550
- Save and click **Connect**.



ACTIVITY 4 : NAVIGATING THE DRONE TO A WAYPOINT

1) Create a Waypoint Mission in QGroundControl:

Switch to the **Plan View in QGroundControl.**

- In QGroundControl, click the **Plan tab** in the toolbar at the top of the screen.
- The map interface will change to show planning options.

Add a Takeoff **waypoint with an altitude of 10 meters**.

a) Click on the **map near the desired takeoff location.**
b) From the context menu, select **Takeoff as the waypoint type.**

Add a **second waypoint at a specific location.**

- Click Upload to send the mission to SITL.

2) Waypoint and Parameters

Click on other locations on the map to add subsequent waypoints.

- Each click will add a waypoint sequentially.
- Waypoints can be moved by dragging them on the map.

Edit Waypoint Parameters (optional):

- Click on a waypoint in the mission list (on the right panel) to adjust:
    i. **Altitude**: Specify the flight altitude for the waypoint.
    ii. **Hold Time:** Set how long the drone will stay at the waypoint.
    iii. **Actions:** Add specific commands like taking a photo or changing flight speed.

Add a Landing Command

- For a complete mission, add a landing command at the desired location:
    - Click on the map near the intended landing point.
    - From the context menu, select **Land**.

Upload the Mission

1. Click the **Upload** button at the top of the right-hand panel to send the mission to SITL.
    - You'll see a confirmation message if the upload is successful.
2. Verify that the mission waypoints are displayed on the map.

Example Mission

- Takeoff Waypoint:
    - Latitude/Longitude: Near the drone's starting position.
    - Altitude: 10 meters.

- Waypoint 1:
    - Location: A specific position nearby.
    - Altitude: 15 meters.

- Waypoint 2:
    - Location: Another position farther away.
    - Altitude: 20 meters.

- Landing:
    - Location: Near the starting point.

Review and Save the Mission

1. Check the mission timeline to ensure all waypoints and commands are correct.
2. Optionally, save the mission file to your computer:
    - Click the **Save** button and specify a file name.

Switch to Fly View

1. In **QGroundControl**, click on the **Fly** tab in the top menu.
2. The interface will show:
    - The map with the vehicle's position.
    - The mission waypoints overlaid on the map.
    - Vehicle telemetry, including altitude, speed, battery, and mode.