Mission Planner

Kenyatta University, 16.01.2025

[Mission Planner Demo]

Overview

- Review the importance of GCS software in UAV Operations

- Develop an understanding of the features and interface of "Mission Planner".

- Learn how the ArduPilot SITL can be used for testing and development of Autonomous UAV solutions.

- Explore Mission Planner and the SITL simulator through a series of Practical exercises

Background Information

- Ground Control Station:
  - Displays vital **statistics** and **information** to UAV operators.
  - Telemetry.
  - Control of autonomous missions.
  - Custom code to allow full automation.
  - Various Software Options:
    - Mission Planner (We Use This!)
    - QGroundControl
    - APM Planner

UAV

GCS
Laptop

Remote
Pilot

Custom
Control
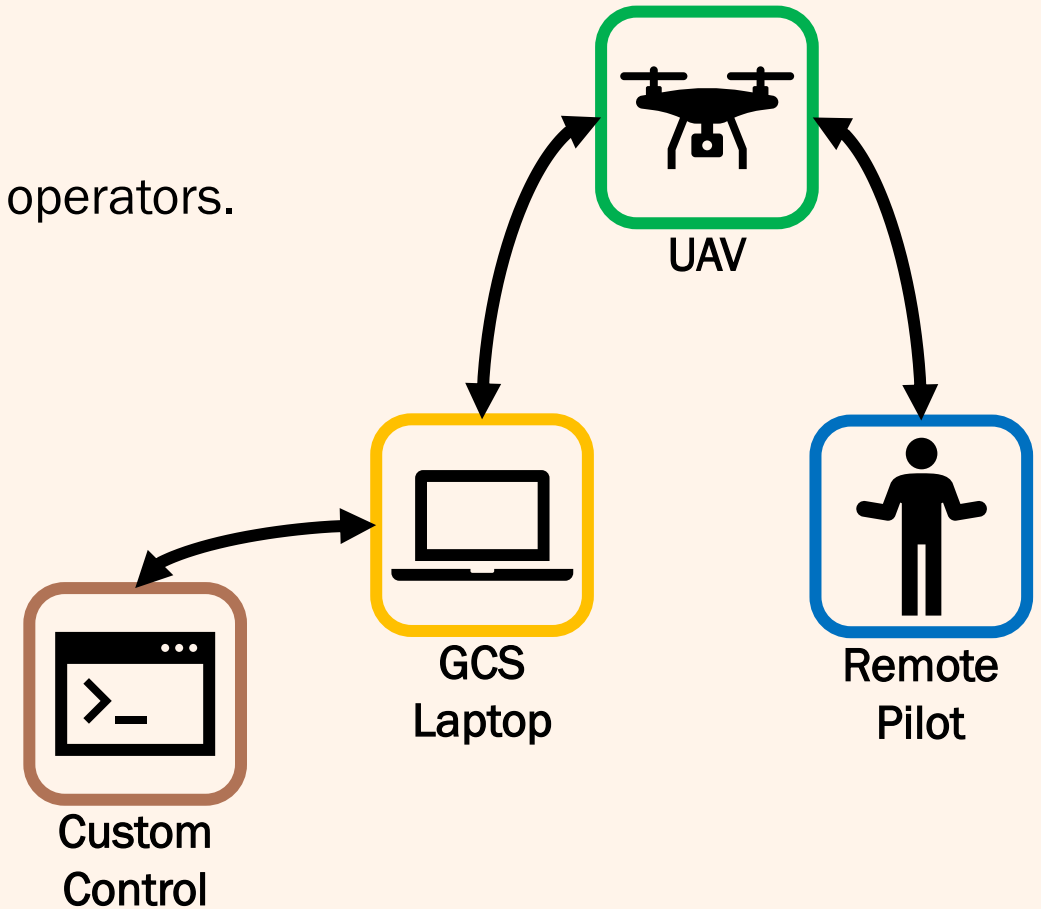
Mission Planner

- Open Source.

- Used to plan autonomous missions.

- Can be used to setup UAVs and Autopilots

- Wired and Wireless Telemetry.

- Able to view and set current parameters.

- Log error messages.
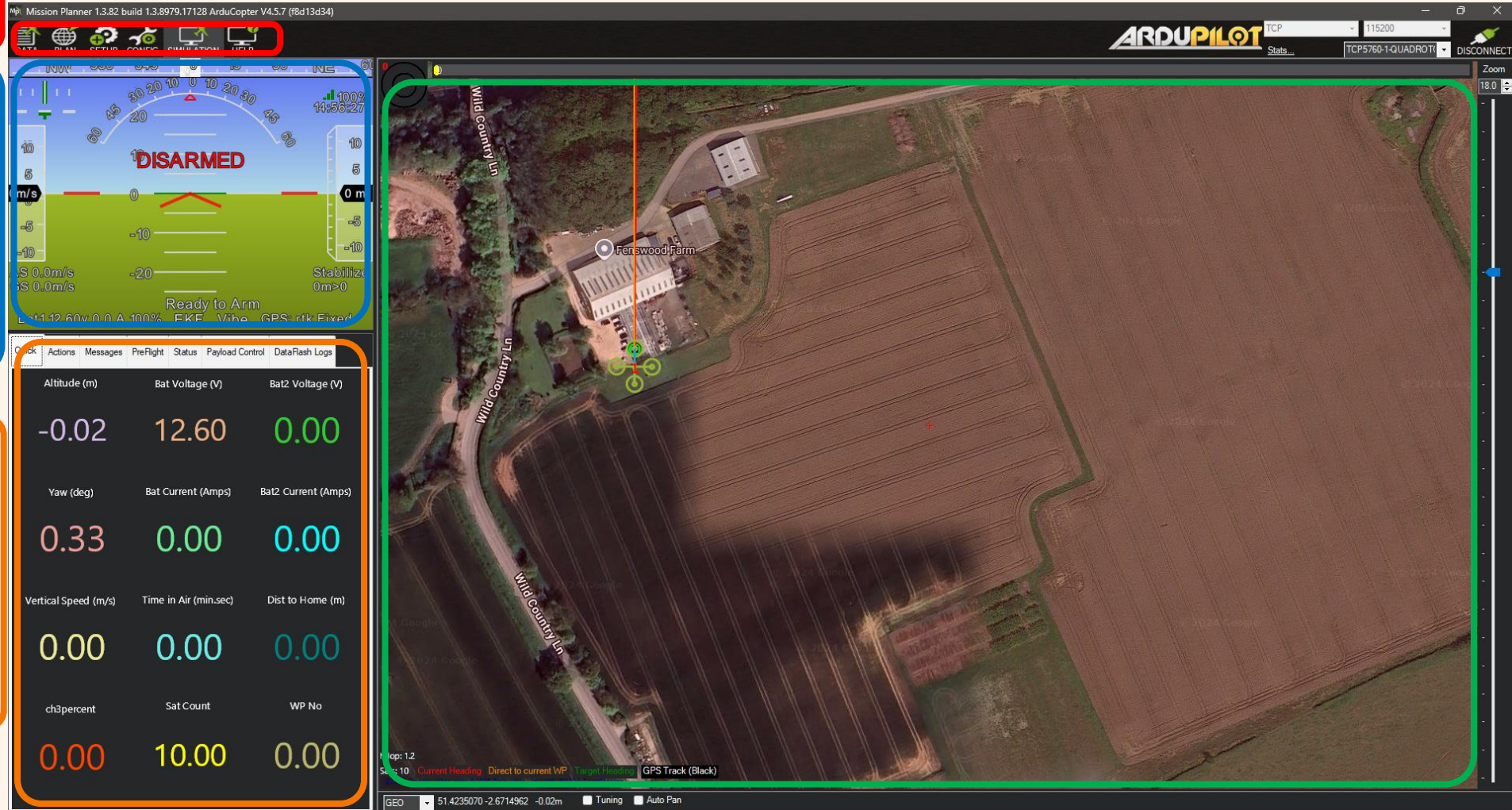
- Simulated UAVs for development.
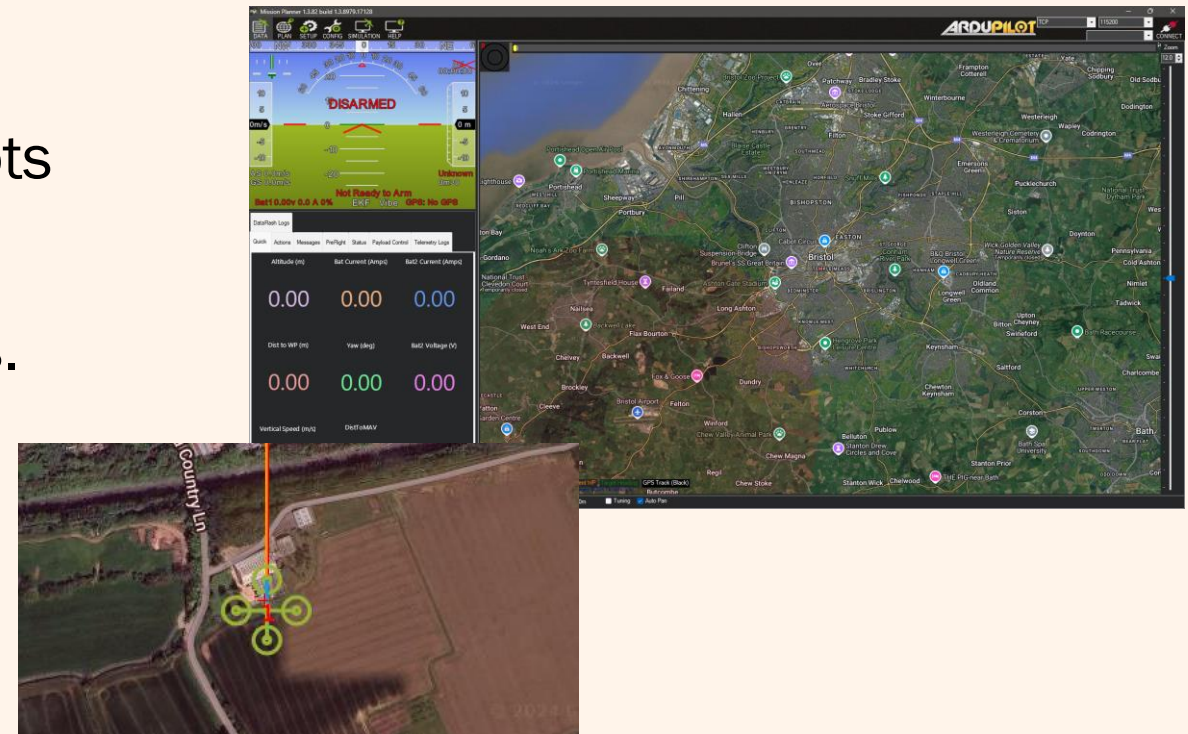
Navigation tabs

HUD:
• Artificial Horizon
• Speed & Heading
• Altitude
• Current Mode

Multi-Tab Panel:
• Quick-View Telemetry
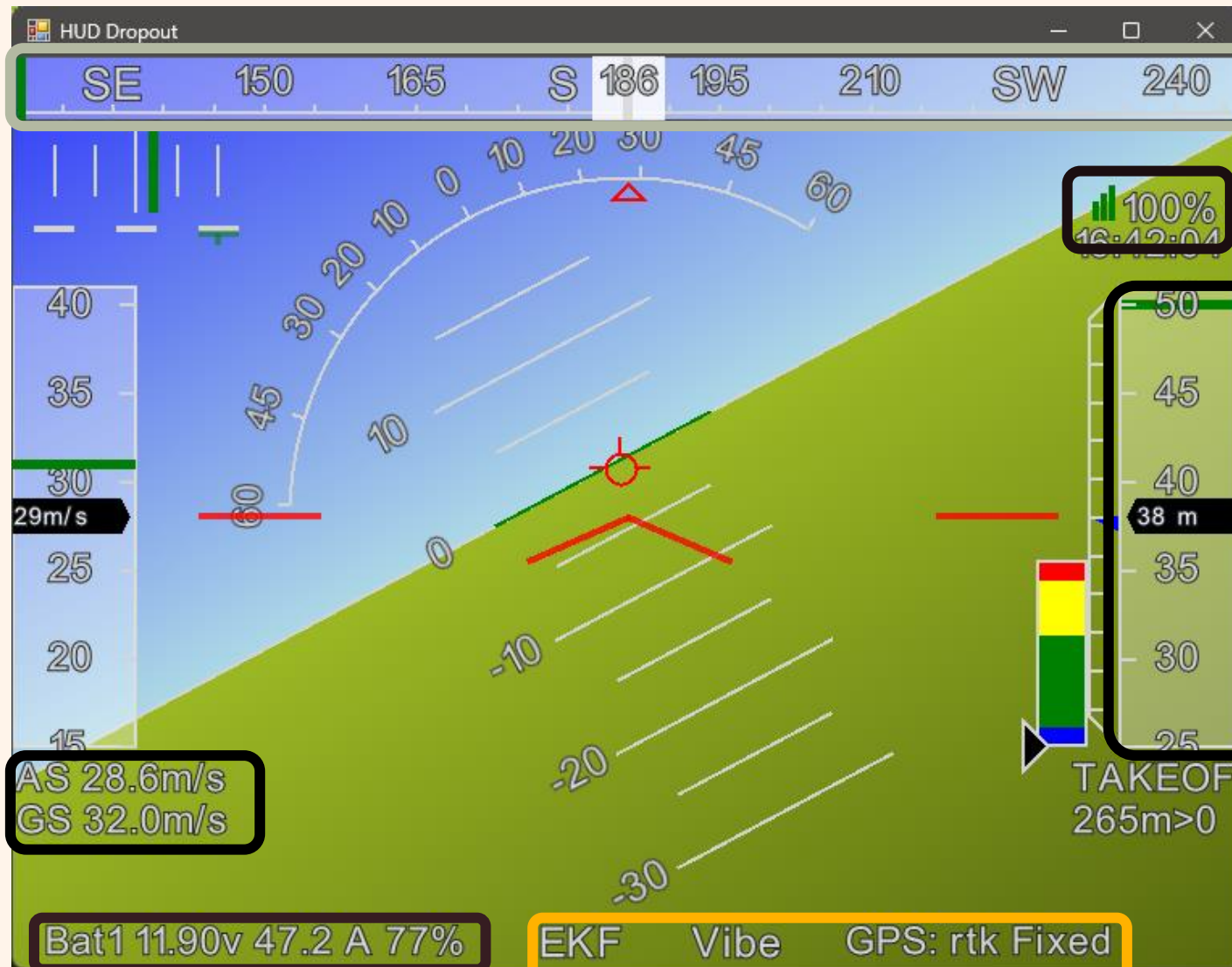• UAV Control Buttons
• Payload Gimbal Controls

Map Display:
• Current Route Waypoints
• Drone Position
• Home Location
• Movement Track

• Data Page

UAV Heading

Received Signal Strength Indicator (RSSI)

Altitude Indicator

Airspeed & Groundspeed

Battery Remaining Percentage, Voltage and Current Draw

Drone Positioning System Status Indicators

- Head's Up Display (HUD)

WildDrone.eu

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Import and Export of Waypoint Files

Upload/Download Mission To/From UAV

Current Mission Waypoint Table

- Planning Page

ardupilot.org/planner/docs/mission-planner-installation.html

- Mission Planner Installation – NOTE: This is an EXTERNAL software – download at your own risk!

Bugfix Parameter File

- meierkilian/ArdupilotIntro
    - Download "Plane.parm"

- https://github.com/meierkilian/ArdupilotIntro

[SITL Waypoint Mission Demo]

Simulation Setup

- Select 'Simulation' from top tab
- In Model, select 'plane'
- Click on the Plane
- Select 'Stable' version
- SITL will download and connect
- Go to 'Plan' tab to create waypoints
- Take off and control from 'Actions' menu
- Quick display menu
- Full status in Status Menu
- Error messages in 'Messages' menu
- ardupilot.org/planner/docs/mission-planner-simulation.html

Waypoint File Structure

```
QGC WPL 110
<INDEX> <CURRENT WP> <COORD FRAME> <COMMAND> <PARAM1> <PARAM2> <PARAM3> <PARAM4> <PARAM5/X/LATITUDE> <PARAM6/Y/LONGITUDE> <PARAM7/Z/ALTITUDE> <AUTOCONTINUE>
```

\<INDEX\> - Unique Index of Waypoint Starting from 0

\<CURRENT WP\> - Equal to 1 if the waypoint is the initial point, 0 Otherwise

\<COORD FRAME\> - Altitude Reference 3 – Relative to Home, 0 – Absolute, 10 - Relative to Terrain

\<COMMAND\> - Numerical Identifier of the "Command" to be performed

\<PARAM1\> - Parameter Dependent on Command

\<PARAM2\> - Parameter Dependent on Command

\<PARAM3\> - Parameter Dependent on Command

\<PARAM4\> - Parameter Dependent on Command

\<PARAM5/X/LATITUDE\> - X Coordinate of Waypoint (Lat.), based on CRF chosen

\<PARAM6/Y/LONGITUDE\> - Y Coordinate of Waypoint (Long.), based on CRF chosen

\<PARAM7/Z/ALTITUDE\> - Z Coordinate of Waypoint (Alt.), in metres

\<AUTOCONTINUE\> - Equal to 1 if the mission should automatically continue to the next waypoint

Mission Navigation Commands

Command	ID	PARAM 1	PARAM 2	PARAM 3	PARAM 4
WAYPOINT	16	HOLD TIME [s]	ACCEPT RADIUS [m]	PASS RADIUS [m]	YAW [deg]
LOITER UNLIMITED	17			RADIUS [m]	YAW [deg]
LOITER TURNS	18	NUM TURNS	HEADING REQ.	RADIUS [m]	
LOITER TIME	19	LOTER TIME [s]	HEADING REQ.	RADIUS [m]	
RETURN TO LAUNCH	20				
LAND	21	ABORT ALT. [m]	LAND MODE		YAW [deg]
TAKEOFF	22	PITCH [deg]			YAW [deg]
LOITER TO ALT	31	HEADING REQ.	RADIUS [m]		
VTOL TAKEOFF	84		HEADING [deg]		YAW [deg]
VTOL LAND	85	LAND OPTIONS		APPROAD ALT. [m]	YAW [deg]
SPLINE WAYPOINT	82	HOLD TIME [s]			

Mission Action Commands

Command	ID	PARAM 1	PARAM 2	PARAM 3	PARAM 4
SET MODE	176	MODE			
CHANGE SPEED	178	SPEED TYPE	SPEED	SPEED [m/s]	
MOUNT CONTROL*	205	PITCH [deg]	ROLL [deg]	YAW [deg]	ALTITUDE [m]
PAYLOAD PLACE	94	MAX DESCENT [m]			
DO JUMP	177	WAYPOINT NUM.	REPEATS		YAW [deg]

Mission Planner Tasks

- Task 1 – SITL Experimentation:
  - Using the SITL simulation. Load a plane.
  - Set the plane's Mode to TAKEOFF and then arm the vehicle.
  - Experiment with enabling and disabling the aileron servo – how does the vehicle behave?
  - Can you disable the rudder as well, but this time using the parameter list?

Mission Planner Tasks

- Task 2 – Waypoint Mission Planning:
  - Using the SITL you already have running, plan a mission which includes Take-off and Landing from the same location, and at least 4 standard waypoints.
  - You should take-off to 40m, and then ascend to 120m by the final waypoint.
  - Consider how you will make the aircraft descend and reach the landing point as accurately as possible

Mission Planner Tasks

- Task 3 – Weather effects
  - Using the SITL you already have running have the plane takeoff and loiter at 100m.
  - Now set these two parameters in mission planner:
    - SIM_WIND_DIR = 60
    - SIM_WIND_SPD = 7.5
  - What do you notice about the loiter circle?
  - Now change SIM_WIND_TURB to 3
  - You should see that the "neat" loiter circle now varies a lot more.
  - Run the same mission you produced for task 2.
  - Reset these parameters to:
    - SIM_WIND_DIR = 180
    - SIM_WIND_SPD = 0
    - SIM_WIND_TURB = 0

Mission Planner Tasks

- Task 4 – Sensor Failures
  - Restart the Plane SITL simulation.
  - Have the plane takeoff to 100m again.
  - Now Set:
    - SIM_GPS_DISABLE = 1
  - What happens?
  - Next:
    - SIM_GPS_DISABLE = 0
    - SIM_RC_FAIL = 1