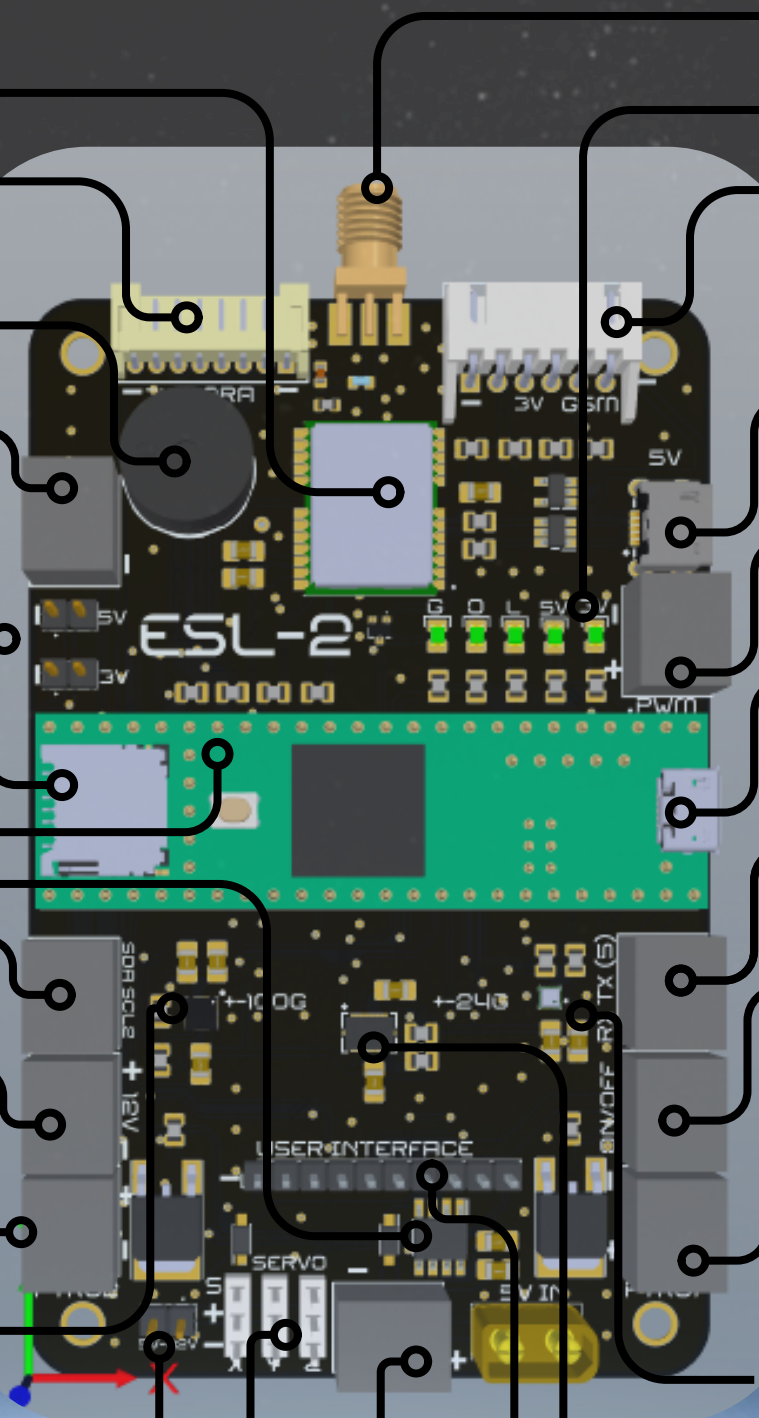
FLIGHT COMPUTER USER GUIDE

HERMES 2.0



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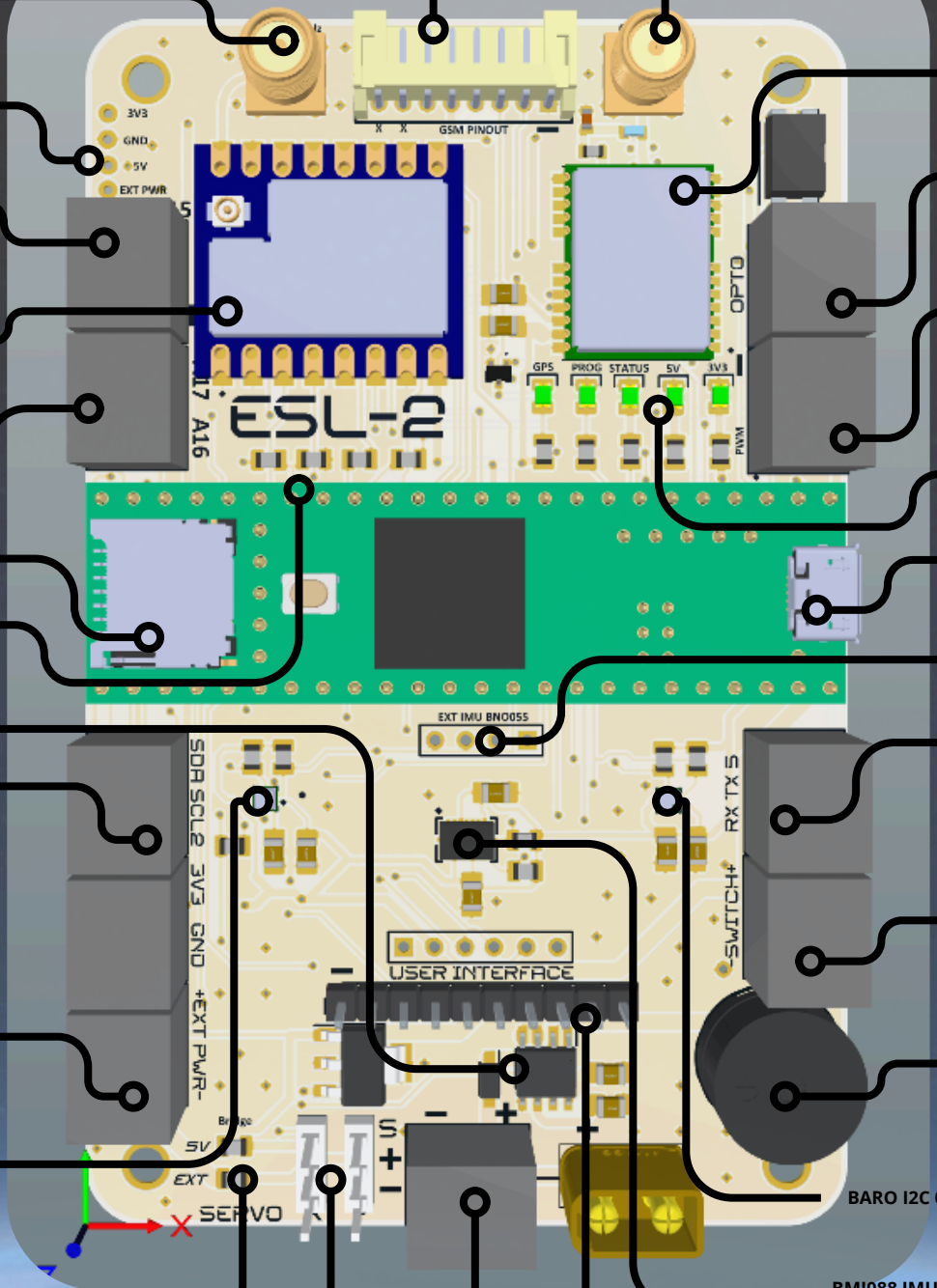
Avionics Team ESL 2023-2024

HERMES 2.1



SIM 800L JST: NC NC GND 5V 3.3V TX0 RX1 (SERIAL 1) GND

LoRa 868MHz SMA antenna port

Testing ports

A15,39

LoRa (Rst 3, Busy 9, RXE 4, TXE 5,Miso 12, MOSI 11, CS 10, SCK 13, DIO1 2)

Analog A17 (41) ,A16 (40)

SD BUILTIN

Voltage Divider (A12, 26)

CURRENT SENSOR (A13, 27)

I2C 2 (SDA 25, SCL 24)

External Power IN (+ -)

BARO I2C 1, SDA 17 SCL 16

Bridge to get EXT Voltage on Servo ports

SERVO Ports (X:11, Y:12, Z:7)

Main Power In (5V)

GPS SMA antenna port

GPS Serial8 (RX 34 TX 35)

OPTO out 22

PWM (14)

LEDs: GPS led, Prog led (6 Status led (15), 5 V , 3V

USB MCU

BNO055 I2C 1, SDA 17 SCL 16

UART 5 TX 20 RX 21

POWER ON OFF

Buzzer 23

BARO I2C 0, SDA 18 SCL 19

BMI088 IMU I2C 0, SDA 18 SCL 19 int ACCEL (5), ADRR ACCEL (0X19), GYR(0X69)

UI pins: launch switch (36), Telem Switch(37), On led (6), telem led (7), launch led (33), Jack (8)

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USE CASE

During the C'space 2024 launch campaign, both of these flight computers were used. Let's see what they are capable of!

Hermes 2.0 was used as the rocket's timer. After detecting liftoff by pulling on the jack port, a counter starts. After 20 seconds, it opens the rocket's nose cone to release the drogue chute, and after about a minute, the main parachute is released. The flight computer does this by controlling a 5V servo and an L298N, which can deliver +12V or -12V to linear actuators. Hooked up to the UI PCB, buttons can set the actuators in a high or low position, allowing the team to handle and set up the mechanisms easily. Another button controls the servo motor, setting it to 180° or 0°.

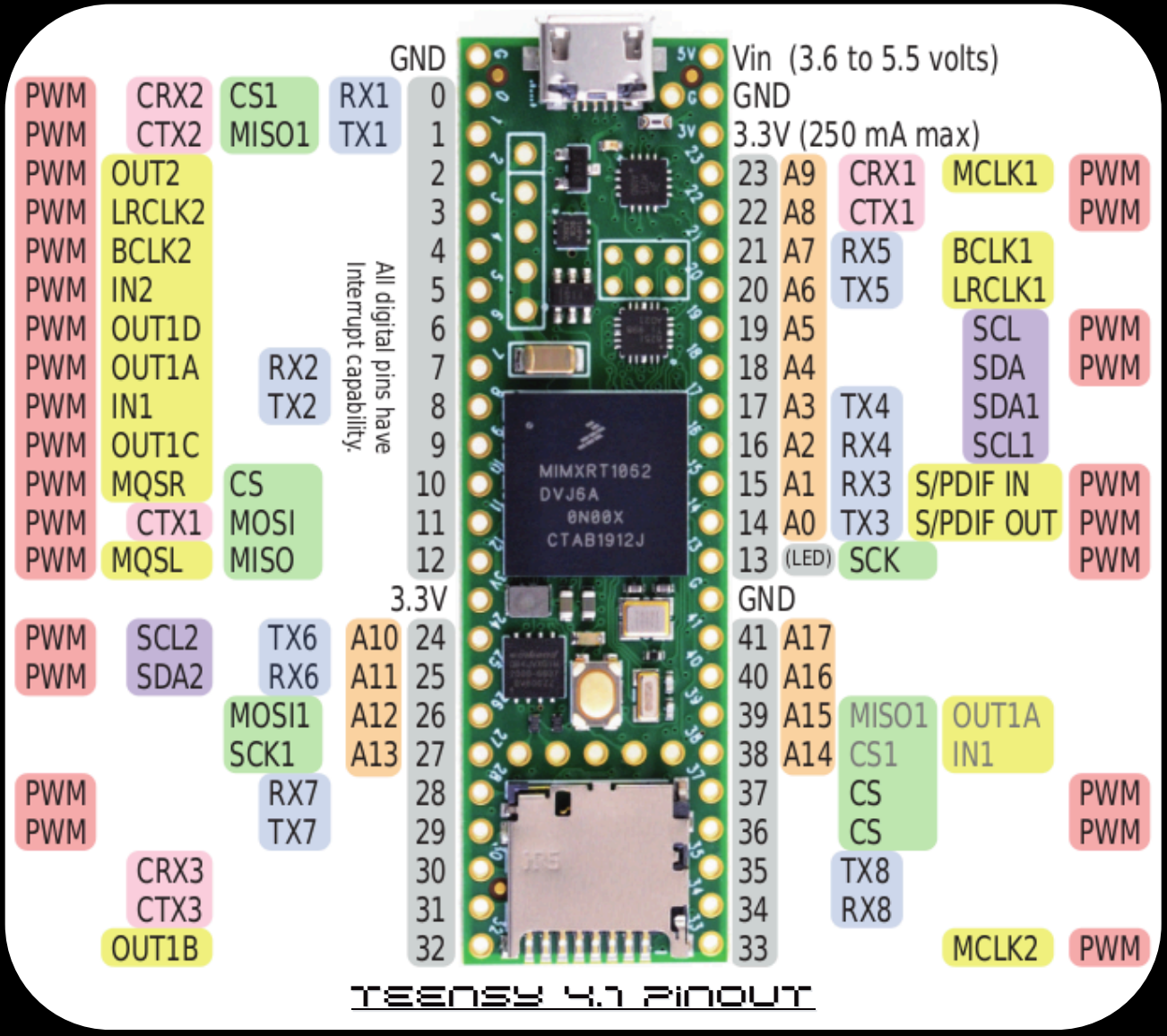
Hermes 2.1 was used for sensor data acquisition, logging data onto an SD card, and sending the most crucial data wirelessly through an onboard LoRa radio.

Common to Hermes 2.0 and 2.1:
- Teensy 4.1 MCU: Clocking at 600MHz, this MCU has 55 input and output pins, 8 serial ports, 3 SPI ports, and 3 I2C ports. The onboard storage allows for large programs, the buitin SD card slot is also very usefull.
- Bosch BMI088 IMU: Provides precise acceleration and gyro readings on the X, Y, and Z axes (±24g).
- BMP388 Barometer: Offers temperature, pressure, and altitude readings.
-*Ublox NEO M9N GNSS: Provides XYZ positioning or latitude, longitude, and altitude.
- ACS712 Current Sensor: Monitors current flow.
- Additional Features: Both boards have a buzzer, LEDs, and a connector to the flight computer UI.

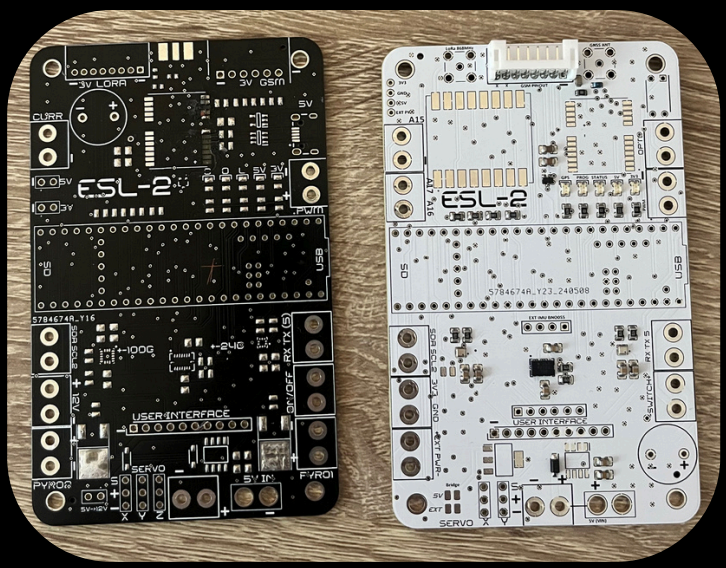
Hermes 2.0 Capabilities:
- Designed to act as a timer, controlling actuators, servos, and pyrotechnic charges.
- Controls:
  - 2 pyro charges
  - 3 servo motors
  - Multiple PWM pins for other uses (L298N)

Hermes 2.1 Capabilities:
- Equipped with two barometers for redundancy.
- Header ports for connecting a Bosch BNO055, which provides 9DOF data acquisition, including magnetometer values.
- LoRa SX1262 radio from Waveshare allows wireless communication on the 869.15MHz frequency, emitting at up to 20dBm, with a range of up to 20km.The Data is then received by the ESL Black Turret.
- Long-term goal of developing a Kalman filter for accurate position tracking.
-SIM800L GSM board header allows us to send 2G messages like GPS position
-Optocopleur for electrical isolation from 2.0 board (C'space reglementation)

PICTURES



TEENSY 4.1 PINOUT



2.0 (BLACK) 2.1 (WHITE)

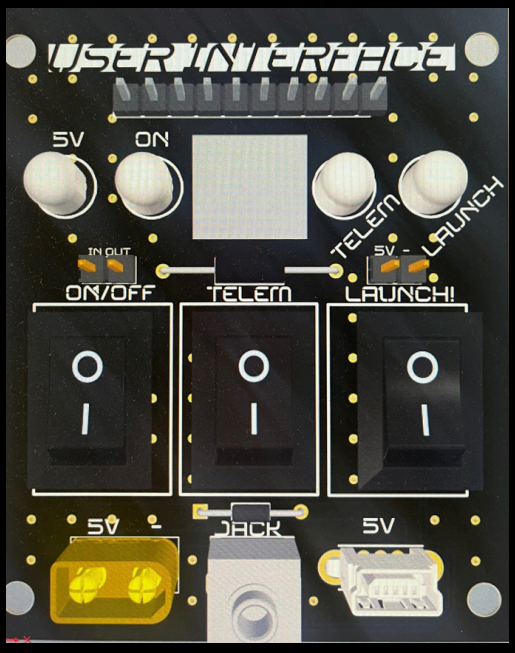
AVIONICS UNIT FOR ESL-2 – HERMES – ESTACA SPACE ODYSSEY

Avionics Team ESL 2023-2024

PICTURES

2.1 EMITTER

BLACK TURRET



USER INTERFERENCE (UI) PCB

ASSEMBLED AVIONICS RACK

AVIONICS UNIT FOR ESL-2 – HERMES – ESTACA SPACE ODYSSEY

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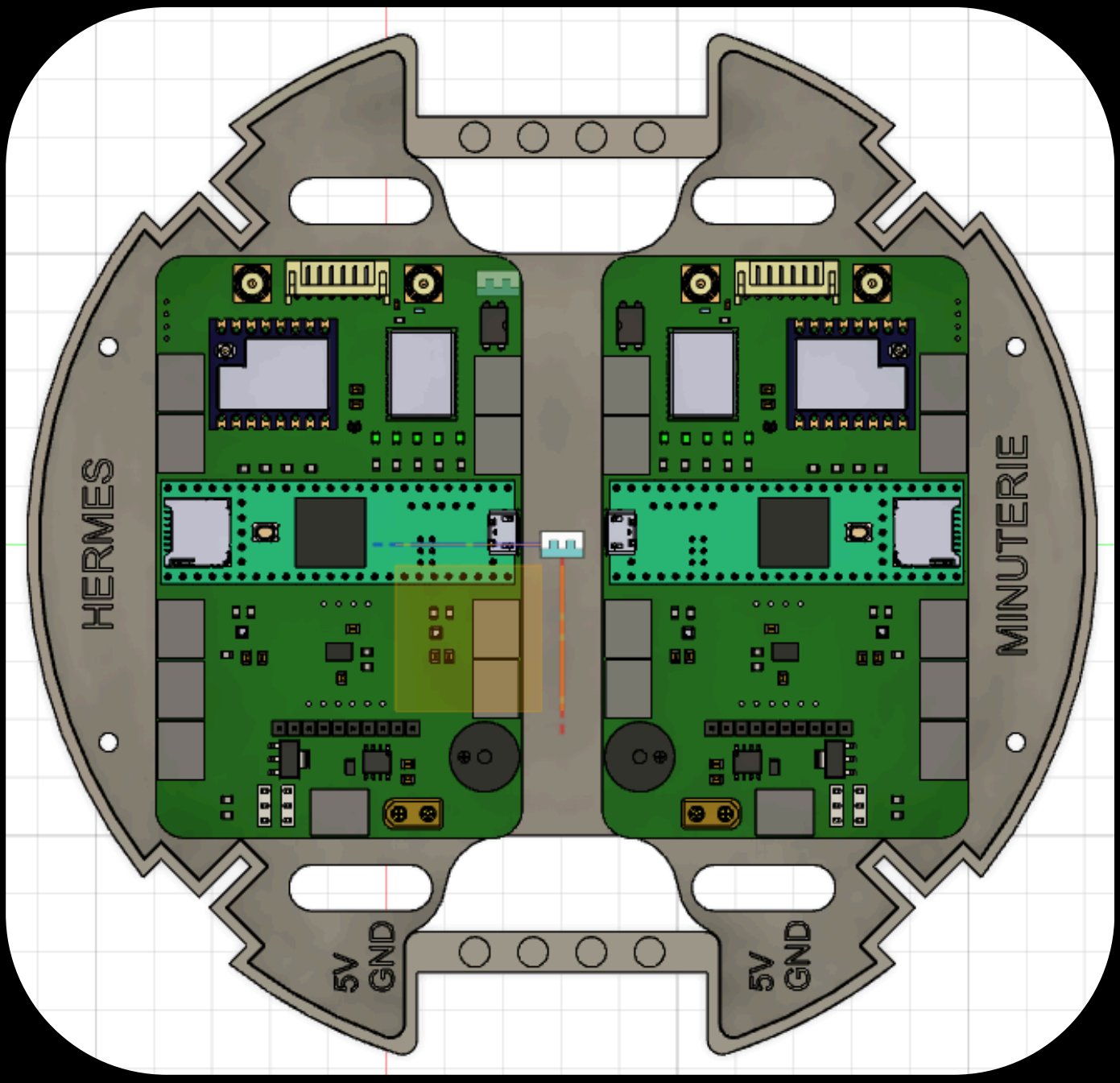
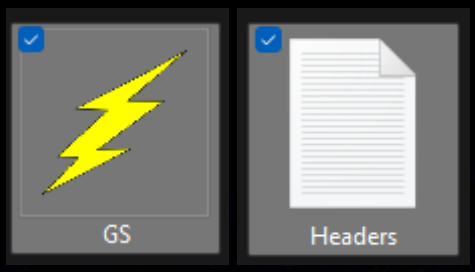
PICTURES



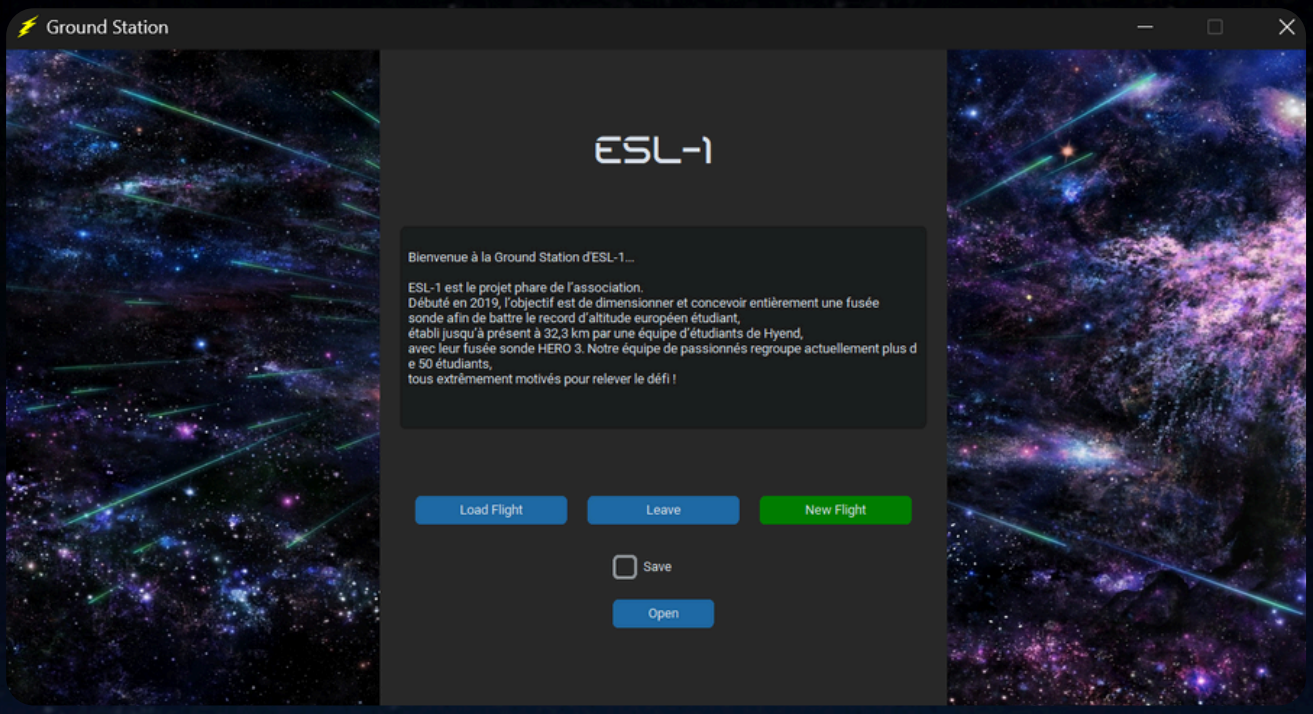
HERMES 2.1 NEXT TO 2.0 INSIDE THE RACK

GROUND STATION USER GUIDE

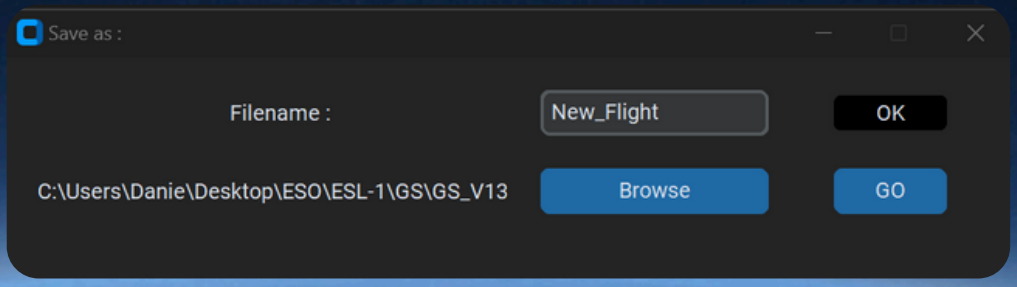


Documents › 2-Programme ESL › ESL-1 › Pôle Avionique › **6_Fabrication**

Download both of theese files (GS.exe, Headers.txt) and place them on your desktop!



After opening up GS.exe click on "New Flight button, check the save box if you want to save your Flight Data onto a .csv file! NOTE: It is preferred to start the program being already connected to the WIFI.



If you've checked the "save" checkbox, write your file name and browse your "save to" file location then click on GO!

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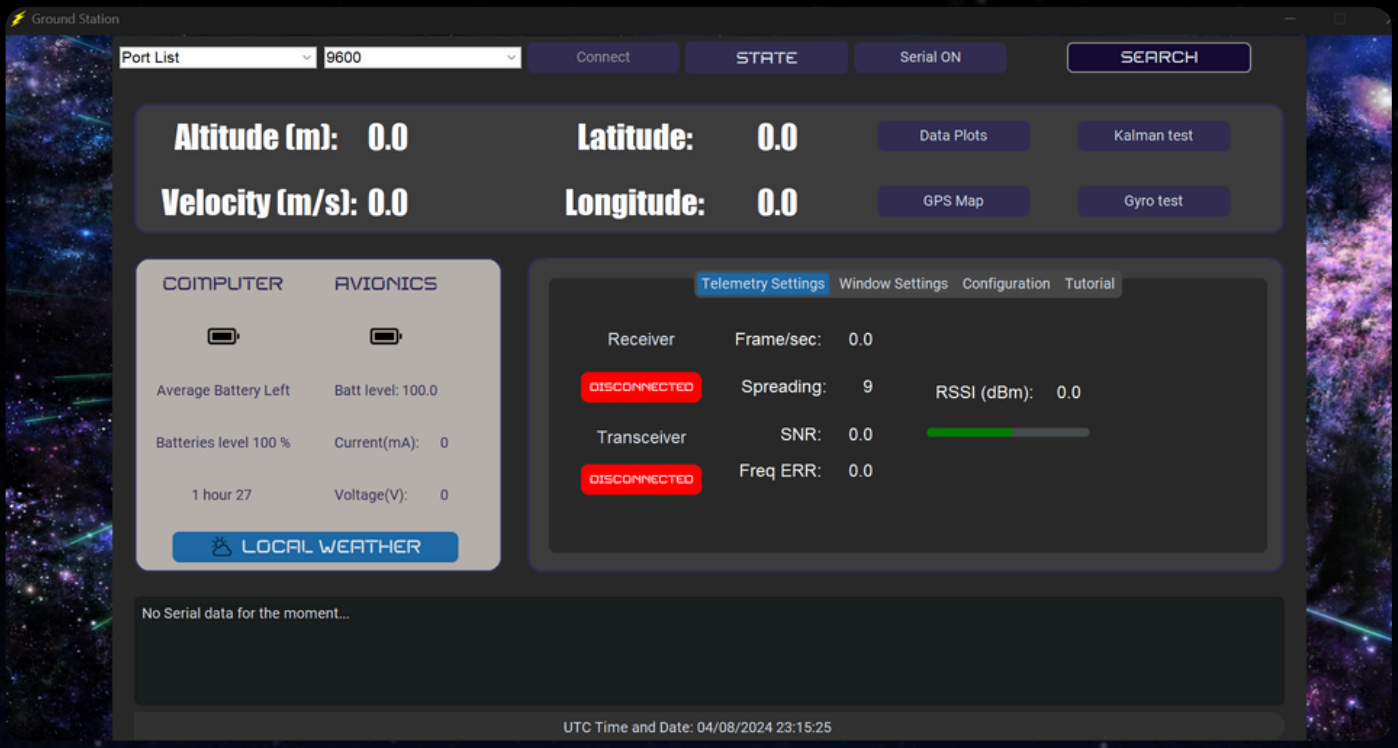
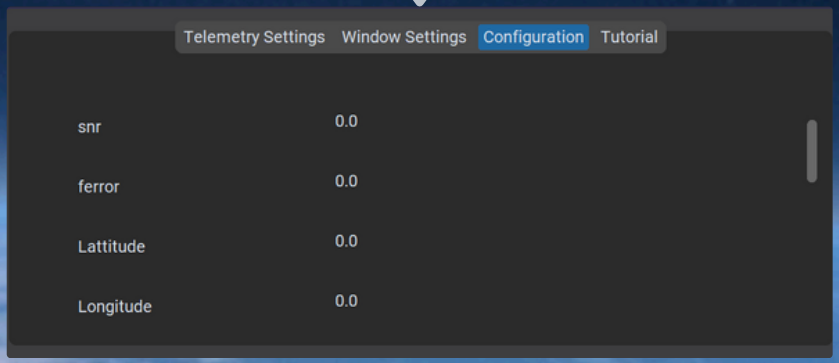
GROUND STATION USER GUIDE



Welcome to the ESL Ground Station! To get started, connect your device via USB, select the port and the appropriate baud rate, then click "Connect" to begin data acquisition.
Ensure your Arduino's `Serial.println` data follows this structure: "Data1XData2X...Data nX1". For example, send: "23.5X1013.3X128X1" for temperature, pressure, and altitude. This allows the program to parse data correctly.
To change header values, edit the `Headers.txt` file with your desired names. Data will be displayed in the Configuration tab.
Enjoy using the ESL Ground Station!

```
rssi,snr,ferror,Lattitude,Longitude,Altitude,acc x,acc y, acc z, gyro x,
gyro y, gyro z,BMP388 Pressure (Pa),Temperature BMP388 (°C), altitude
BMP388 (m),Tension (V),courant (mA),Time stamp (ms), SIV
```



This example HEADER.txt data gives this GS configuration layout for the temperature sensor example the layout of HEADERS.txt would of been in this order: Temperature,Pressure,Altitude

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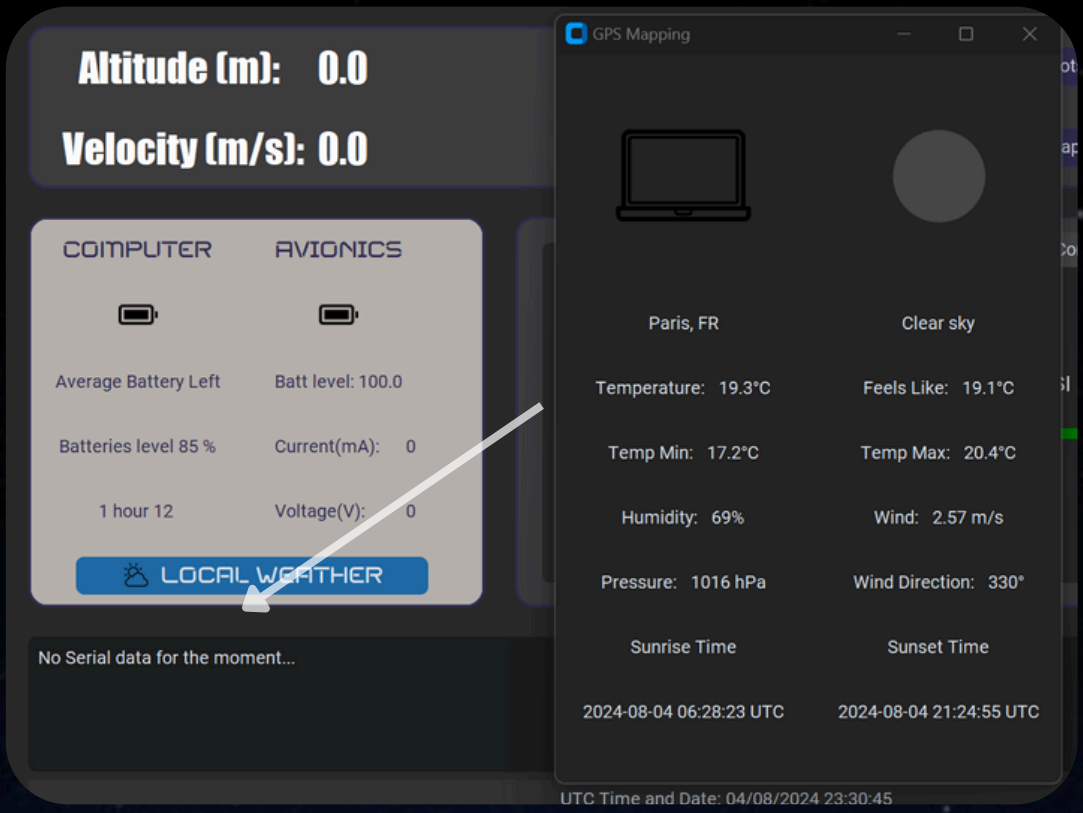
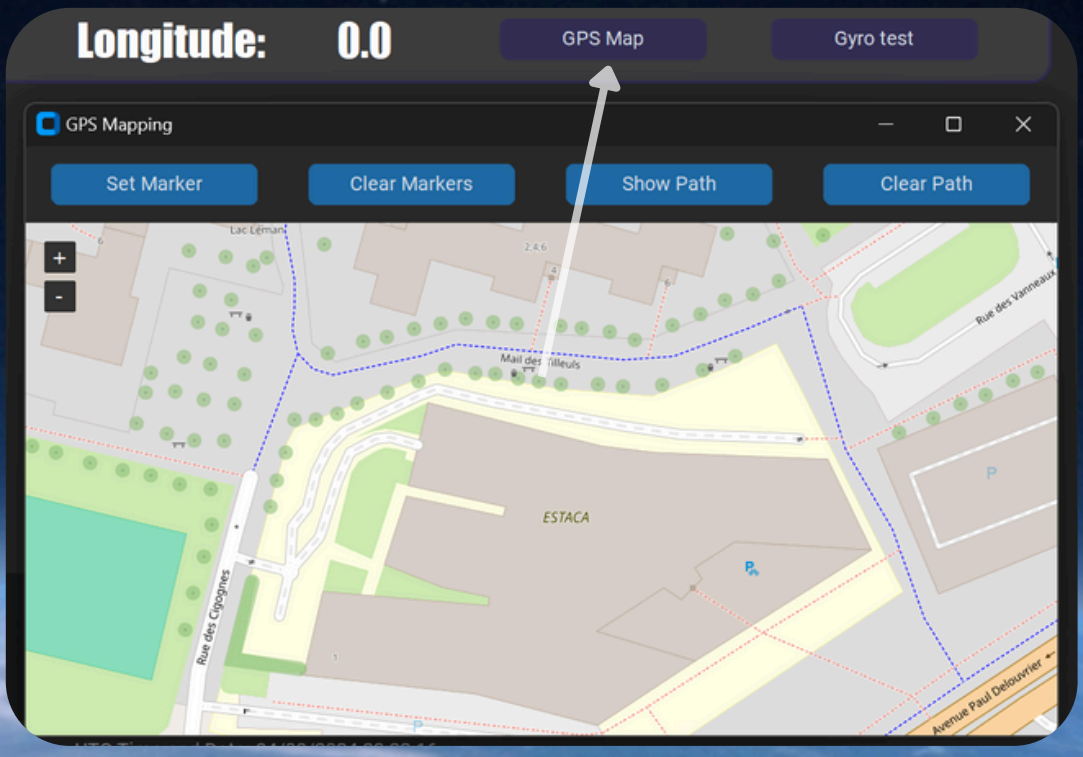
GROUND STATION USER GUIDE



Clicking on this button will give you the weather forcast for the computers location (winds and pressure are important)!



You can get a GPS Map and a path marking option if your GPS data is on the same order as the HEADERS.txt

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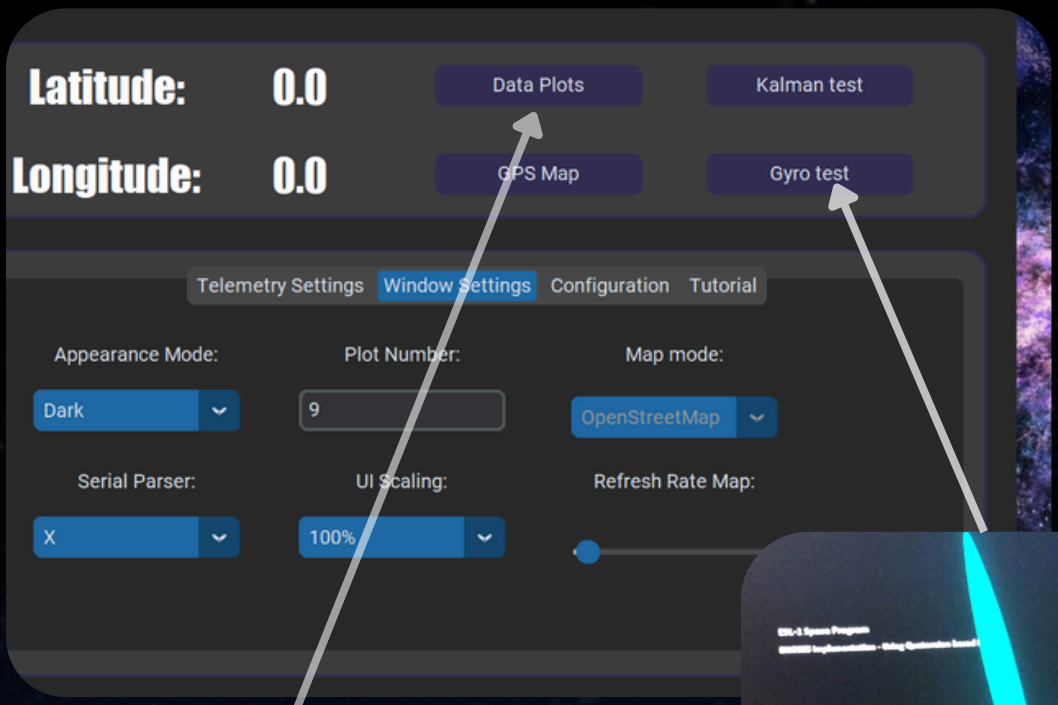
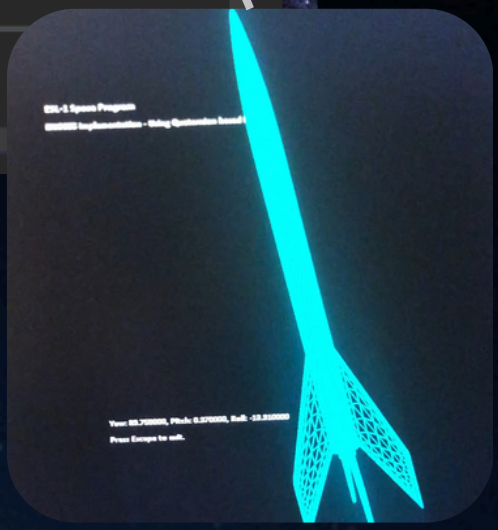
GROUND STATION USER GUIDE





If you click on "Gyro Test" you can see in real time the orientation of your BNO055 sensor. By moving the sensor you can move the 3D rocket!

If you click on "Data Plots" you can see in real time the Data being plotted on this window! NOTE: This is recommended for Testing the sensors only, it will shutdown the main GS window closing the saving file!

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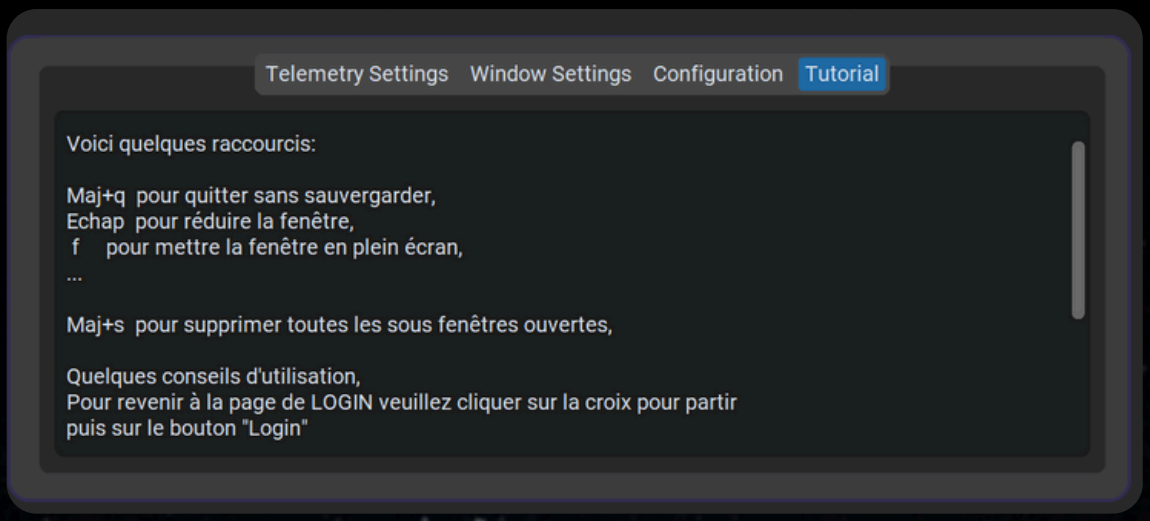
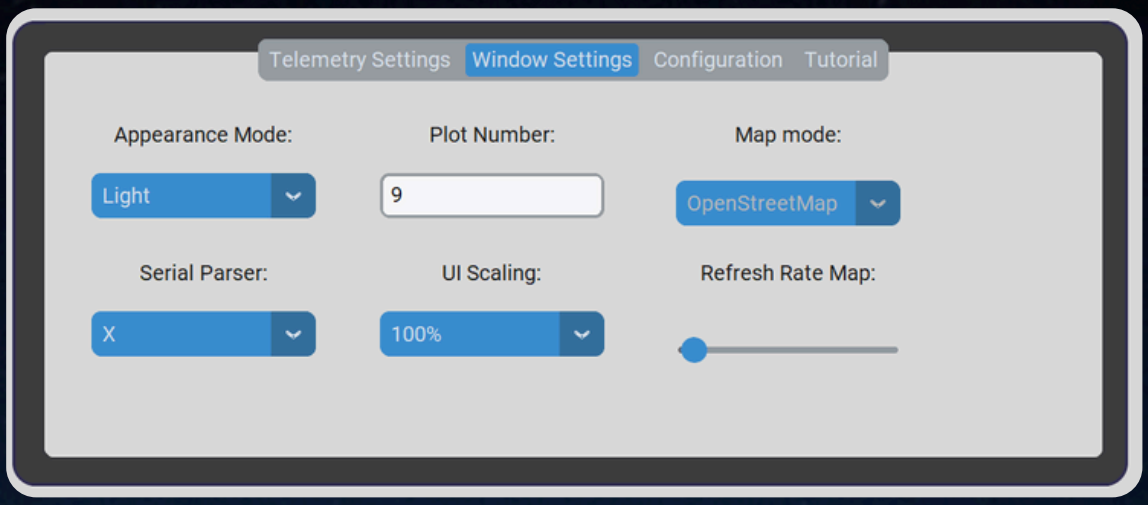
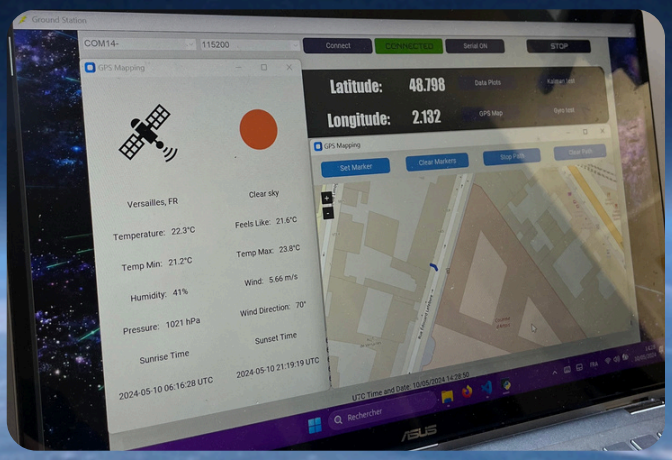
GROUND STATION USER GUIDE

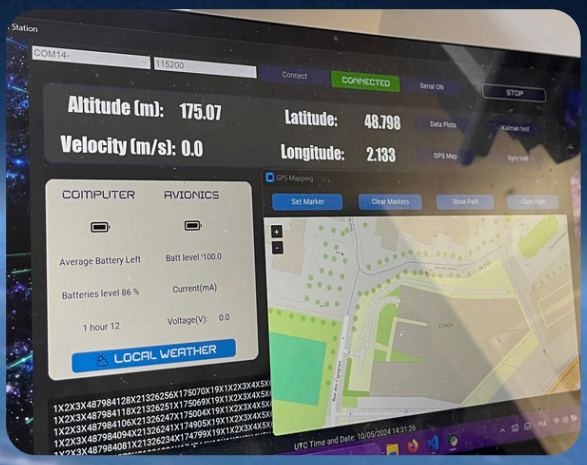


Under the tutorial tab you can find a tutorial text showing how to use shortcuts and other fun hacks!



Under the Window Settings tab you can change appearence mode, map mode (google satellite is pretty cool) and other settings





GS being used !

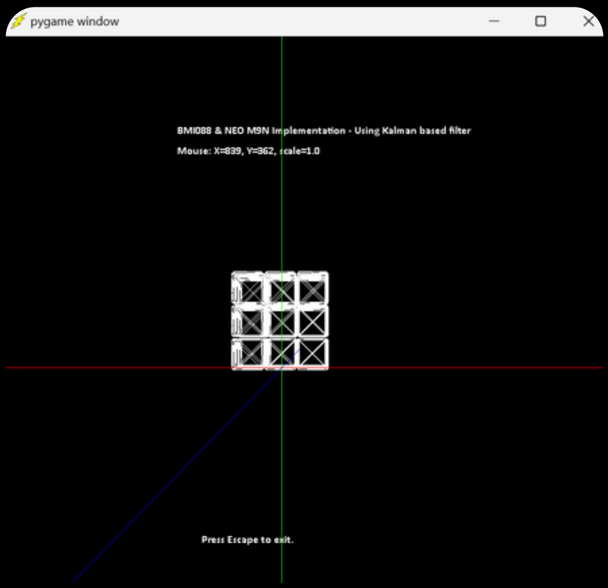
Avionics Team ESL 2023-2024

GROUND STATION USER GUIDE

I coded the ESL ground station as a member of the ESL-1 Avionics team. Written in Python, it was tested during C'space 2023 and 2024, performing flawlessly on both occasions. This tool is also useful for testing flight software and verifying sensor data.

The program uses the CustomTkinter library, a modern version of Tkinter (a graphical user interface library for Python). It utilizes the Serial library to read incoming data and connect to the MCU, and threading to perform tasks simultaneously while reading data. For example, this allows the GPS map to open while data is being read. The ground station is still a work in progress, and since I learned to code as the project developed, the codes quality is varied.

If you'd like to look at the code, it's in the same folder as the rest of the project files. Feel free to suggest any features you'd like to see added to the GUI. The next planned feature is a window displaying a floating cube, intended to show real-time position tracking from our future Kalman filter!




Main:
def __init__(self):
self.root.title("Ground Station")
self.root.iconbitmap(current_path + "/image, obj and fonts/logo_2.ico")
self.root.geometry("1300x650+0+0")
self.root.resizable(False,False)
#self.root.wm_attributes('-fullscreen', True) # This just maximizes it sc
self.main_font=('Impact',20)
self.state = False
print("\nStarting ESL-1 Ground Station -- Author: Daniel Devy -- for the
for i in range(25):
print("█" ,end = " ")
time.sleep(0.05)
print(r"100% COMPLETED")
print(r"""
""")
self.bg_image = ctk.CTkImage(Image.open(current_path + "/image, obj and fo
self.bg_image_label = ctk.CTkLabel(self.root, image=self.bg_image)
self.bg_image_label.grid()