Sensors & Sensing Lab 4

Andrey Yanov and Elina Murtazina

March 12, 2025

You may see the code for this lab on GitHub via link and link

Abstract

In this lab, we explored the integration of the MPU-9250 IMU sensor with a microcontroller via the I2C interface. We calibrated the magnetometer, accelerometer, and gyroscope to improve measurement accuracy. An algorithm was developed to compute Yaw, Pitch, and Roll angles, which were tested by attaching the sensor to a BLDC motor and observing rotational behavior along different axes.

1 Topic

Study of IMU sensor and determination of Yaw Pitch Row angles.

2 Purpose

- To connect to the IMU sensor via I2C interface and receive data.
- To calibrate the magnetometer, accelerometer and gyroscope inside the sensor.
- To conduct experiments and estimate angles using motor.

3 Description of the sensor application

IMU sensors such as the MPU-9260 IMU module is a 9-axis Motion Processing Unit for smartphones, tablets, wearable sensors, and other consumer markets.

- Robotics: For navigation, stability control, and motion tracking in autonomous systems.
- Virtual Reality (VR): To track head movements and enhance immersive experiences.
- Consumer electronics: This exact model was created for usage in smartphones, tablets, wearable sensors, and other consumer markets.

4 List of used equipment

- Arduino R3 UNO (Aliexpress, Datasheet)
- MPU-9250 IMU module (Documentation)
- CANable (Original)(Shop, Datasheet)

5 Description of experiments

1. **Connecting the electric circuit:** We connected MPU-9250 to Arduino UNO in such way so it would answer the standarts of I2C. That means that VCC was connected to 3.3V (as Operating Voltage of a module is 1.71 – 3.6), GND - GNG, SCL/SCLK was connected to pin A5 as it is Serial Clock Line, and SDA/SDI is connected to A4 as it is Serial Data Line, both of them can be used specifically in case of I2C communication. The motor was connected as usual, through CANable and connected to a power supply. Pictures will be attached below.
2. **Writing the program:** We wrote the code with use of specialized libraries for our IMU sensor and applied some of filters, allowing us to get more "clear" data. Unfortunally, we could not get results from the magnetometer since the system stated that it is out of response. You can see the code at link
3. **Calibration:**
4. **Yaw Pitch Row angles with motor:**

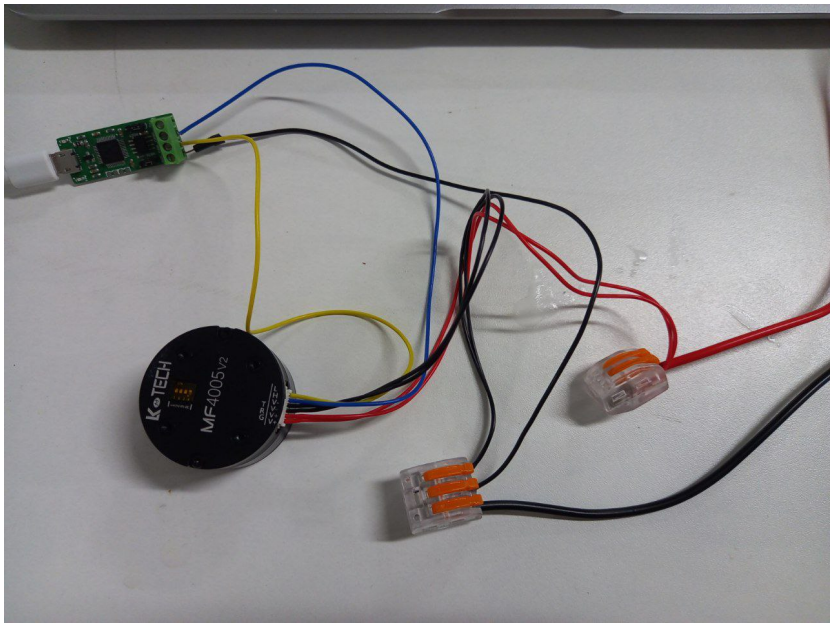

Figure 1: Connection of the motor

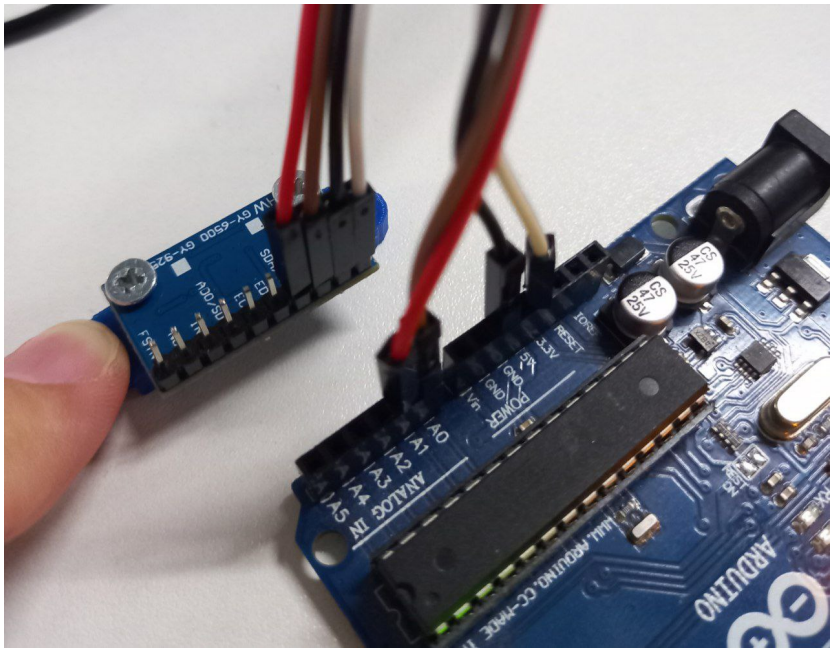

Figure 2: Connection of pins on the Arduino UNO

6 Description of the results of the experiments

Unfortunally we couldn't perform experiments since we couldn't get data from magnetometer, and it's role is to determine the orientation of an object with respect to a magnetic field. It also plays a role in determining the information about the angle of yaw.

7 Answers to questions

> Question: Were correct rotation values obtained in all axes? Which axes did not succeed? Why?

Answer: in our solution, the yaw did not succeed due to miscommunication with the magnetometer.