Li-Gyro Source Code

I. File list

Table 1 Li-Gyro file list

檔名	內容
Li-Gyro.ino	Main file (which controls main execution flow)
Options.h	Option file (which provides log option settings)
Motor.h	Header file of Motor.cpp
Motor.cpp	Code for DC motor and servo control
PID.h	Header file of PID.cpp
PID.cpp	Code for PID control unit
Sensor.h	Header file of Sensor.cpp
Sensor.cpp	Code for MPU6050 operation

Table 1 shows file list of Li-Gyro. The files are categorized based on their functionalities for the sake of readability. The operation of each file is described in the following chapters.

II. Li-Gyro main function

In setup stage, Li-Gyro enables softAP mode, and initiates motors and MPU6050. Then, it waits for connection request from smartphone with V7RC installed. When waiting for connection request, Li-Gyro suppresses throttle control and sets servos to 90 degrees for the sake of safety. After connection has been established, Li-Gyro enters a loop of the following control steps.

1. Read MPU5060 status to derive aircraft orientation, including roll, pitch and yaw;
2. Receive V7RC command sent from smartphone with V7RC installed. V7RC command should follow V7RC protocol. A V7RC command has "SRV" initial, which is followed by 8 channel commands. For example, it looks like SRV15001500150015001500150015001500;
3. Calculate the desired roll, pitch, and yaw based on the V7RC command received in the previous loop;
4. According to the results obtained from Step 1 and Step 3, calculate the errors in roll, pitch, and yaw between the current aircraft orientation and the desired orientation. The errors are

used to further compute the compensated control in roll, pitch, and yaw based on the given PID parameters. The compensated control aims to pull the aircraft back to the desired flying path;
5. Use the results obtained from Step 3 and Step 4 to mix the final control commands of the DC motors and the servos on Li-Gyro flight controller;
6. Submit the final control commands to the DC motors and servos;
7. Feed the V7RC command received in the current loop to PID control unit, used as input parameters for the next loop.

III. Motor functions

In the setup stage, Motor initiates DC motor and serve configuration. Moreover, when motor_control is invoked by the main function, it configure the commands to control the DC motors and the servos on Li-Gyro flight controller.

IV. PID control unit

PID provides the functions that Li-Gyro requires to execute the calculations at Step 3, 4, and 7.

There are three PID control samples provided in the code, including two DC motors (differential thrust) RC aircraft, two DC motors (differential thrust) RC hovercraft, and one DC motor fixed wing RC aircraft. That is,

- Two DC motors (differential thrust) RC aircraft: the concept for the settings is to add desired throttle control to both motors first. Then, desired yaw control is added/subtracted to both motors based on direction control. Finally, PID yaw control is added/subtracted to both motors (which aims to make aircraft stick to the desired flying path);
  - m1_command_scaled = thro_des + yaw_weight * (yaw_des/maxYaw) + yaw_PID;
  - m2_command_scaled = thro_des - yaw_weight * (yaw_des/maxYaw) - yaw_PID;
  - s1_command_scaled = 0;
  - s2_command_scaled = 0;
- Two DC motors (differential thrust) RC hovercraft: the concept for the settings is to add desired throttle control to the central DC motor (which is used to float the hovercraft). Then, using desired

pitch control to give a forward/backward command to the two motors on the hovercraft. Finally, PID yaw control is added/subtracted to both motors to compensate the bias from the desired moving path; (It is noted that the two motors on the hovercraft should connect to the servo ports of Li-Gyro flight controller via brushed motor escs to allow clockwise or counterclockwise rotation control)

- m1_command_scaled = thro_des;
- m2_command_scaled = thro_des;
- s1_command_scaled = (pitch_des/maxPitch) + (yaw_des/maxYaw) + yaw_PID;
- s2_command_scaled = (pitch_des/maxPitch) - (yaw_des/maxYaw) - yaw_PID;

➢ One DC motor fixed wing RC aircraft: the concept for the settings is to add desired throttle control to the DC motor for speed control. Then, desired yaw control is added to the rudder, which is compensated by PID yaw control. Finally, desired pitch control is added to the elevator, which is compensated by PID pitch control.

- m1_command_scaled = thro_des;
- m2_command_scaled = thro_des;
- s1_command_scaled = (yaw_des/maxYaw) + yaw_PID;
- s2_command_scaled = (pitch_des/maxPitch) - pitch_PID;

V. Sensor unit

In the setup stage, Sensor initiates and calibrates MPU6050. Then, in each control loop, it derives aircraft orientation for Li-Gyro to perform PID control.