Maestría en Ingeniería en Automatización de Procesos Industriales

PID control experimental for elevation control

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1. Introduction

The robots or unmanned flying vehicles (UAV) are gaining more and more interest due to a wide area of possible applications. While the UAV market has been boosted for the first time by large and expensive military and UAV applications, recent results in miniaturization, mechatronics and microelectronics also offer huge potential for small and inexpensive Micro-UAVs for commercial use [1].

UAVs are a class of aircraft capable of performing missions autonomously or semi-autonomously. Currently there is a wide variety of this type of aircraft, which are classified mainly into three types according to the structure they have: fixed wing, swing and rotary. [2]

Antecedent

This work gives continuity a stability control implemented on a test bench. The instrumentation was made using two brushless motors [3].

2. Objectives

2.1. General objective

Implement a motion control for a quadrotor type drone

2.2. Specific objectives

- Implement a translation control on the x axes, and to give mobility to the drone.
- Test the developed roll and pitch controls to put the drone in space.
- Adjust stabilization control for the takeoff of the robot on the roll, pitch and yaw axes.

3. Methods

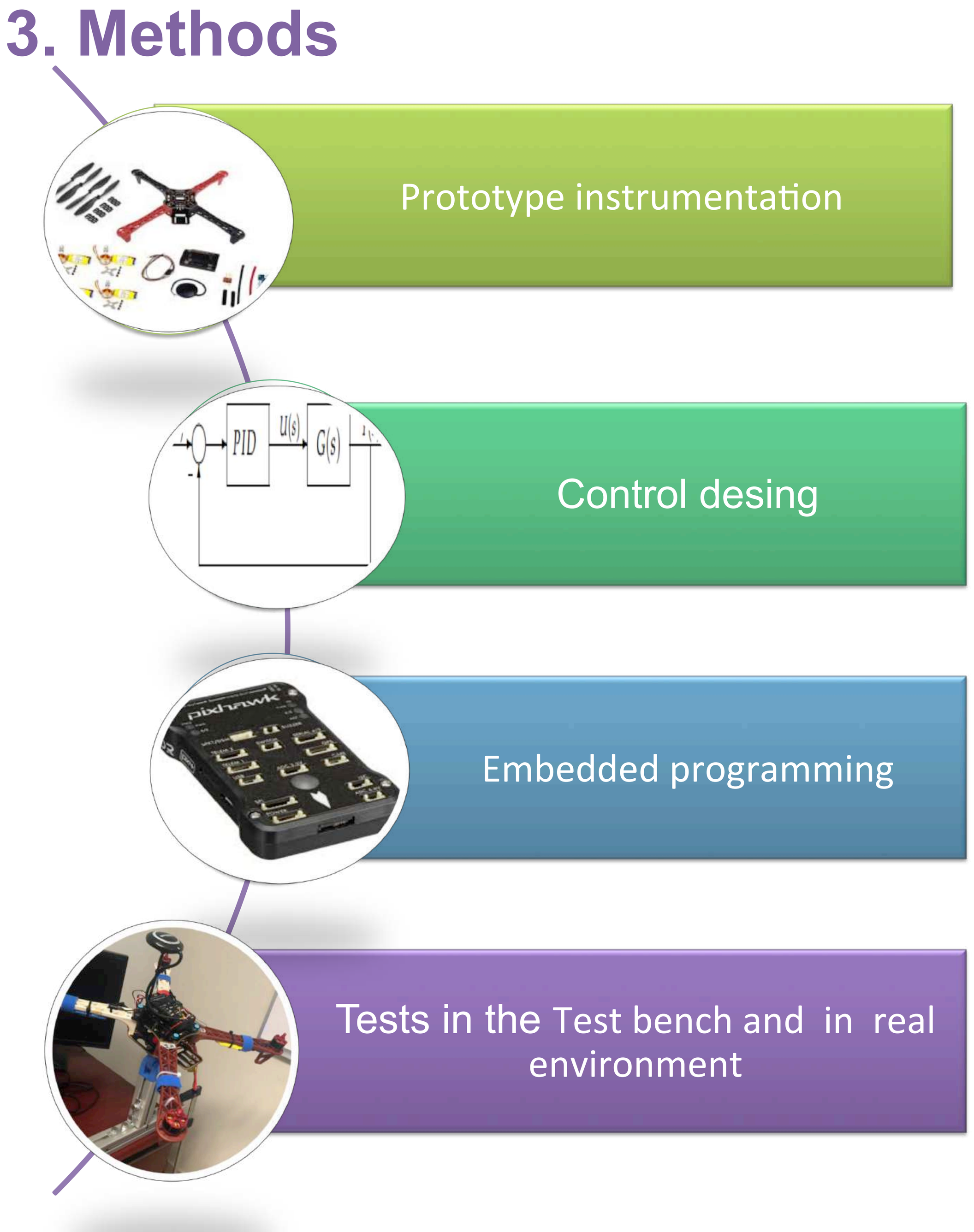

Figure 1. Methodology used in this research.

Motor-order

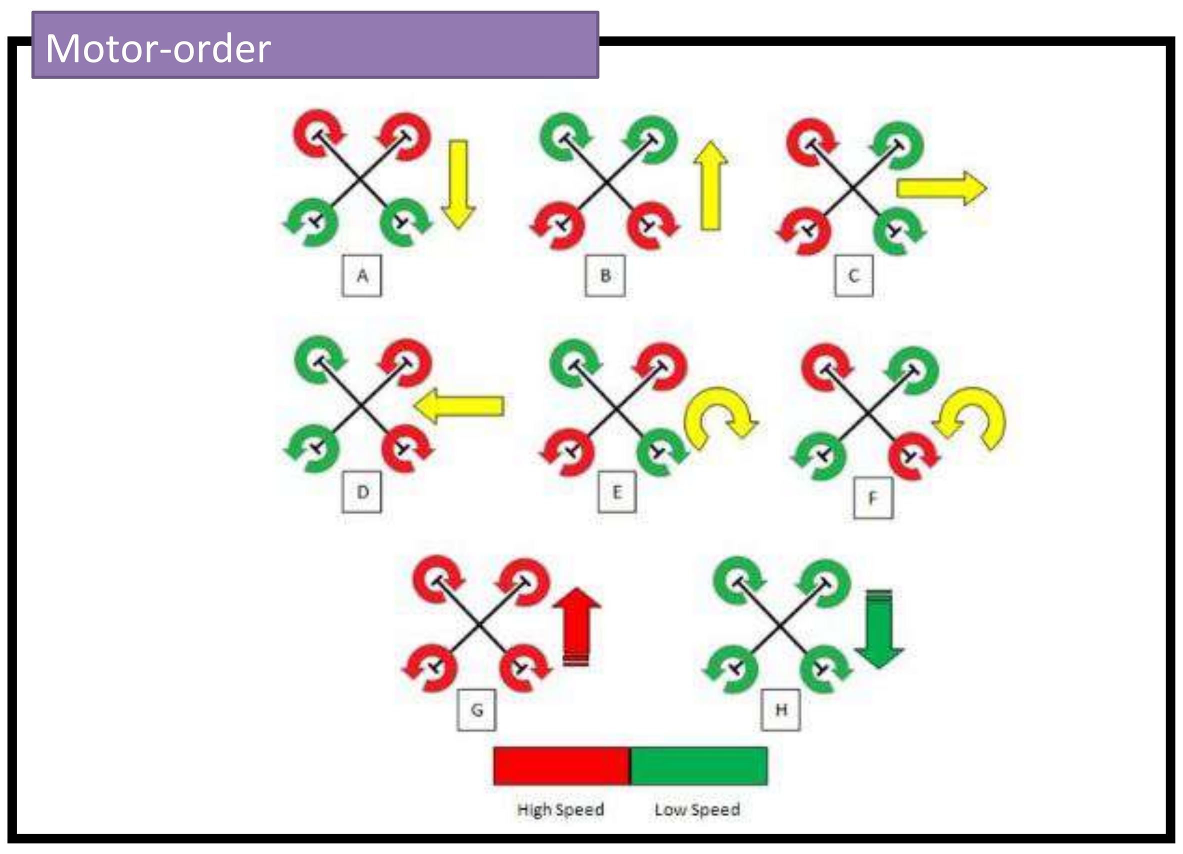

Figure 2. Configuration of quadrotor type X , the motors have propellers counterclockwise or clockwise , its have a specific position in the quadrotor

Control

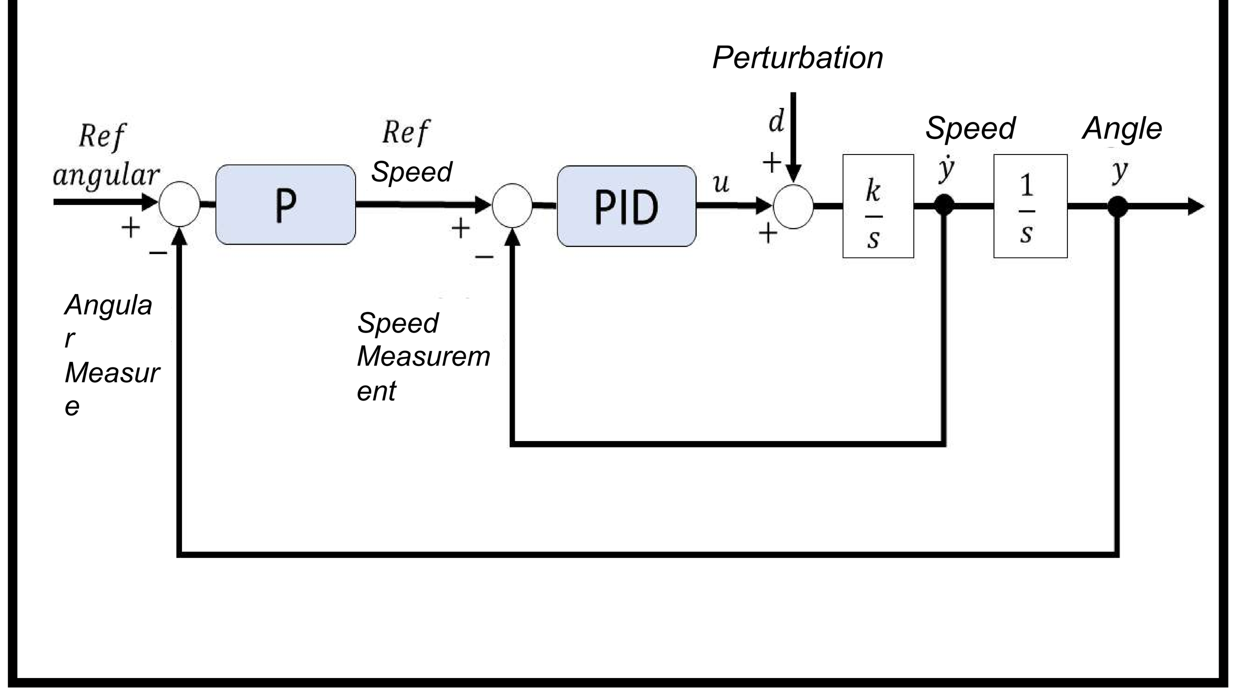

Figure 3. Orientation control of the Pixhawk.

To a takeoff we need a desired position, which will be measured with the inertial unit of measure, with this we can give motions to the motors thanks to the PID, the configuration is quad X (figure 2) with brushless motors clockwise and counterclockwise, the PID will define the pwm of the motors to drive the output, and feedback with the inertial unit this will tell us the current angle

Test Bench

Figure 3. This is a test bench were implemented to support the drone and make the test

To test the control proposals, it is important to have an environment in which the results can be verify, for this reason a test bench was build. In this test bench the quadrotor can be mounted and also allows two pitch and roll movements and test of stability. The test bench was designed in CAD software (Solidworks).It is shown in Figure 3.

4. Results

Figure 4. Takeoff test outdoors with acceptable weather

1. The instrumentation was completed calibrate the esc for the rest of the brushless motors
2. Add PPM Encoder to Pixhawk card to add radio control
3. Motor controller tests (figure 2)
4. Selection of first control (Figure 3)
5. Desing and implementation for test bench (figure 4)
6. Experimental controlled test on the bench
7. Enviroment tes for drone (figure 5)
8. Battery consumption analysis

Battery consumption analysis

According to the total energy consumption of the elements included in the quadrotor is 35.323A, the following equation (1) is proposed

$$t=(A_{bat})*(h_{vuelo})/A_{cuad} \qquad (1)$$

Where A_{bat} is the amperage of the battery to be used, H_{vuelo} is the equivalent of one hour in min and A_{cuad} is the energy consumption of the quadrotor. For this particular case the calculations are made for a battery of 5200mha = 5.2A, so substituting the values in equation (2) we obtain:

$$t=(5.2A)*(60min)/35.323A=8.84\ min \qquad (2)$$

5. Conclusion

The project has an advance in each of the specific objectives of the project, however the objectives of the pitch and roll movements are in development since both are held by the hand, the part of the takeoff is ready and tested in the test bank. The test bench works well and allows mobility for the pitch and roll movements.

Acknowledgements

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