Lab 2

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<u>In Lab</u>

Question 3.1)

The barometer is not very accurate when it comes to estimating absolute altitude. Just a few moments after calibration, its readings begin to drift. In addition, air pressure is not constant in all places across altitudes, so the absolute measurement is not always going to be spot on. It can approximate the altitude (and by a quick calculation, also the vertical speed) but it is really sensitive; especially indoors. A tiny change in air pressure from a door or window being open, or the air conditioner being turned on, could cause the quadcopter to think it is moving and thus change its throttle speed. This makes a barometer a bad option for estimating altitude indoors. When it comes to estimating the vertical velocity, a barometer is likely going to be slightly better but still not very accurate. This is because it only relies on a change in pressure to calculate vertical velocity, which the barometer can do quite accurately because it happens very quickly, so external factors are less likely to impact its readings. However, because when you are flying indoors you are typically flying at low altitudes, therefore not having very much change in altitude at once, the barometer may have a hard time detecting such slight changes in air pressure from such a small altitude difference, so still not be the most accurate.

Checkpoint 1)

Checkpoint 1. (3 points) Ask your instructor to help you setup a joystick on Mission Planner and double check your setup before proceeding. ERS

Question 3.2)

It took a couple of seconds to take off and then, as it left the ground, it started to spin drastically for a few moments until steading and lifting to its target altitude. The quadcopter attempted to stay at a fixed altitude, and it looked like it was approximately 30 cm, but it oscillated quite heavily as it hovered. After further testing, however, we noticed that the quadcopter wasn’t stable, sometimes it would stay at around 30 cm, other times It would move up and down uncontrollably.

Question 3.3)

The quadcopter took off after a few moments much like with the barometer, however it did not spin out this time. It reached its target altitude, pretty close to 30cm, in about the same amount of time, however it stayed much closer to this target altitude while it hovered than with the barometer sensor.

Checkpoint 2)

Checkpoint 2. (3 points) Show the collected flight data logs to your instructor. EBS

Question 3.4)

500 Samples / 200 samples/second = 2.5 seconds

Question 3.5)

Kp = 2.5
Ki = 1

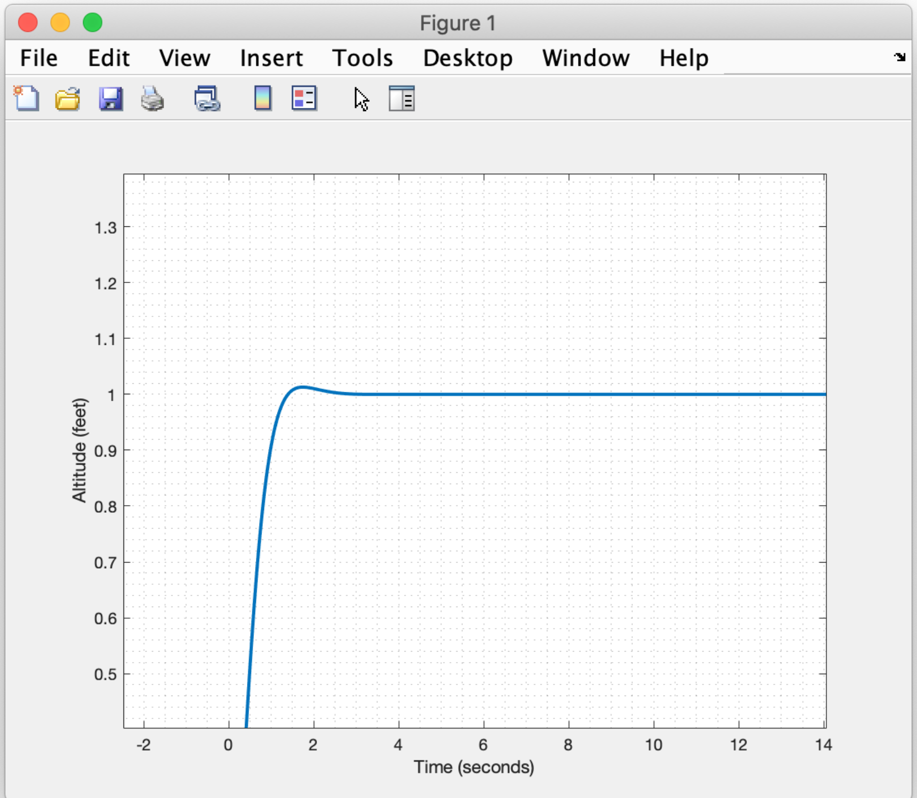
Checkpoint 3)

Checkpoint 3. (4 points) Show your instructor how you can achieve a fast and smooth take-off with your optimized parameters. ERS

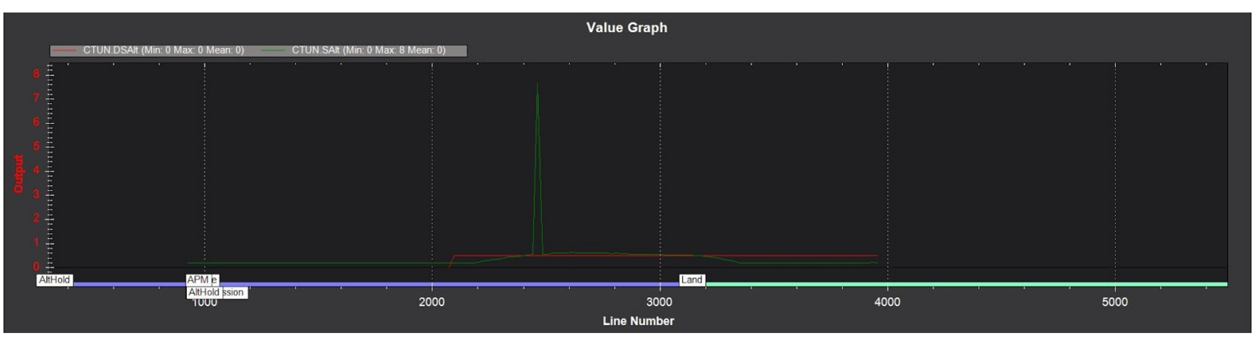
Question 3.6)

Overshoot = 1.3%
MatLab Kp1 = 1.9
Final Kp1 = 1.9
It took the quadcopter only about 300 samples, or 1.5 seconds, to reach its target altitude.

Post Lab



Question 5.1)



One similarity between the two graphs is that it takes the quadcopter about 1.5 seconds to reach its maximum altitude in both the simulation and in our actual test. Another similarity is that the quadcopter slightly overshoots its target altitude and then drifts back down. One difference is that in our actual test, it took the quadcopter longer to settle to the actual target altitude than in the simulation.

Question 5.2)

Overshoot is when, in an attempt to quickly change altitude, the quadcopter accelerates so quickly it exceeds the specified target. Steady-state error is the difference between the actual value and the specified target value when the system is at a “steady state”. For example, if the target altitude is 30 cm and the quadcopter is hovering consistently at 29 cm, there is 1 cm of steady-state error.

Question 5.3)

One situation where a barometer does not provide an accurate estimate of the altitude is when you are indoors and/or flying at low altitudes. Air pressure indoors can fluctuate greatly due to changes from vents or windows, and these changes can affect the barometer’s reading of altitude. In our lab, for example, just a few moments after calibrating the barometer, its readings began to drift which shows its estimate indoors is not entirely reliable. Also, you are likely flying at lower altitudes indoors, and the barometer has a hard time detecting very small changes in altitude.

On the other hand, a situation where you would want to use a barometer instead of a downward-facing proximity sensor to get an accurate estimate of the altitude would be when you are outside and lots of people/animals are walking under the sensor, allowing for almost no stability. Also, facing only downwards also means that the proximity sensor has a limited range compared to the barometer. So using a barometer in open areas would be better if it takes advantage of the wide range and relatively static air pressure.

Question 5.4)

The integral term helps reduce steady-state error but can result in heavy ossification and less response.

The integral term is used for throttle so the throttle can reach its target and overcome the steady state error. However, the integral term cannot determine future changes in the target velocity and acceleration. So the integral term could have an error of zero but be heavily oscillating and not responsive.(i think) If the integral term was to determine the target velocity and acceleration, it would use past error to determine its target and constintitly overshoot and undershoot (oscillate), so it isnt needed to determine both targets.

Question 5.5)

Closed-looped because the drone must constantly measure the altitude, velocity, position, and acceleration of the quadcopter in order to keep it from drifting. If it was open looped, there would be no feedback to alter the quadcopter and it would completely miss its target. If you were to use the ultrasonic sensor and measure the distance from the quadcopter to a specific stationary object, you could just measure this distance over and over again and make the quadcopter always a certain distance away from that object. This process would require a closed-loop controller and would keep the quadcopter stationary.