MANUAL CONTROL DESIGN WITH HELLO 1.0/

A. Encoder Theory
B. Questions 1.1
C. Low-Pass Filter Theory
D. Questions 2.1

REQUIREMENTS

- **Computer**
- **MATLAB – Simulink**
- **Hello 1.0**
- **HelloApp MATLAB Application**

A. Encoder Theory

An encoder is a counter typically built inside a DC motor. Encoders count the There are 2 types of encoders in the market; magnetic and optic counter. The encoder used in this experimental set-up is a built-in magnetic encoder. Research how magnetic encoders work before starting your experiments! Each encoder has a different CPR (count per revolution) value. The CPR denotes the counting encoder sends to the data receiver with each revolution of the DC motor. Because of technical limitations, the CPR count is generally relatively small thus gear trains (reductors) get implemented so that the data received can be analyzed with precision. The gear trains transmit the spin motion of the shaft to the encoder, with this transmission, encoder wheel can spin and count the shafts' revolution according to counts per revolution.
In figures 1 and 2 you can find the general explanation of the DC motor used in this experimental set-up. Table 1 shows the CPR and gear train ratio of the DC motor.

FIGURE 1

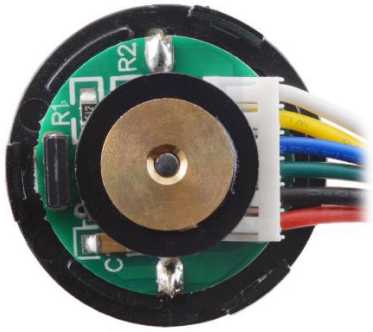

FIGURE 2

Gear Train Ratio	Count Per Minute Value
9.8	465.6

Table 1: Gear Train Ratio of DC motor and CPR value of encoder

B. Questions 1

Question 1.1:
Set the block model as shown in figure 3 and figure 4. Run the model for 3 seconds. Plot the data obtained. Calculate how many revolutions DC motor made and compare your calculations to the obtained data. Comment on how derivation block affects the general outcome.

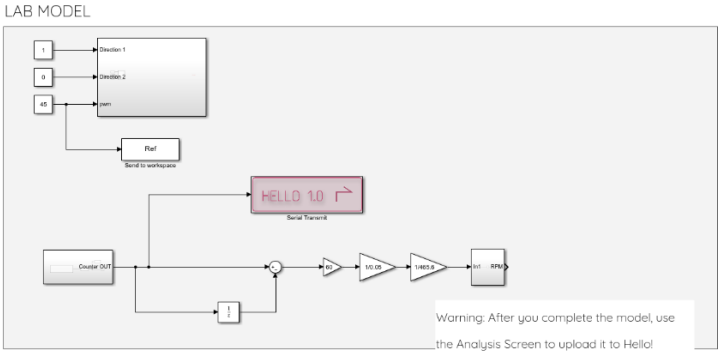

Figure 3

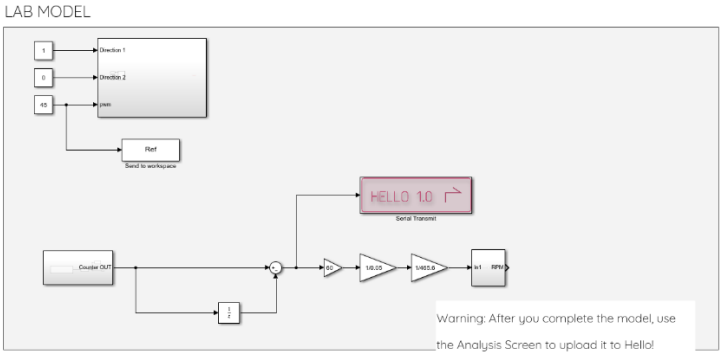

Figure 4

Question 1.2:
Set the block model as shown in figure 6. Run the model for 3 seconds. Plot the data obtained. Calculate RPM of the DC motor and compare your calculations to the plot obtained data. Comment on how the purpose of gain blocks in the block model.
Hint: to understand the gain block the serial transmit block connection can be altered to connect between each gain block.

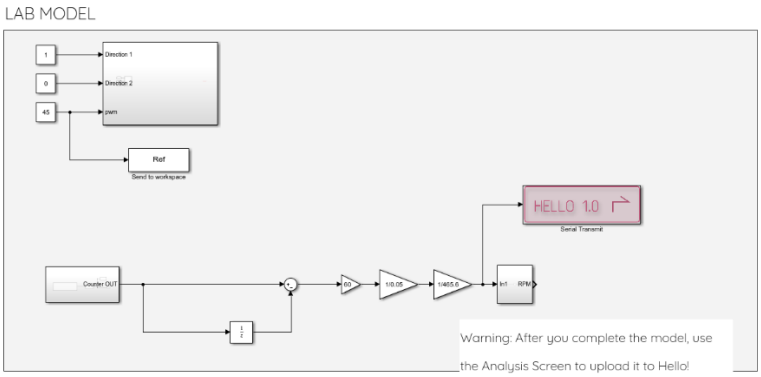

Figure 6

C. Low-Pass Filter Theory

Low-Pass filters are filters designed to eliminate the noise from the sensors. In this experimental set-up, the sensor in question is the built-in magnetic encoder. The way low-pass filters reduce the noise is by reducing the sample time that data is obtained so that random noises received by sensors are neglected or reduced. The sample time is generally shown as τ (tau) in the filter equations.

In Figure 5 is the low-pass filter implemented in Hello.App. The main design of the low-pass filter as in the block model is shown in Figure 6.

To acces and modify the τ value follow the specific steps below:

- Acces Settings A.
- Double click on the block shown in Figure 5
- Double click the middle block shown in Figure 6
- Change the value 0.05 in Denominator Coefficients like shown in Figure 7

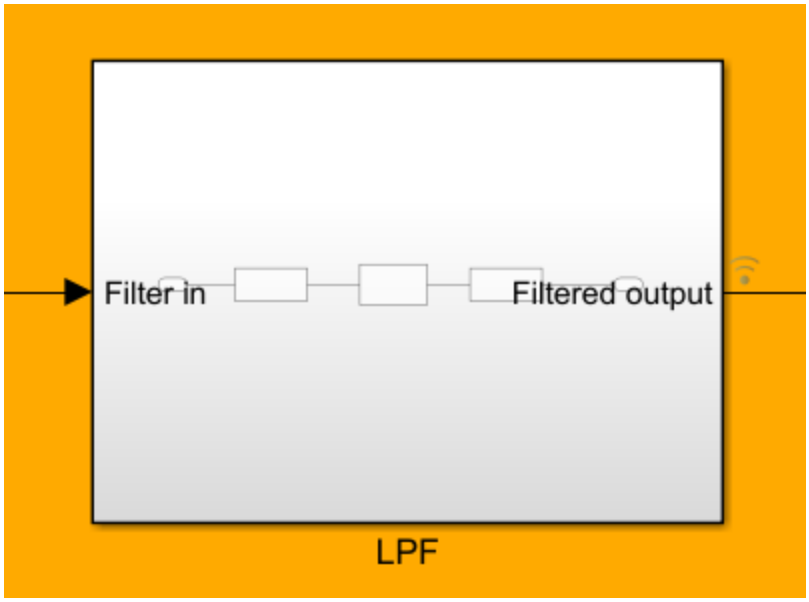

Figure 5: Low-Pass filter

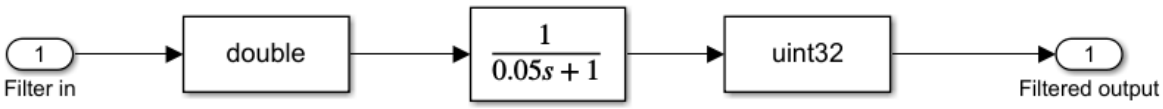

Figure 6: Low-Pass filter block model

D. Questions 2

Question 2: Modify the Tau number as shown in figure 7 according to values given in Table 1. Run the block model shown in figure 8 for 10 seconds with ramp slope value of 20. Plot your analysis' for each Tau value and compare the results. Comment on your comparison.

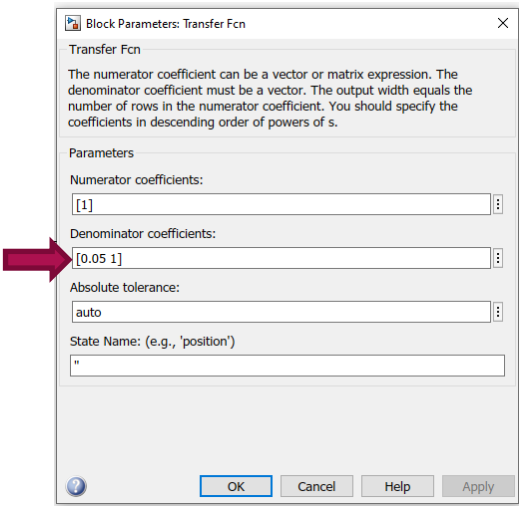

Figure 7

Tau Value
0.05
0.1
0.2

Table 1

LAB MODEL

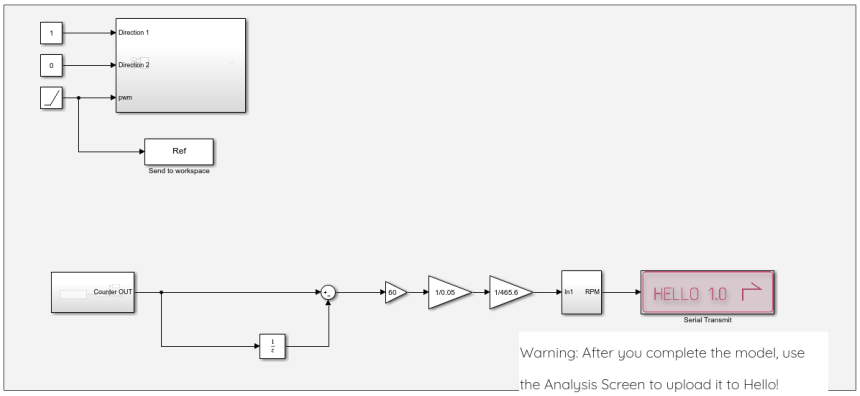

Figure 8

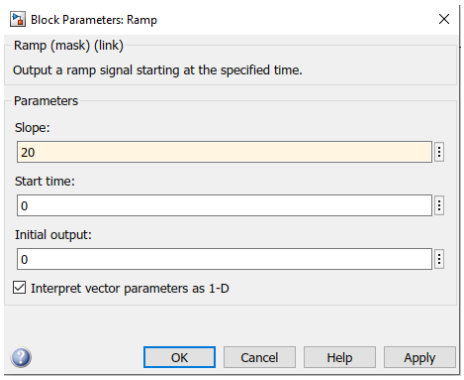

Figure 9

Hint: Changing start time in ramp block table changes how system works. Additional research would help understanding the systems.