Lab Procedure
Stability Analysis Virtual

Introduction

Ensure the following:

1. You have reviewed the Application Guide – Stability Analysis
2. Make sure you have Quanser Interactive Labs open in the Qube 3 - DC Motor → Servo Workspace.
3. Launch MATLAB and browse to the working directory that includes the Simulink models for this lab.

The **Hardware Interfacing** and **Filtering** labs explained the basic blocks to read and write from the Qube-Servo 3. For simplicity, all labs forward will use a Qube-Servo 3 block that sets up the system beforehand and outputs the available information from the Qube.

Using the gains found to convert encoder and tachometer into rads and rads/s from the instrumentation labs update the qs3_stability.slx file. Make sure to apply a step of 5V to the motor at second 1 and that the model runs for 5 seconds. It should look like Figure 1.

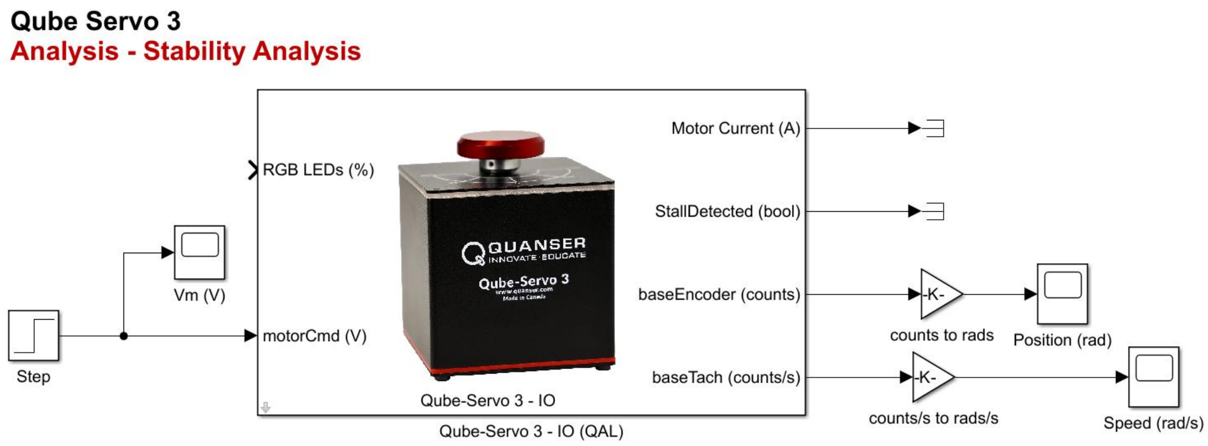


Figure 1: Unity feedback position control for the Qube-Servo 3

Ensure that a step of 5V is applied at 1 second and the controller runs for 5 seconds.

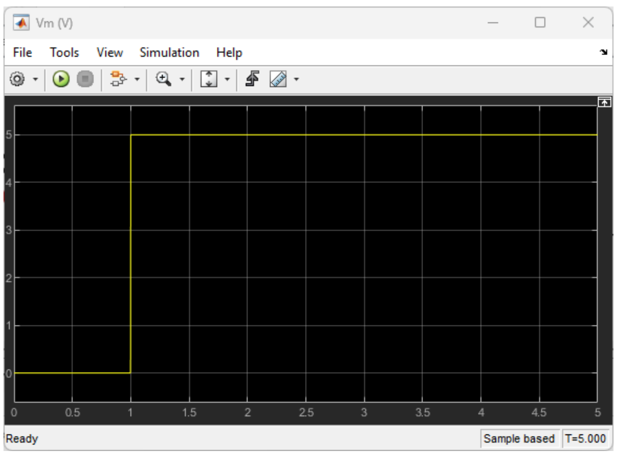
System Stability

1. Determine the stability of voltage-to-speed transfer function of the servo system from its poles. The equations are shown in the Application Guide.

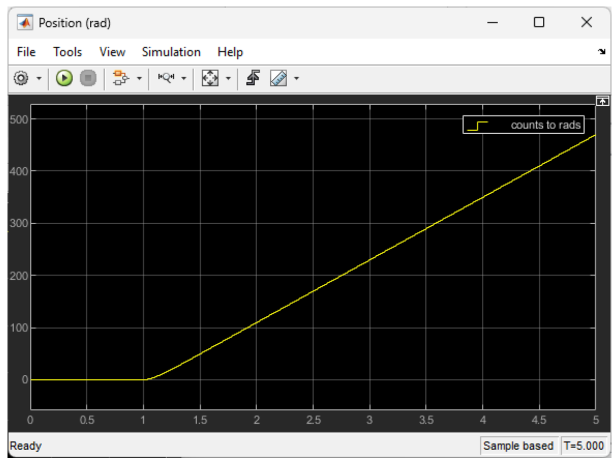
2. Determine the stability of voltage-to-position transfer function of the servo system from its poles. The equations are shown in the Application Guide.

3. Make sure to make sure your model is configured correctly to apply a step of 5V to the motor at second 1 and that the model runs for 5 seconds.

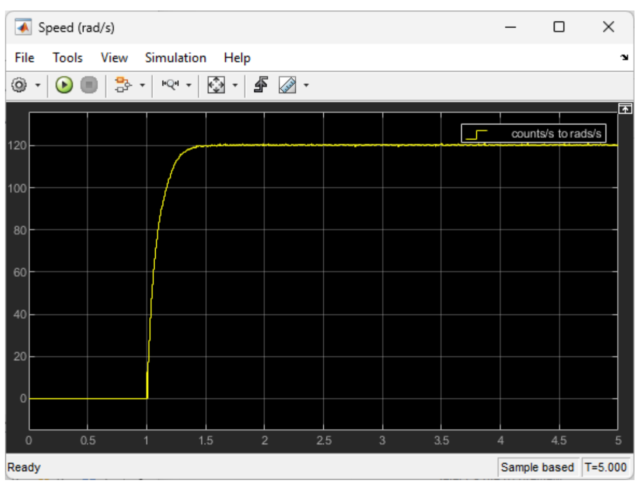
4. Run the QUARC controller using the `Run` button on the `Simulation` tab. The model will run for 5 seconds and then stop. The response from the 3 scopes should be similar to Figure 2.



(a) Voltage Input



(b) Position Response



(c) Speed Response

Figure 2. Qube-Servo Step Response

5. Based on the speed response and the BIBO principle described in the application guide, what is the stability of the system? How does this compare with your results from the pole analysis.

6. Based on the position response and the BIBO principle, what is the stability of the system? How does this compare with your results from the pole analysis.

7. Is there an input where the open-loop servo position response is stable? If so, then modify your Simulink diagram to include your input, test it on the servo, and show the position response.
   Hint: Try an impulse (i.e. short step) or sinusoid input and compare the position response with the step response observed earlier.

8. Based on this result, how could you define marginal stability in terms of bounded inputs?

9. Close your model. Ensure you save a copy of the files for review later.

10. Close Quanser Interactive Labs.