Running Rotary Inverted Pendulum Experiment

Contents

Purpose

The goal of this experiment is to design, implement and test a state-feedback control system to balance the pendulum in the upright, vertical position (Fig.1).

Figure 1. Rotary Inverted Pendulum

Physical Setup

Figure 2 presents the schematic of how the wiring should be set up.

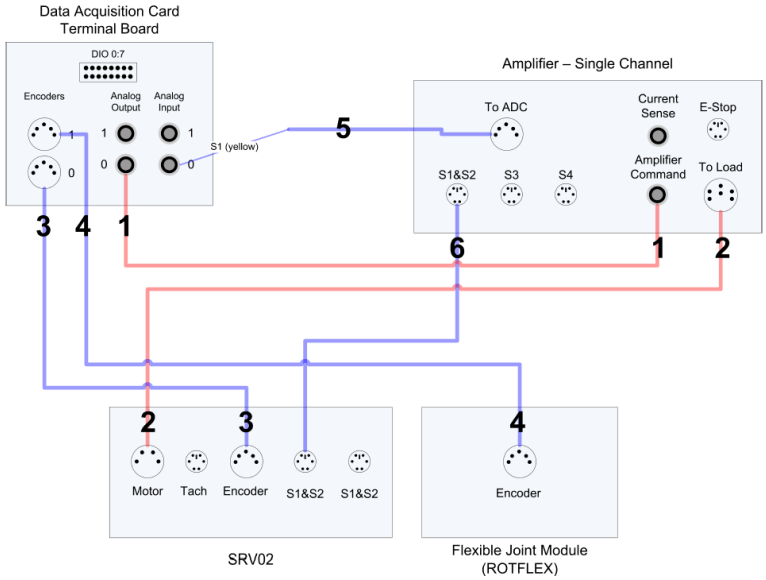

Figure 2. Wiring Diagram.

Procedures

Step 1: Setting Up MATLAB Environment

1. Open MATLAB
2. Assuming that the user who has logged into the computer connected to this apparatus has not run any experiments with the apparatus on this computer, enter the code below into the Command Prompt. These commands will ensure that the proper compiler is selected and will ensure the MATLAB scripts are translated into code the assembly can understand:

```
>> mex -setup
>> y
>> 1
>> y
```

3. Ensure that all necessary cords are attached and unit is powered ON.
4. Change the Current Folder to

Desktop\Quarc\Rotary Labs with Manuals\Exp08 – Inverted Pendulum\Lab Files

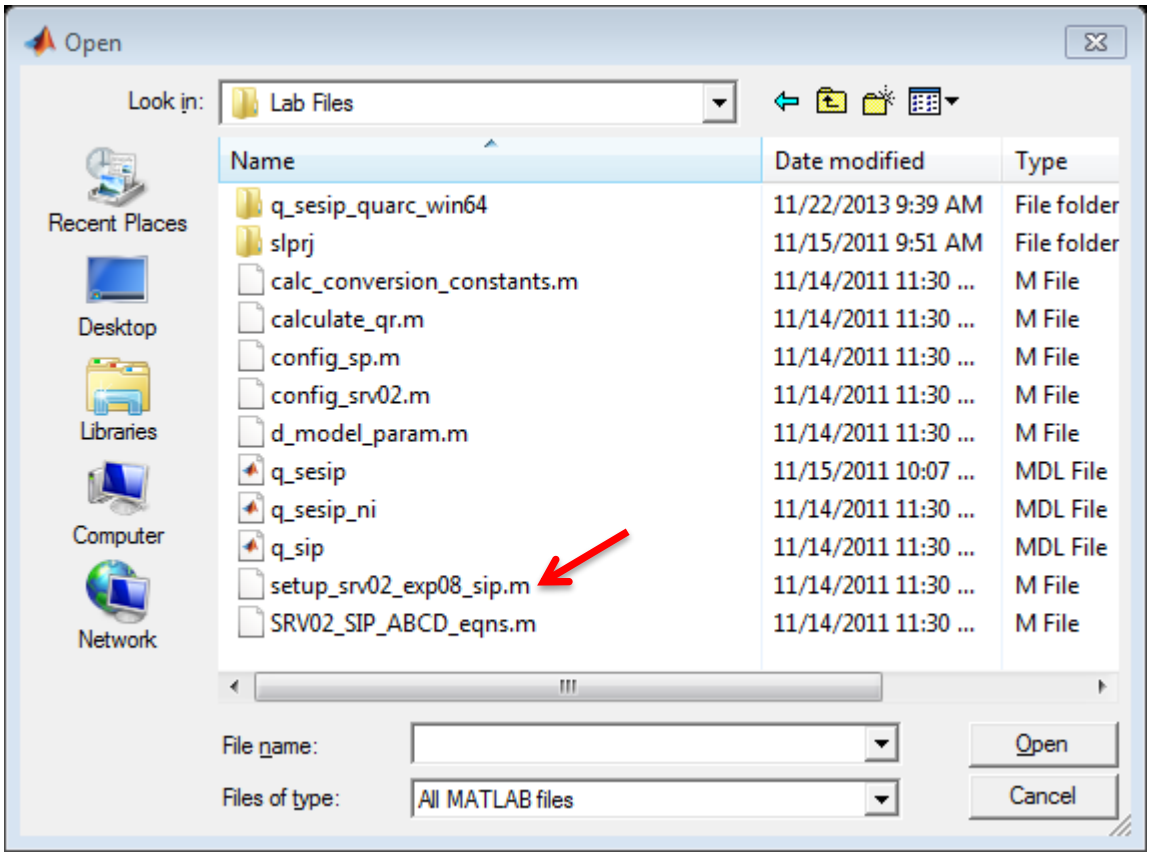

Figure 3. MATLAB main screen, Current folder line at top. Current Folder Icon highlighted.

5. Right Click setup_srv02_exp08_sip.m, click 'Run' (In Current Folder panel to left).

Step 2: Running Simulink Model

1. Open Simulink q_sesip.mdl
2. Confirm the Simulink model is configured for the proper OS.
    a. On the Simulink screen, select: Tools>Code Generation>Options. Under the Code Generation options, confirm the operating system matches the computer's OS. As of the date of this lab settings are Win64 for HP and Win32 for Dell.

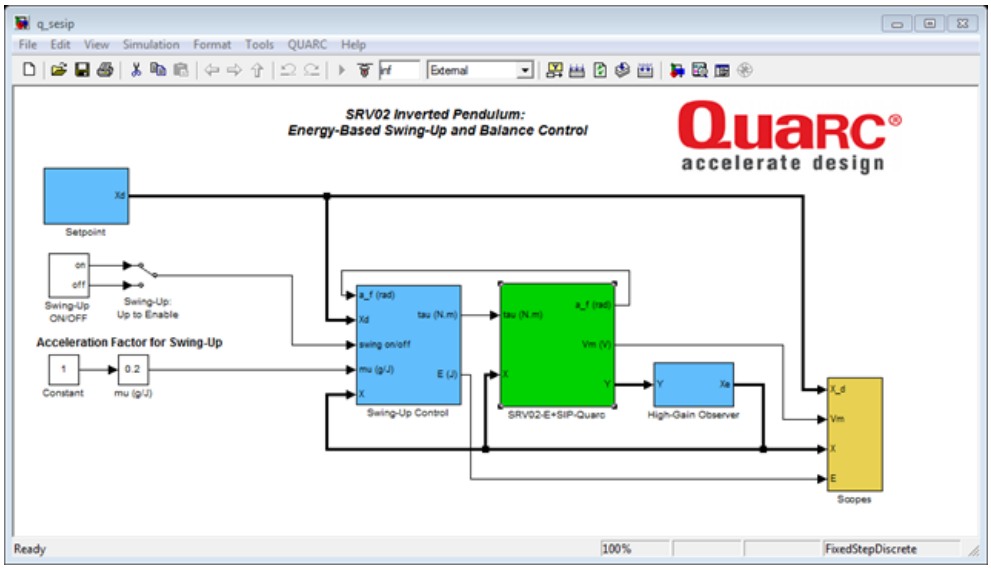

Figure 4. System block diagram, q_sesip.mdl file.

3. Ensure that the Simulink model is configured for the proper data acquisition board.
   a. Double-click the green SRV02-ET+ROTPEN block in the model.
   b. Double-click the HIL Initialize icon in the top right corner of the model that just opened.
   c. From the drop down menu, in Board Type, choose the correct data acquisition board and connection mode (q2_usb). Exit the ROTPEN specific model.

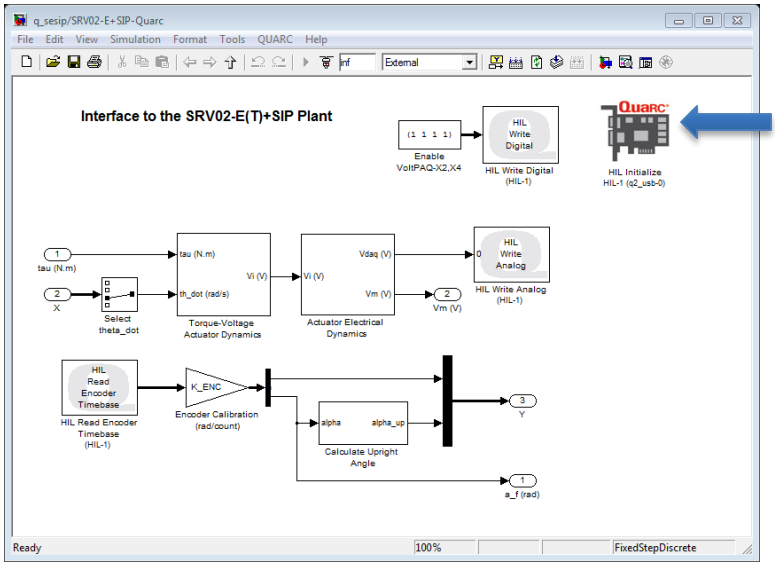

Figure 5. HIL Initialize.

4. On the MATLAB screen, run the SETUP_SRV02-EXP08-SIP script to calculate the variables.
5. After the variables have been calculated, click the Incremental Build button on the Simulink model to compile the code for the inverted pendulum.

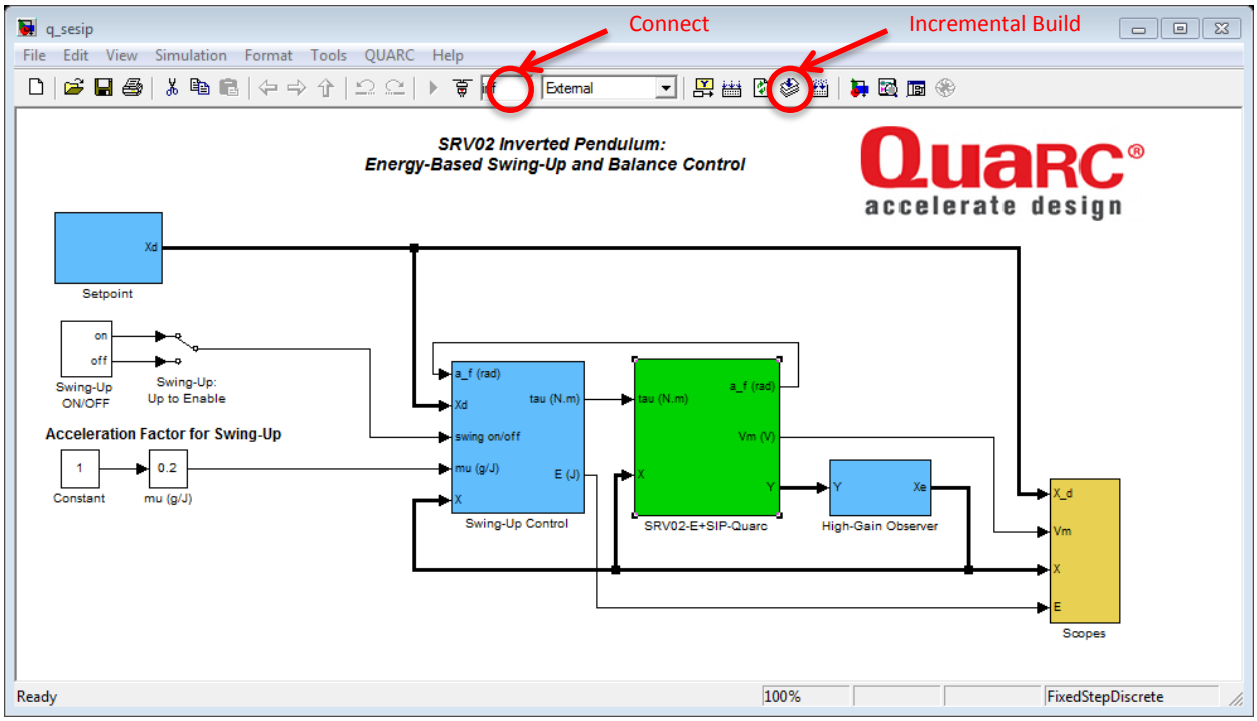

Figure 6. Displaying the Incremental Build and Connect buttons on the Simulink Model.

6. After the code has been compiled, connect to the test equipment by pressing the connect button as shown in Figure 4.
7. Click the start button (to the left of the connect button on the Simulink Model) after the program is connected to run the program (the start button will be the color black when the program is ready to be run).

References

[1] Bruce Francis, *ECE1619 linear systems course notes*, University of Toronto, 2001.
[2] Quanser Inc., *QUARC User Manual* (type `doc quarc` in MATLAB to access).
[3] Quanser Inc., *SRV02 QUARC Integration*, 2008.
[4] Quanser Inc., *SRV02 User Manual*, 2009.
[5] Quanser Inc., *QUARC Compatibility Table*, 2010.
[6] Quanser Inc. *SRV02 Rotary Pendulum User Manual*, 2010.
[7] Quanser Inc., *VoltPAQ User Guide*, 2010.
[8] Quanser Inc., *SRV02 lab manual using QUARC*, 2011.
[9] Norman S. Nise, *Control Systems Engineering*, John Wiley & Sons Inc., 2008.
[10] K. J. Aström and K. Furuta. Swinging up a Pendulum by Energy Control. *Proceedings of the 13th IFAC World Congress*, 1996.