Running Gyroscope Position Control Experiment

Contents

Purpose

The goal of this experiment is to design, implement and test a controller that maintains the direction of the gyroscope module while the top base plate is rotated relative to the bottom plate (Fig.1).

Figure 1. Rotary Gyroscope system.

Physical Setup

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

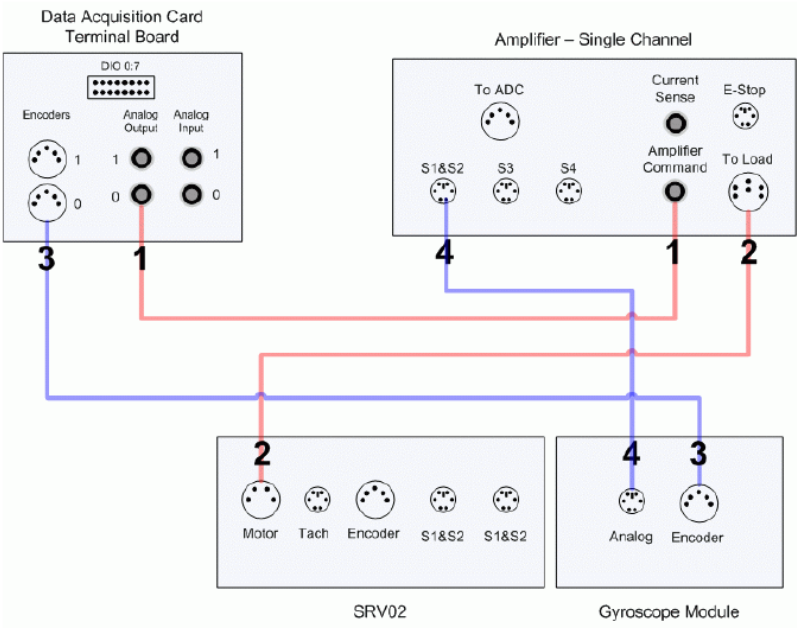

Figure 2. Schematic of SRV02 Gyroscope experiment.

Physical wiring for this lab should resemble Figure 3. Note, Fig.3 features using a 8-channel DAQ board, while in principle it is enough to utile just a 2-channel DAQ board (depicted in Fig.2).

Figure 3. Physical setup of experiment.

Procedures

Step 1: Starting MATLAB

Turn on the computer and login using your NPS login & password. Open MATLAB. (You may need to search for it under 'search all programs and files' as sometimes the shortcut does not appear on the desktop or in the list of programs.) Change 'Current Folder' in top MATLAB toolbar to

C:\Users\Public\Desktop\Quarc\Rotary Labs with Manuals\Exp10 - Gyroscope\Lab Files

Step 2: Running Setup Script(s) to Compute Controller's Gains

Open 'setup_lab_srv02_exp10_gyro.m'.

Make sure `CONTROL_TYPE` is set to '`MANUAL`'. Ensure that the other system related parameters that are set using this script match the specifications of the system, e.g. "AMP_TYPE" variable is set according to the amplifier model (VoltPAQ). Enter the derived proportional and derivative gain for the system.

Run 'setup_lab_srv02_exp10_gyro.m' script by clicking on the green arrow at the top of the .m file toolbar.

Step 3: Opening/Building a Simulink Model, Connecting to the Target

Open '`q_gyro.mdl`' Simulink model (Fig.4).

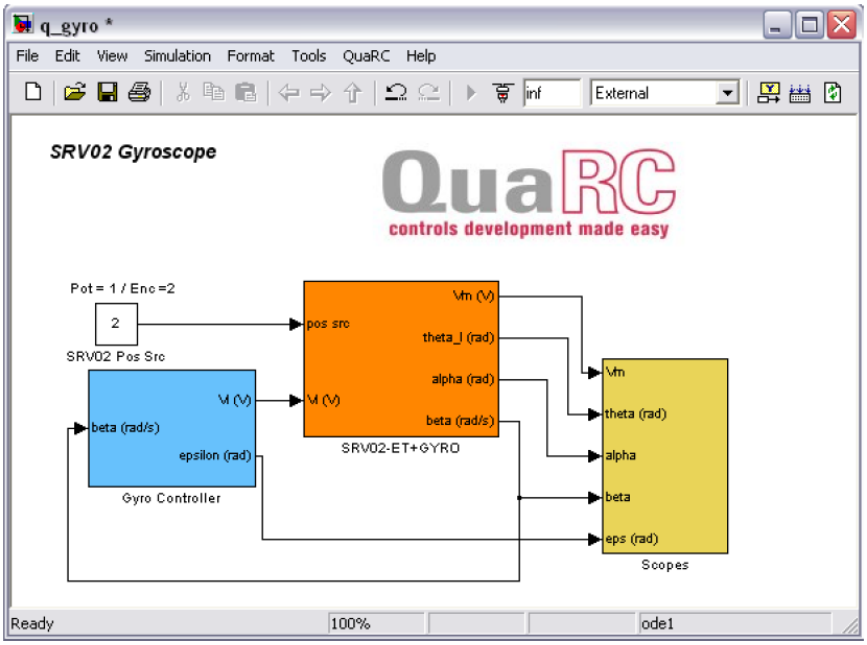

Figure 3. Simulink model for gyroscope experiment.

Configure the DAQ: Ensure that the DAQ device is the same as the system that the experiment is running on. Double-click on the "`HIL Initialize`" block found in "`SRV02-ET+GYRO`" block.

Configure SRV02 Sensor: Ensure that the sensor is measured by the system. This is done by setting the "`SRV02 Pos Src`" block in "q_gyro.mdl" to 2 (using encoder).

Turn on Amplifier (on/off button is located on rear of box). Wait for a green light on front of box to indicate on.

In the Simulink model window, click on the 'Incremental Build' button in the toolbar (or in the QUARC dropdown, choose 'Build'). Wait for MATLAB to build the model.

In the Simulink model window, click on the 'Connect to Target' button in the toolbar.

Step 4: Running the Model

In the Simulink model window, click on the 'Start real-time code' button (forward arrow) in the toolbar.

Start to apply a disturbance to the system by slowly rotating the support base plate relative to the bottom support plate and observe the gyroscope module direction. If the calculated gains are good, the system should maintain its orientation while a disturbance is introduced.

If the result is not ideal, recalculate the gains to improve performance. After changing values in the .m file, you will need to rerun the incremental build in order to set those values within the system.

References

[1] Quanser Inc., *Data-Acquisition Device User Manual*.
[2] Quanser Inc., *QUARC User Manual* (type `doc quarc` in MATLAB to access).
[3] Quanser Inc., *QUARC Installation Guide*, 2009.
[4] Quanser Inc., *Amplifier User Manual*.
[5] Quanser Inc., *SRV02 User Manual*, 2009.
[6] Quanser Inc., *SRV02 QUARC Integration*, 2008.
[7] Quanser Inc., *Rotary Experiment #1: SRV02 Modeling*.
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[9] Carl Machover, *Basics of Gyroscopes*, John F. Rider Inc., 1960.
[10] Paul H. Savet, *Gyroscopes: Theory and Design*, McGraw Hill, 1961.
[11] Robert H. Cannon, *Dynamics of Physical Systems*, McGraw Hill, 1967.
[12] Quanser Inc., *SRV02 Rotary Gyroscope User Manual*.