**Setting up the Quanser 3-DOF pantograph and QuaRC**

The following guide will illustrate how to physically connect the Quanser 3-DOF Pantograph to a PC, how to install and setup the necessary software for a single PC running Windows and QuaRC 1.1, and how to setup a project that will help you get started using the robot.

This guide assumes you have some experience installing computer hardware and software. Troubleshooting is beyond the scope of this guide; the installation and user manuals should be used as a supplement if a problem arises. There is no QuaRC user manual, all the information is built into the Matlab help and can be accessed by right clicking a block and selecting Help.

**Hardware**

The hardware is connected as shown in Figure 1. When tracing the signals if troubleshooting notice that the motor signals go through the current drivers and the encoder signals do not.

![Figure 1. Pantograph connection diagram](image)

1. Open the PC case and remove the metal tab beside an empty PCI slot.
2. Plug the three ribbon cables labeled 1, 2, and 3 into the corresponding slots on the Q8 data acquisition board (the circuit board is marked).
3. Feed the other end of the cables through the slot at the back of the PC. Be careful not to damage the cables.
4. Install the Q8 data acquisition board into the empty PCI slot.
5. Plug the other end of the cables in the Q8-to-QPA adapter box. Be sure the cables are in the correct slots (this circuit board is also marked).
6. Replace the case on the PC.
7. Connect the fourth ribbon cable from Connector A to the I/O slot on the QPA.
8. Attach the encoder and motor cables to the QPA and the Pantograph.
9. Plug the Emergency stop bottom and power cable into the QPA.
Software

1. Install Windows XP Professional with Service Pack 2 or 3, or Windows Vista with Service Pack 1. Windows XP Home edition is not supported.
2. Install Matlab. Supported versions are R2007a, R2007b, or R2008a.
4. Install QuaRC 1.1. The Q8 data acquisition board, Matlab and Visual Studio must be installed before you install QuaRC.
5. If you are using Visual Studio Express Edition it requires further configuration. Please refer to the QuaRC 1.1 Installation Guide, pages 7 and 8.
6. Copy the license for QuaRC on to the computer.
7. Open the License Manager by clicking:
   Start → All Programs → Quanser → QuaRC → Configure Licensing
8. Ensure both check boxes are selected and click OK. Select the license file and click OK.

Project

1. Start by viewing the demos that are included with QuaRC by typing “demo quarc” at the Matlab prompt. The demos will show you how to set up your Simulink model to use an external target and how to build the code.
2. Open a new Simulink model. Keep one of the demos open.
3. Open the Model Explorer for each model by clicking View → Model Explorer.
4. Copy the “Windows Configuration” from the demo to the new model, and make sure it is set to active. You can now close the demo.
5. Add the following blocks to a subsystem: HIL Initialize, HIL Read Encoder, Haptic 3-DOF Pantograph Cartesian Plant, Haptic 3-DOF Pantograph Enable, HIL Write, Gain (optional).
6. Double-click a block to change the parameters and set the following:
   a. HIL Read Encoders: Channels = [3 2 1 0]
   b. HIL Write: Analog channels = [3 2 1 0], Digital channels = [0 1 2 3]
7. Connect the blocks as shown in Figure 3.

Force is applied to the arm of the robot by feeding the input a 1x3 vector of the form [X Y T] where X and Y are forces in the X and Y directions, and T is a torque. Position is returned as a 1x3 vector with the form [X Y θ] where X and Y are the X and Y position, and θ is the amount of rotation. Encoder counts are returned as a 1x4 vector, one for each encoder. The encoders and motors are numbered, and the x-y axis are defined as shown in Figure 2. The encoder counts (and thus also the position) are set to zero when the program starts regardless of the position of the arm, so the pantograph needs to be calibrated each time the computer is restarted.

Figure 2. 3-DOF Pantograph
Figure 3. Subsystem setup