  
User Manual

HD2-QArm   
Teleoperation

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# A. Introduction

This demo demonstrates teleoperation of a QArm with haptic feedback using an HD2. The demo can be run with both devices connected to the same PC, or two different PCs connected over a network. It Is also possible to run the demo using a virtual QArm using Quanser Interactive Labs (QLabs). It is assumed that before running this demo, you have already read the user guides for the QArm and HD2. and are familiar with the function of both devices.

# B. Setup

The demo consists of three Simulink models. All three models must be running simultaneously for the demo to work. The function of each model is described in Table 1:

Table 1: Required Simulink files with descriptions.

|  |  |
| --- | --- |
| **Model Name** | **Model Description** |
| HD2\_Driver\_PY\_v3 | * Performs low-level control and communication with the HD2. * Receives force feedback commands from HD2\_QArmTeleopClient over stream. * Sends rate command information to HD2\_QArmTeleopClient over stream. |
| HD2\_QArmTeleopClient | * Acts as an interface between the HD2 and the QArm * Talks to HD2\_Driver\_PY\_v3 and QArm\_TeleopServer over stream. * Displays the camera stream received from the QArm. |
| QArm\_TeleopServer | * Receives rate commands from HD2\_QArmTeleopClient to control the QArm. * Sends camera feed and joint currents to HD2\_QArmTeleopClient over stream. |

Depending on the desired setup configuration (single or dual PC), you may need to modify some of the model settings. The detailed setup instructions for each configuration are provided below.

**Note:** If you Intend on using a virtual rather than a physical QArm, use the QArm\_TeleopServer\_Virtual model file Instead of QArm\_TeleopServer. Also, the "QArm Workspace" Inside QLabs must be running before starting the demo. All other Instructions for running the demo are the same as for the physical arm.

## Single PC Configuration

If you would like to run the demo using a single PC, no addition configuration of the models is required. To get started, follow these steps:

1. Ensure the HD2 and QArm are connected to the host PC and powered on.
2. Open Matlab and navigate to the folder containing the demo files.
3. Open and build each of the three .slx model files.
4. Start all three models and leave them running (start order does not matter).

## Dual PC Configuration

If you would like to run the demo using two separate PCs, you will need to do some additional setup to ensure the two PCs can talk to each other. The intended setup is to have the HD2 connected to the first PC (referred to as the **host PC**) and the QArm connected to the second PC (referred to as the **remote PC**). Note: these instructions assume you know the IP address of both PCs. If you don’t, you can find a PC’s IP address using the ipconfig command inside a command prompt on windows. Ensure both PCs are on the same network and can ping each other’s IP addresses.

#### On the Host PC:

1. Open HD2\_QArmTeleopClient.slx.
2. Modify the two red “string constant” blocks (highlighted in Figure 1), replacing “localhost” with the IP address of the remote PC.
3. Save and build HD2\_QArmTeleopClient.slx.
4. Open and build HD2\_Driver\_PY\_v3.slx.
5. Ensure the HD2 is connected and powered on.
6. Start both models and leave them running (start order does not matter).

#### On the Remote PC:

1. Open QArm\_TeleopServer.slx
2. Modify the two red “string constant” blocks (highlighted in Figure 2), replacing “localhost” with the IP address of the host PC.
3. Save and build QArm\_TeleopServer.slx.
4. Ensure the QArm is connected and powered on.
5. Start QArm\_TeleopServer and leave it running.

A picture containing text, diagram, plan, technical drawing

Description automatically generated

Figure 1: HD2\_QArmTeleopClient block diagram with string constant blocks highlighted.

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Figure 2: QArm\_TeleopServer block diagram with string constant blocks highlighted.

# C. Operation

After following the setup instructions in Section B, you are now ready to operate the QArm using the HD2. The controls for using teleoperation are as follows:

* Manually moving the HD2 end-effector produces a similar motion for the QArm.
* Movement of the arm is enabled using the foot pedal.
* The QArm gripper can be closed by pressing and holding the space button on the host PC.

For best results, it is important to calibrate the HD2 first and reorient the HD2’s coordinate frame orientation as needed. The HD2 can be calibrated as follows:

1. Open HD2\_QArmTeleopClient on the host PC (while it is running).
2. Place the HD2 end-effector in the calibration pose shown in Figure 3 (a).
3. Set the red manual switch in HD2\_QArmTeleopClient (shown in Figure 3 (b)) to pass through 1.
4. Set the red manual switch in HD2\_QArmTeleopClient to pass through 0 (double click).

To reorient the HD2’s coordinate frame orientation, you can update the values of the red constant block titled “HD2 Orientation …” in HD2\_QArmTeleopClient, shown in Figure 3 (b). The default orientations for both the QArm and HD2 are shown in Figure 4.

|  |  |
| --- | --- |
| A close up of a machine  Description automatically generated with low confidence | A picture containing text, screenshot, diagram, line  Description automatically generated |
| (a) Calibration pose for the HD2 | (b) Zoomed-in screenshot of HD2\_QArmTeleopClient.slx |

Figure 3: Calibration of the HD2

|  |  |
| --- | --- |
| A picture containing machine, electronics, cable, audio equipment  Description automatically generated  **X**  **Y** | A picture containing cable, tool, electrical wiring, machine  Description automatically generated  **X**  **Y** |

Figure 4: Coordinate frame orientations for the HD2 and QArm

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