Qball-X4

Set Up and Demo Guide

Qball Hardware

- Quad-rotor
- Sensors
  - Sonar
  - Accelerometer
  - Gyroscope
  - Magnetometer
- Quanser HiQ
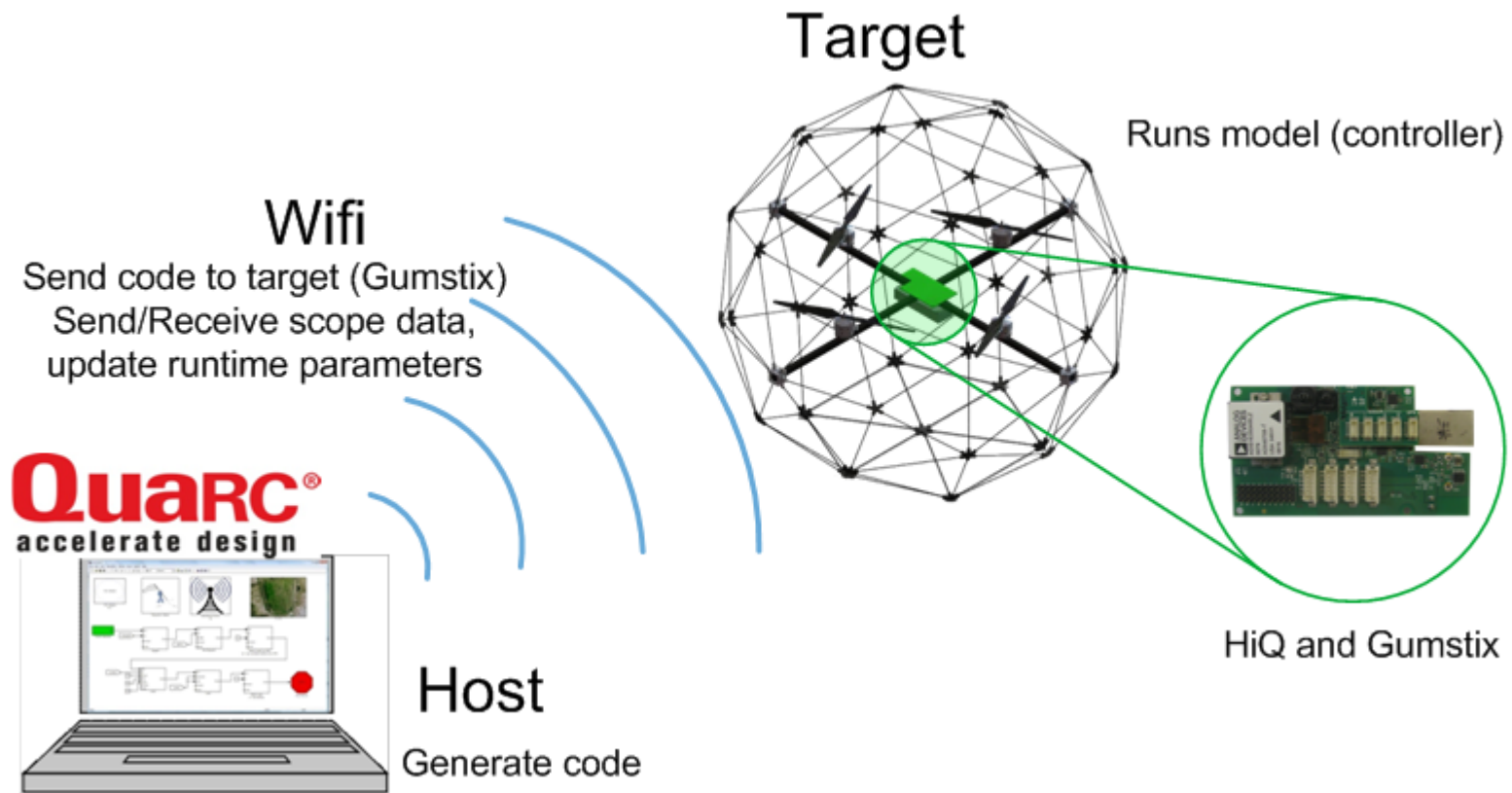 - Gumstix computer + IMU

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Picking up the Qball

- Do NOT pick up the Qball by the cage
- Lift the Qball using both ends of the frame

Operation Overview

- Host PC running QUARC sends commands via TCP/IP connection to Qbot w/ Gumstix

Target

Runs model (controller)

Wifi
Send code to target (Gumstix)
Send/Receive scope data,
update runtime parameters

QuaRC®
accelerate design

Host
Generate code

HiQ and Gumstix

Installation Overview

1. Install/test QUARC on HOST PC
2. Connect charged batteries
3. Set up wireless connection between PC and Qball
4. Test the Qball sonar sensor
5. Fly the Qball using the joystick

QUARC Software Requirements

- You NEED to install the following software BEFORE installing QUARC
  - MATLAB
  - Simulink
  - Simulink Coder
  - MATLAB Coder
  - Control System Toolbox
  - *OptiTrack Users*: also need *Stateflow Toolbox*
- See the ***QUARC Quick Installation Guide*** for details on **the EXACT versions you need!**

QUARC®
accelerate design

QUANSER

Installing QUARC

- To install QUARC, follow the instructions in *QUARC Quick Installation Guide* carefully
- IMPORTANT: On the *Features Installation* screen, make sure select **Gumstix Support** and **Simulink Beta Components** features

Quick Installation Guide:
QUARC 2.3, Quanser Real-Time Rapid Control Prototyping Software for Windows®1

STEP 1 Install MATLAB and Add-On Requirements

QUARC® supports both 32-bit and 64-bit versions of Microsoft Windows® 7.

Depending on the version of Microsoft Windows 7 used, ensure the corresponding 32-bit or 64-bit MATLAB® R2011a, R2011b, R2012a, or R2012b is installed on the computer with the following required add-ons accompanying the corresponding MATLAB version:

- Simulink
- Simulink Coder
- MATLAB Coder
- Control System Toolbox, (required by most of Quanser's control laboratories)

For details, refer to the Compatibility Chart on page 12.

STEP 2 Install Microsoft Compiler Requirements

QUARC requires a MATLAB-supported C++ compiler.

Depending on the MATLAB version used, ensure only **one** of the following two Microsoft compilers is installed:
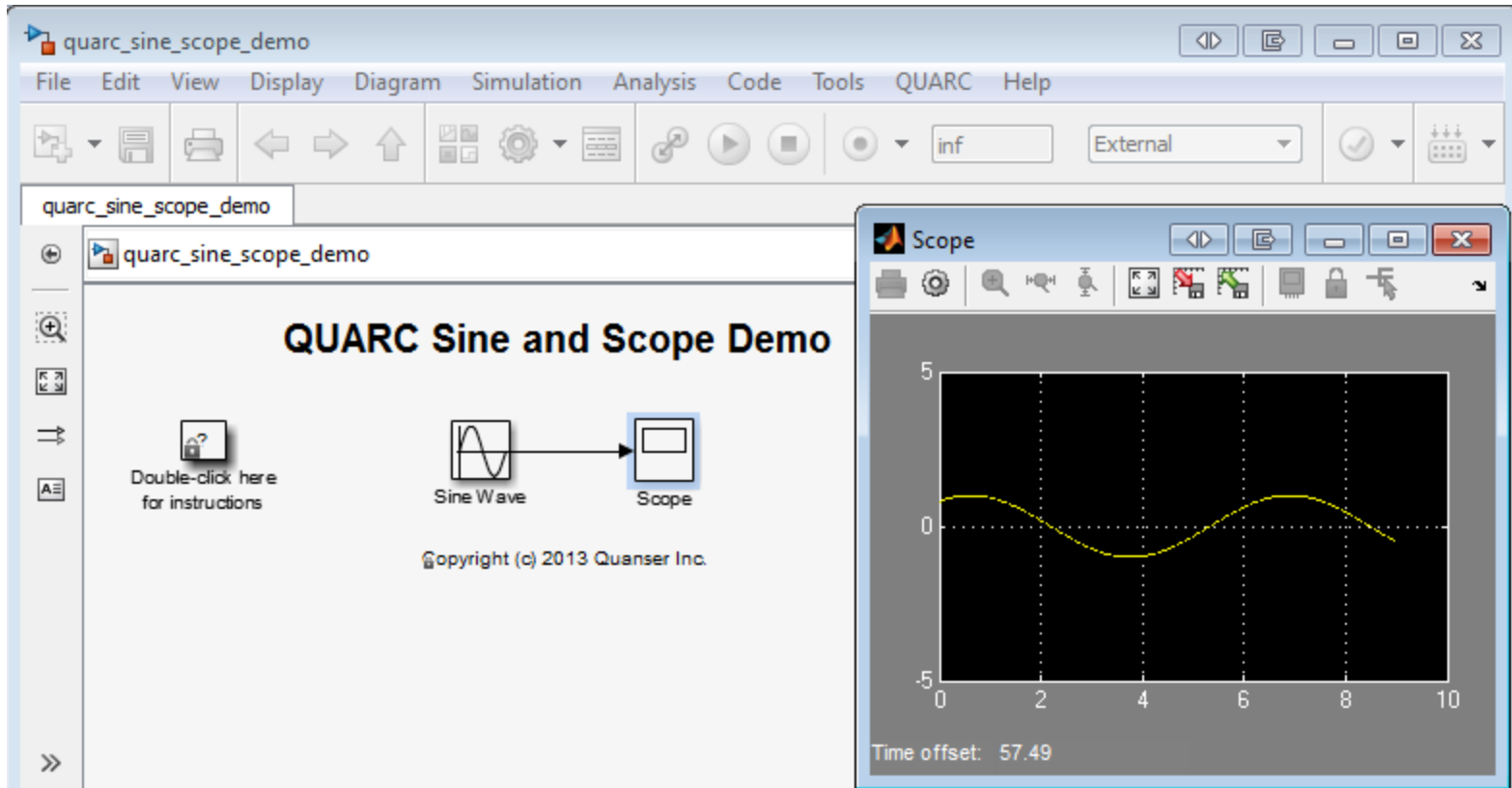
Microsoft Visual Studio Professional Edition 2010 (version 10.0) if MATLAB R2011a, R2011b, R2012a, or R2012b is used.

OR

Microsoft Windows SDK 7.1 if MATLAB R2012a or R2012b is used.

The Microsoft Windows SDK 7.1 can be installed

Testing QUARC

- After installing QUARC on the HOST PC, make sure **you can run the** *quarc_sine_scope_demo*
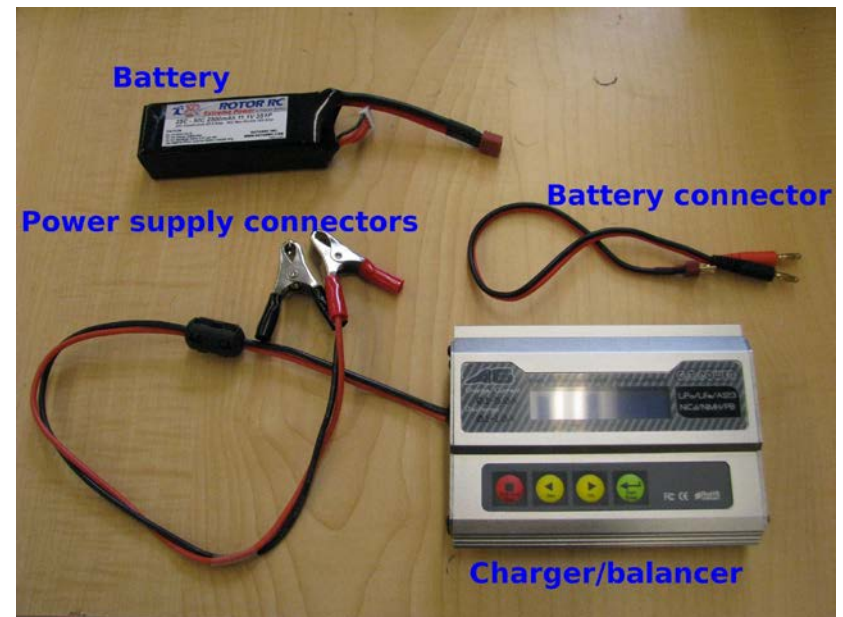
Qball Software

- Qball is already shipped with QUARC installed on the Gumstix embedded computer

- If you need to update QUARC on the Qball:

  – See http://www.quanser.com/tutorials_quarc_gumstix

Step 2) Install Batteries

- Before starting, make sure have two fully charged Li-Po batteries

- See **Section 7** in *Qball-X4 User Manual* for full instructions

Charging Instructions

1. Connect charger to battery. There are 2 connections for each battery:
   1. Connect battery to "3-cell" connector
   2. Connect red/black cables
2. Configure charger for 3-cell LiPo battery – 11.1 (3S) at 2.5A
3. Start charger:
   1. Hold down Start/Enter button until beep is heard
   2. Press Start/Enter again to confirm.
4. Charger will beep and display message when fully charged

Insert Batteries

1. Slide both LiPo batteries into compartment
2. Secure the batteries with the Velcro strap
3. Connect the red/black leads to Qball

Connect batteries to Qball
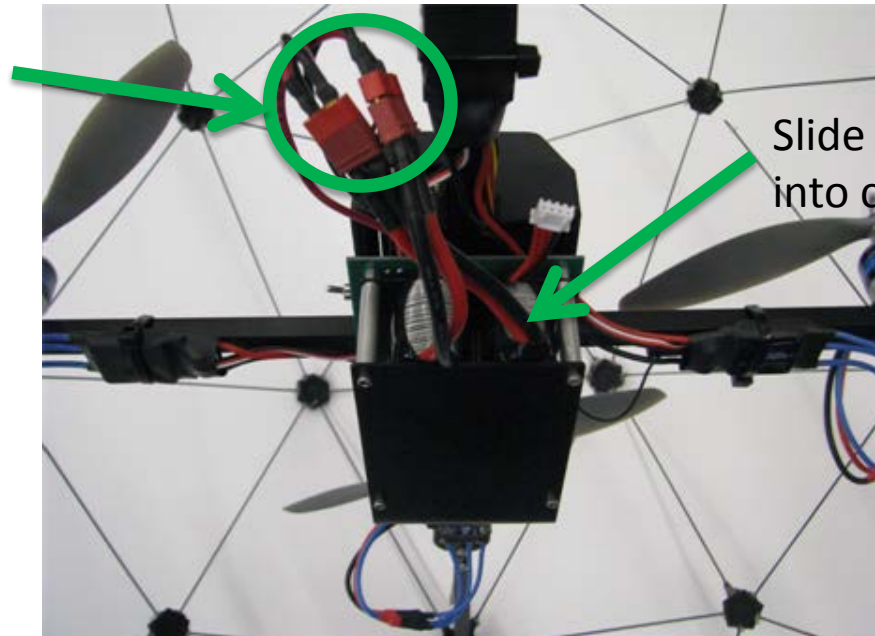
Slide batteries into compartment

Step 3) Wireless Connection

- Establish wireless connection between the **host PC** and the **Gumstix embedded computer** on the Qball/HiQ

TCP/IP
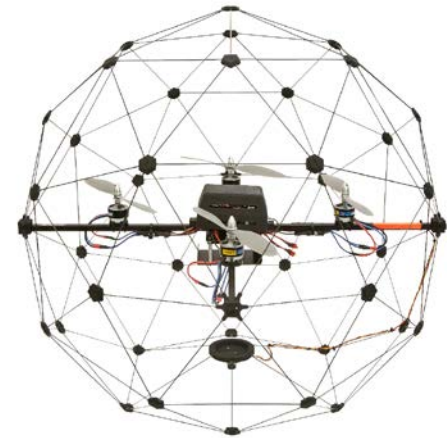
Wireless USB Adapter

- Wireless USB adapter is supplied
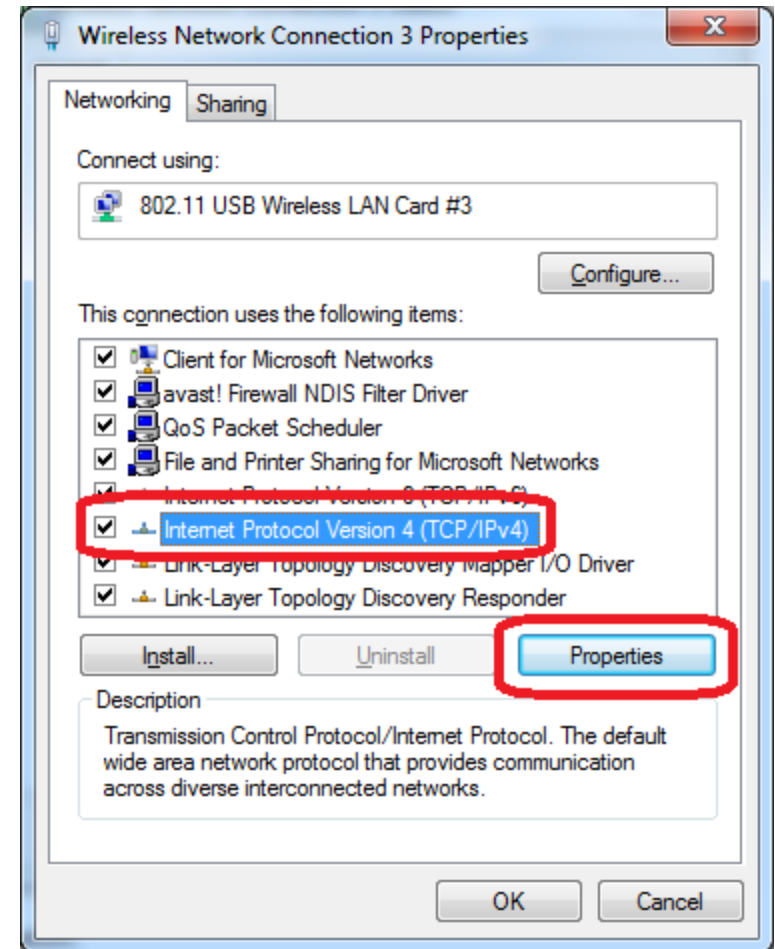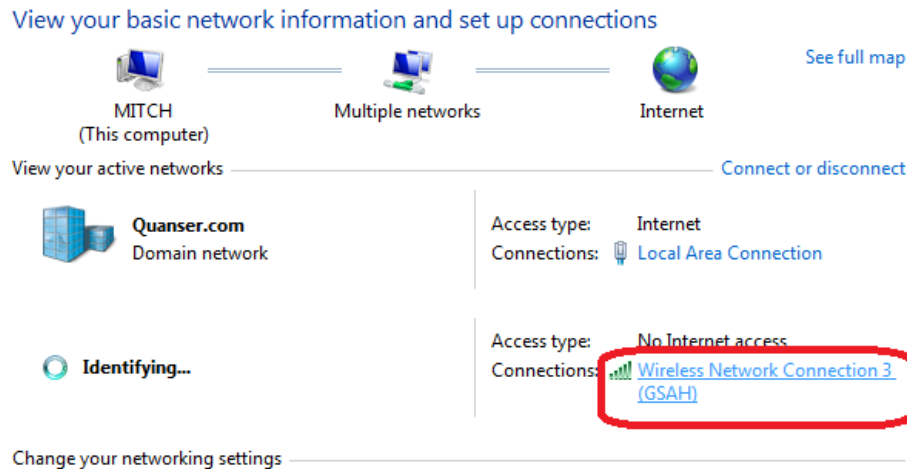- Install supplied wireless USB adapter in host PC

Disable Windows Firewall

- Go to Control Panel | Firewall
- Disable the Firewall (may interfere with Qball communication)
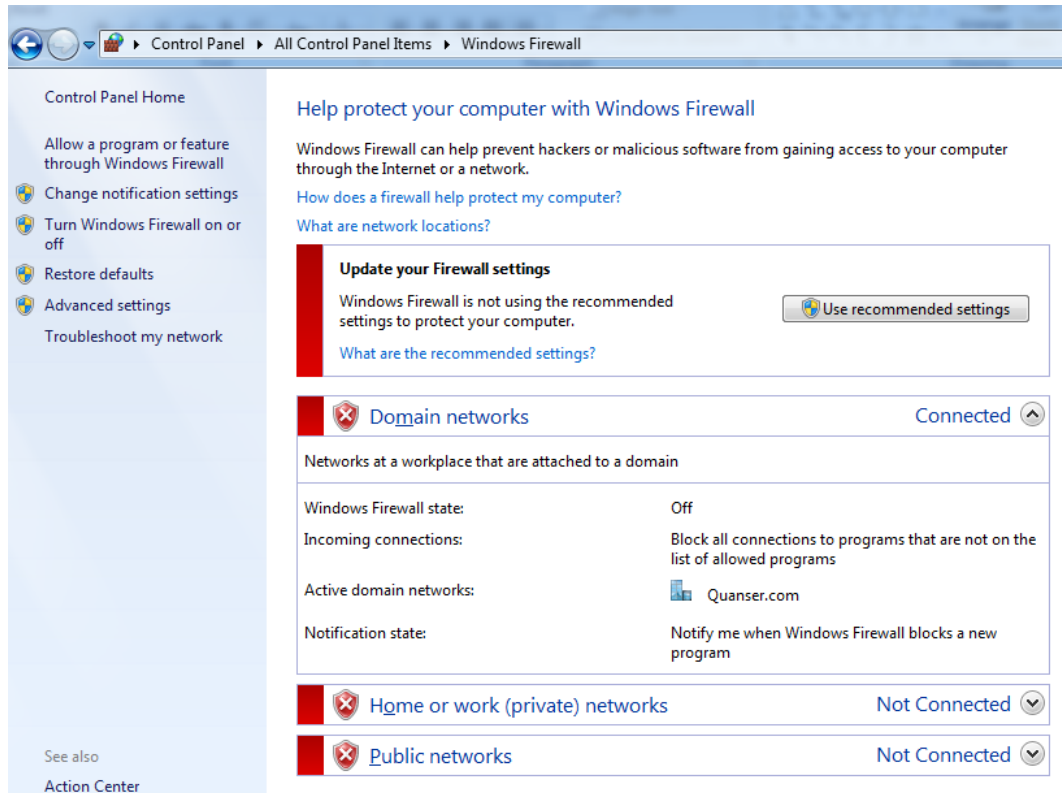
TCP/IP Settings

- Go to the wireless network settings
- Select TCP/IPv4 and go to "Properties"

Set IP Address

- Set host PC wireless adapter to an IP between 182.168.1.10 and 182.168.1.19

- Subnet = 255.255.255.0

- No Gateway needed

Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically

● Use the following IP address:

IP address: 182 . 168 . 1 . 10

Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

○ Obtain DNS server address automatically

● Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

☐ Validate settings upon exit

Advanced...

OK   Cancel

Power up Qball

- Turn ON the power switch on the Qball
- Should start to hear beeping noise
- Propellers will rotate incrementally
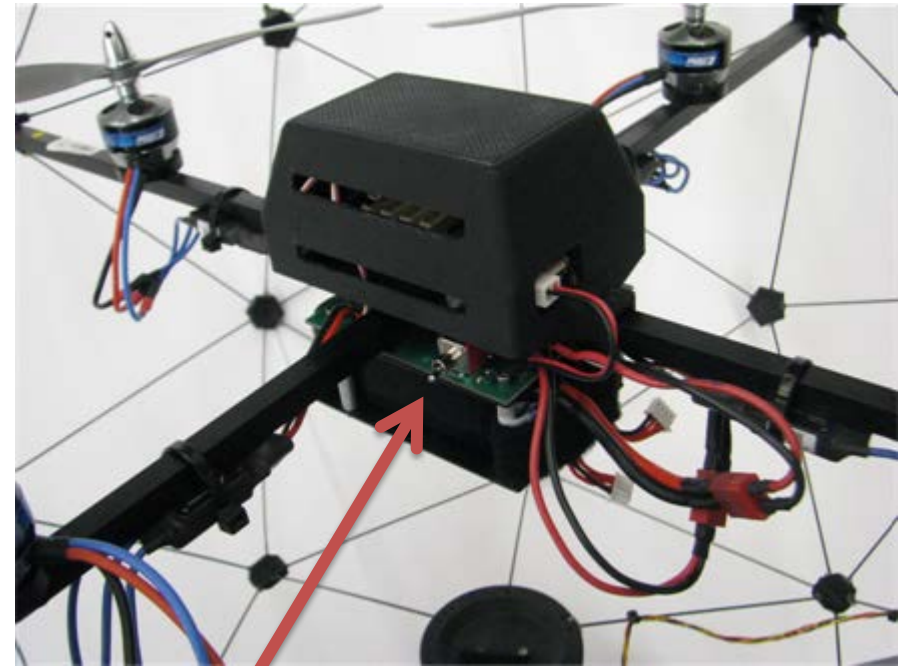
Turn ON power switch

GSAH Network

- "GSAH" network should appear under your wireless networks
- Connect to the GSAH network

Check network status

- Once HOST PC IP is set, the GSAH network should **NO longer say "Identifying…"**
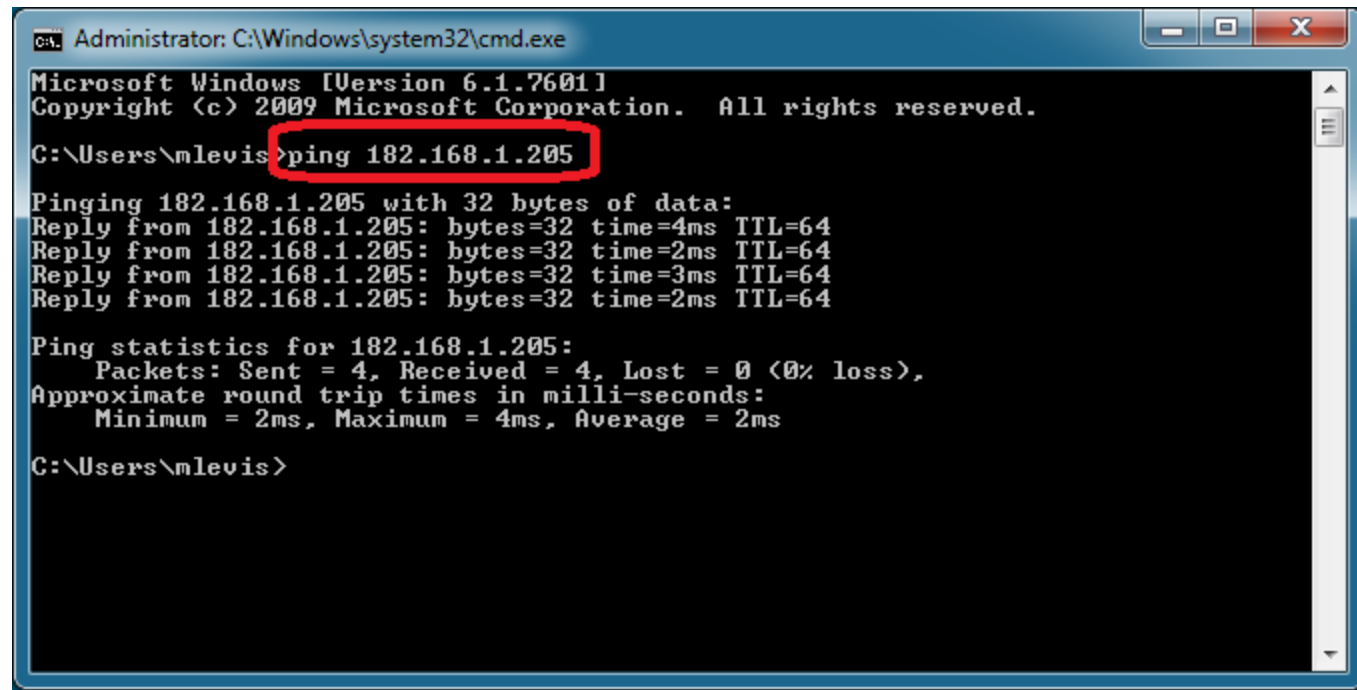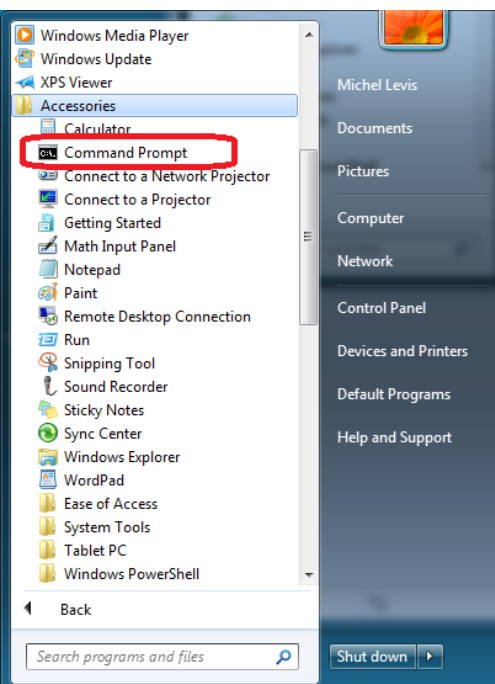- Wireless icon will have an "!" mark
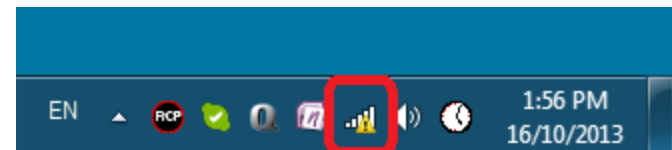
Qball IP

- Each Qball/Gumstix has a unique IP address

- IP address is labelled on the tail
  - between 182.168.1.20 and 182.168.1.254

Ping Test

1. Load "Command Prompt" (under *Start | Accessories*)
2. Enter "ping 182.168.1.xxx" command
3. Should get "Reply" message from Gumstix/Qball

Step 4) Testing the Sonar

1. Open HOST controller
   Sends commands to Qball / monitor signals
2. Open and configure Qball controller
   Download and runs on Gumstix
3. Run both controllers to fly Qball

Target
Runs model (controller)

Wifi
Send code to target (Gumstix)
Send/Receive scope data,
update runtime parameters

QuaRC®
accelerate design

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HiQ and Gumstix
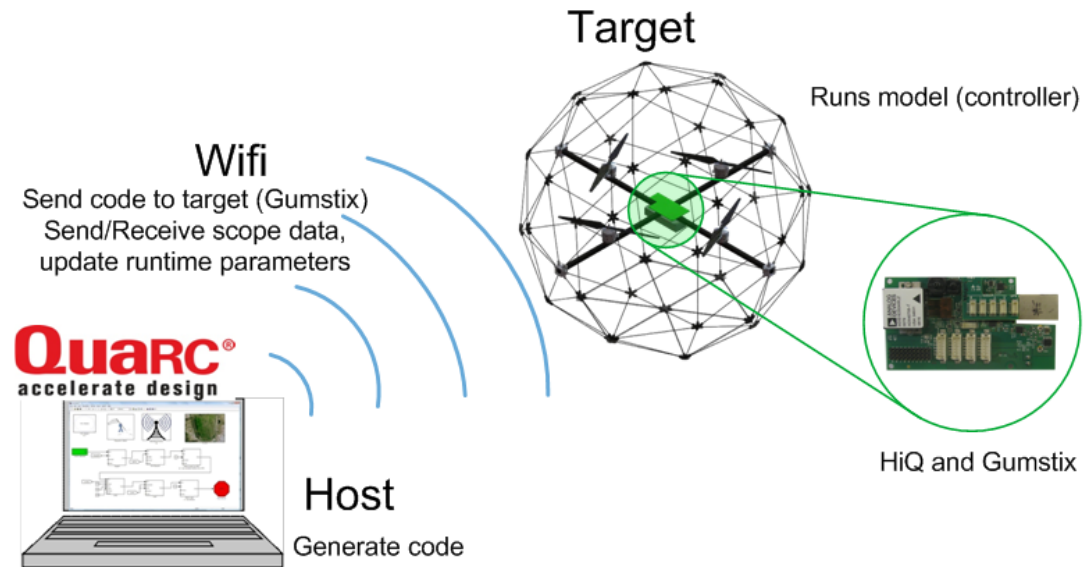
Initial Sonar Test

- Before flying the Qball, we will first make sure the **sonar sensor is reading properly**

- Using the sonar to detect the Qball height makes it easier to fly – especially the 1st time
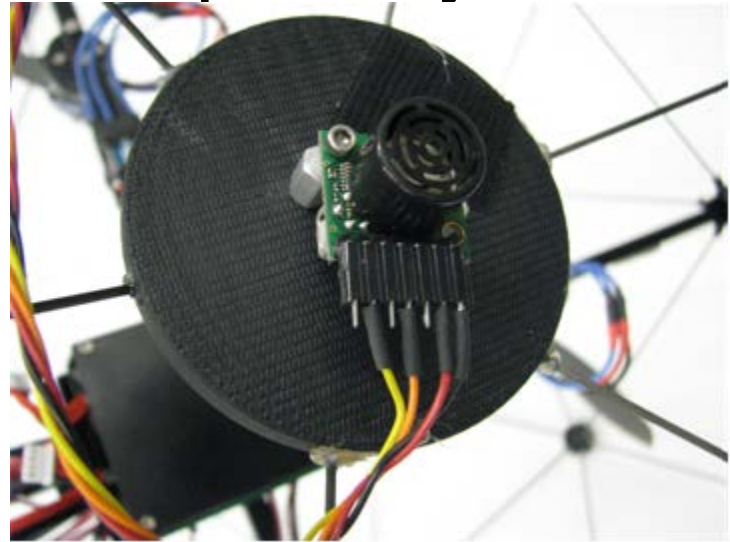
Joystick

- Connect joystick your PC via USB
- Make sure throttle is initially in the "down" position!

Throttle – place in 'down' position

Open HOST Controller

1. Go to the "\QBALL-X4\Controllers\Qball-X4" folder in MATLAB

2. Open the "**Host_Joystick_TYPE_A**" Simulink model

   Or "Host_Joystick_TYPE_B" -- check label on your joystick
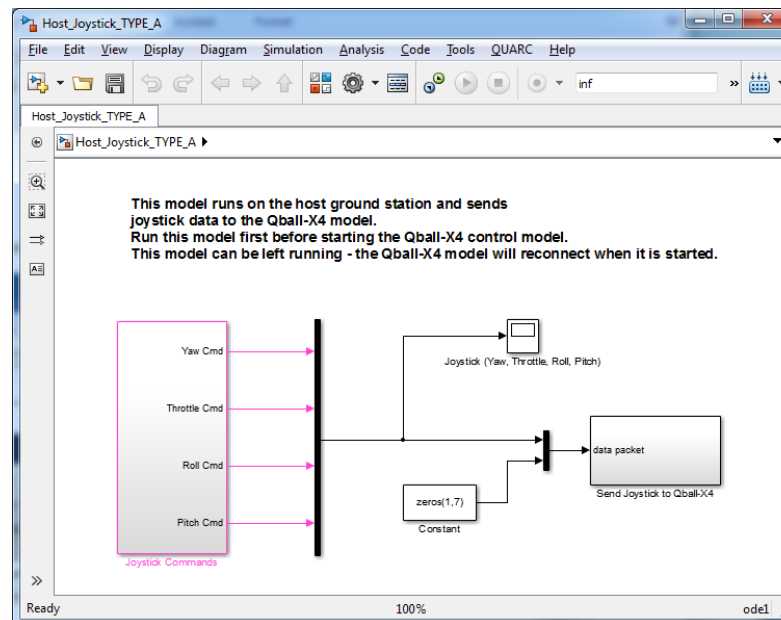
Open QBALL Controller

- Open "qball_x4_control_v4" Simulink model
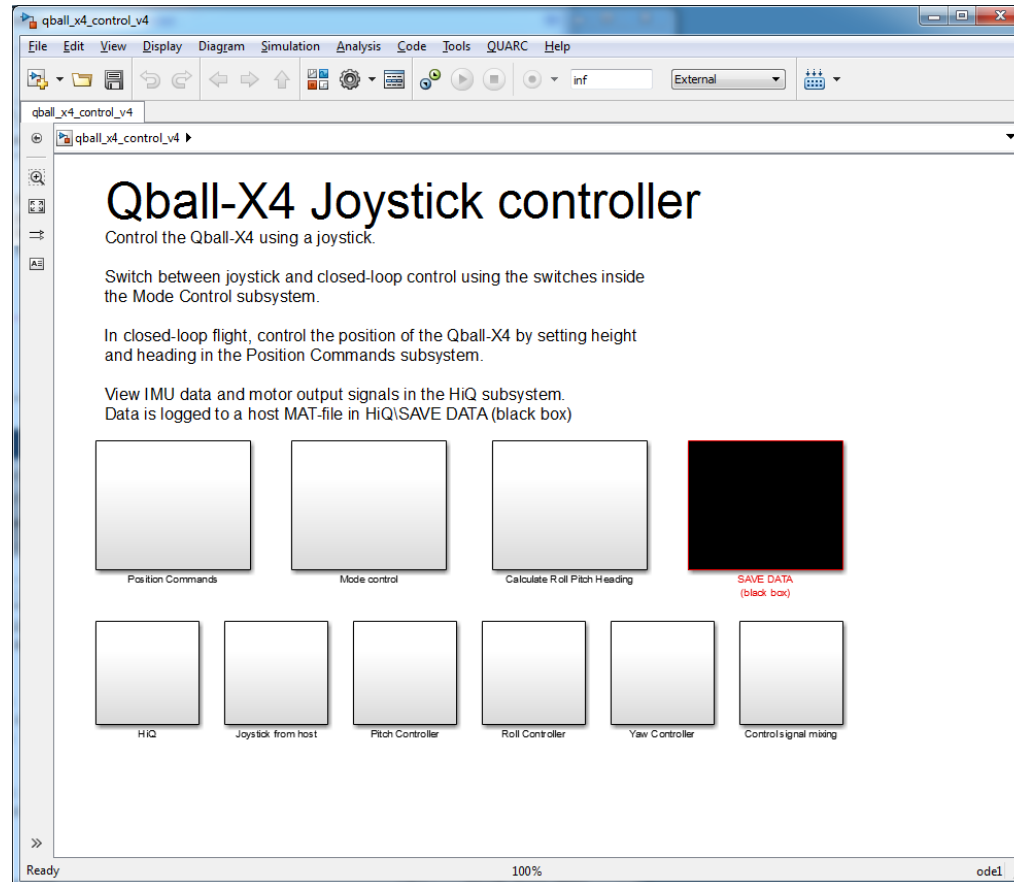
Configure Model

- In *qball_x4_control_v4*, go to QUARC | Options and select the *Interface* panel
- Add the following to the *MEX-file arguments* field: `tcpip://{IP of Gumstix}:17001`
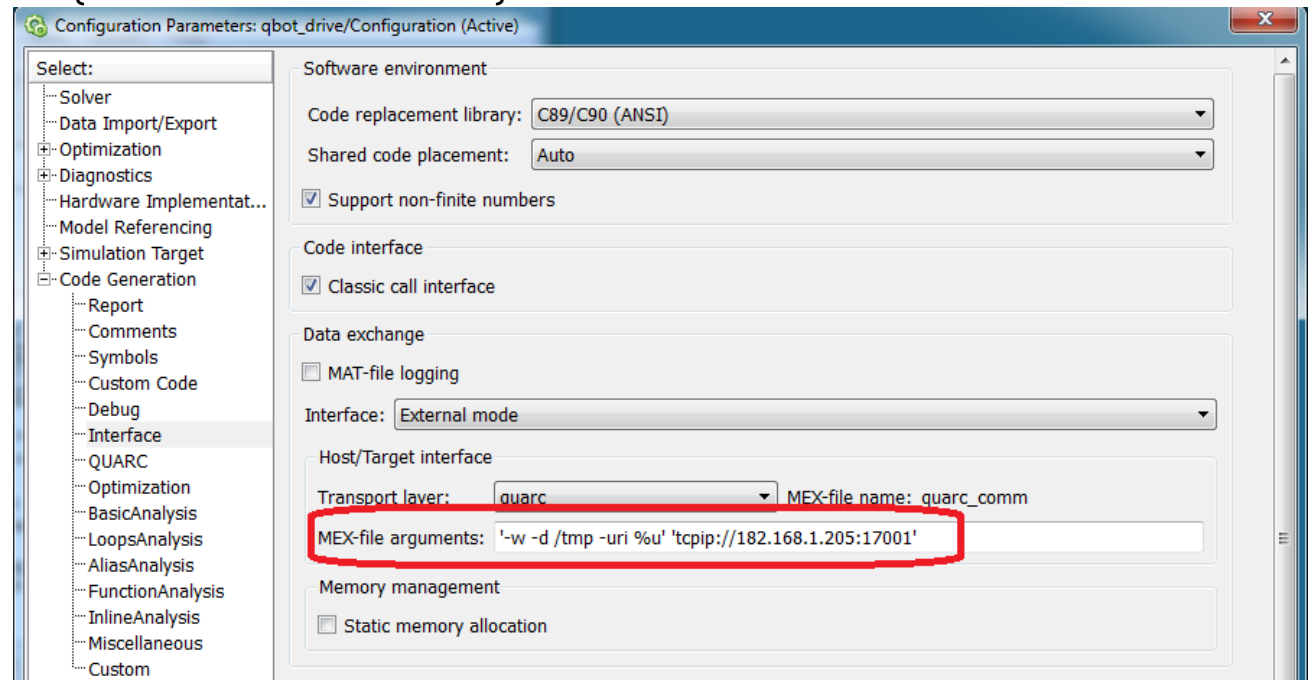
Setup HOST IP

1. In *qball_x4_control*, go to the "Joystick from host" subsystem

2. Set the IP address of your HOST PC in the *Stream Client* block (e.g. 182.168.1.6)
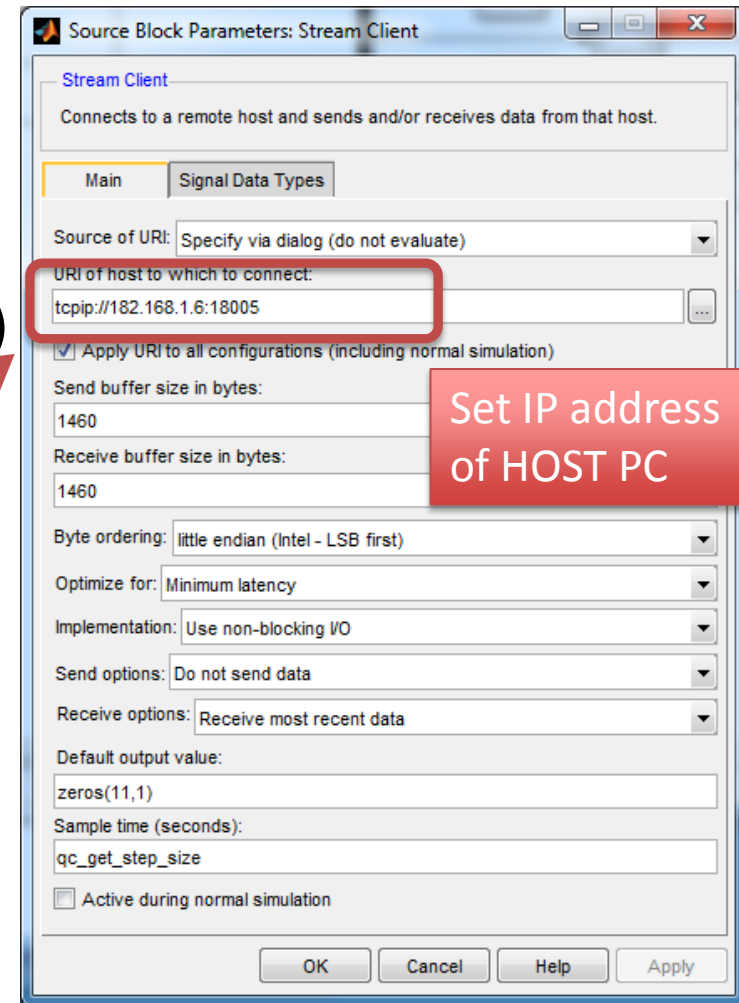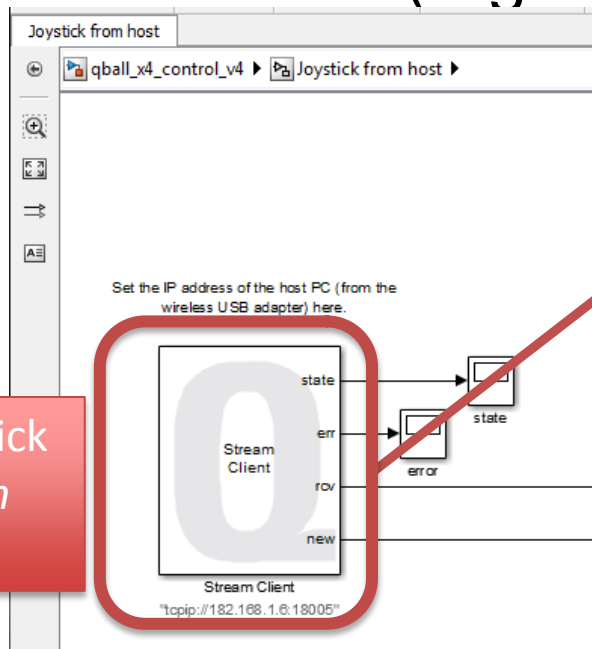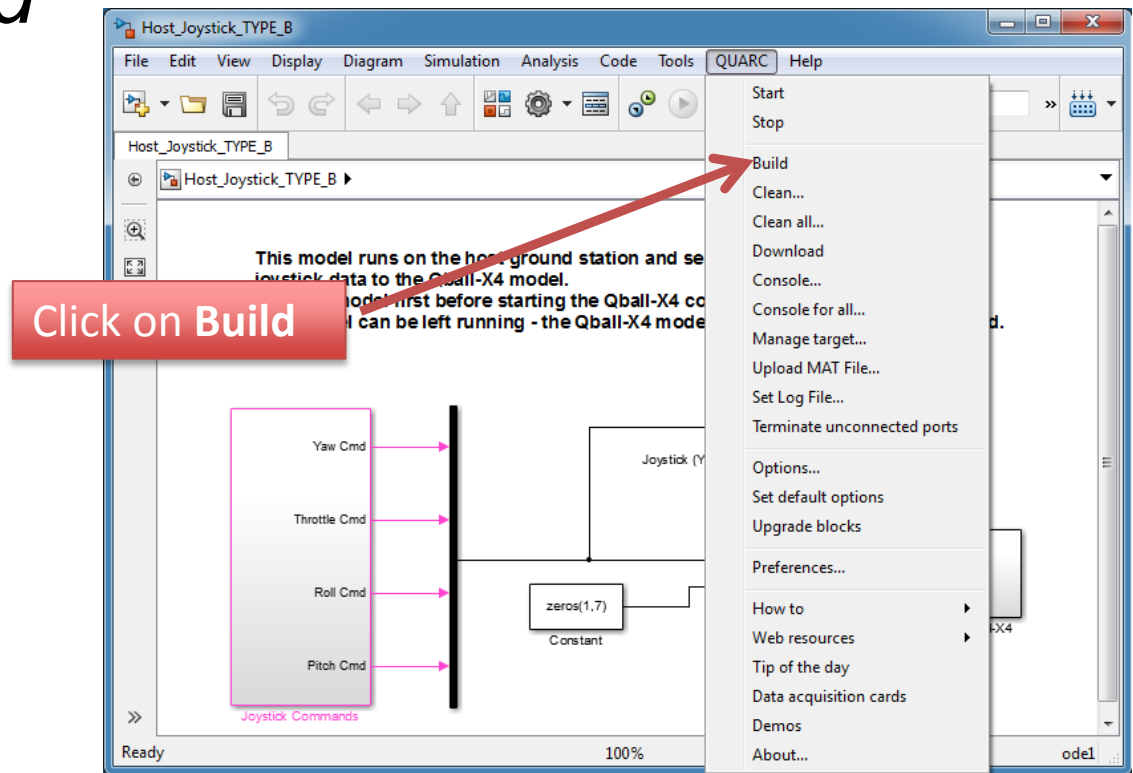

Double-click on *Stream Client*

Set IP address of HOST PC

Turn OFF Motors (for now)

1. In order to test the sonar, we need to temporarily deactivate the motors
2. Go to *HiQ* subsystem
3. Set the *Gain* block to "[1 1 1 1]*0"

Motor outputs: back, front, left, right

Set to [1 1 1 1]*0 to shut off motors
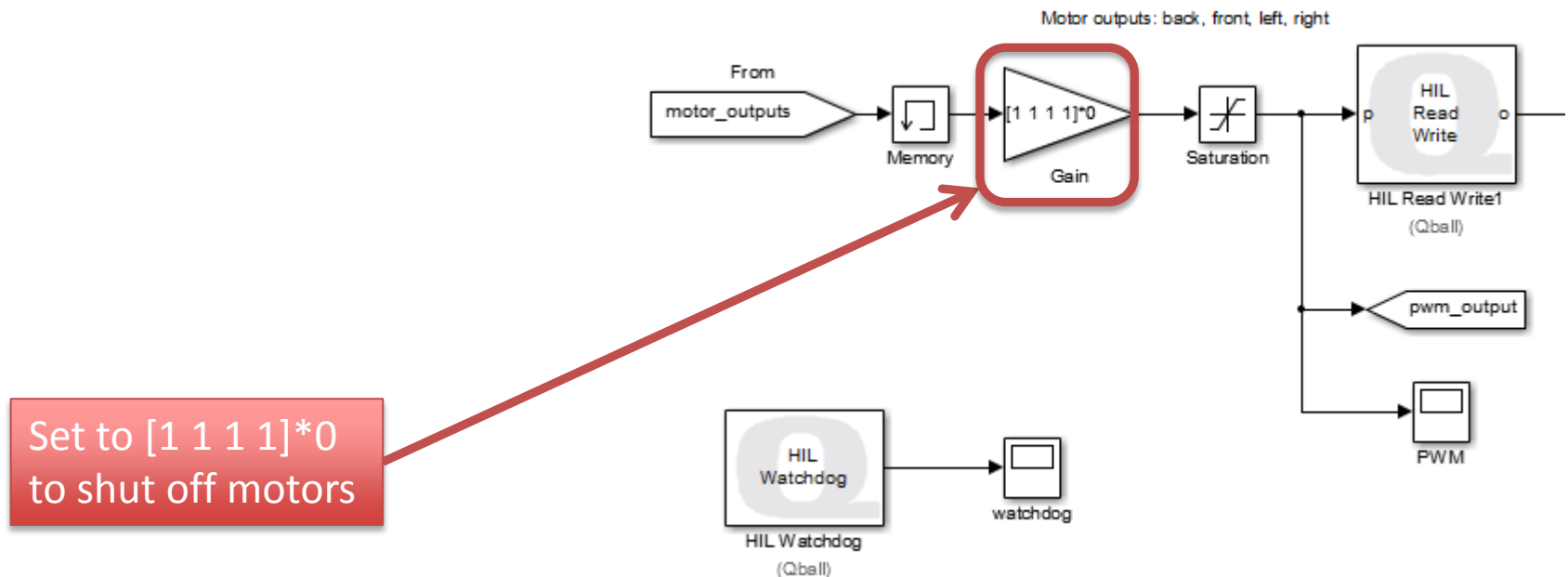
Build HOST Controller

- In the *Host_Joystick_TYPE_B*, go to *QUARC | Build*

Build Qball Controller

- In *qball_x4_control_v4*, go to *QUARC | Build*
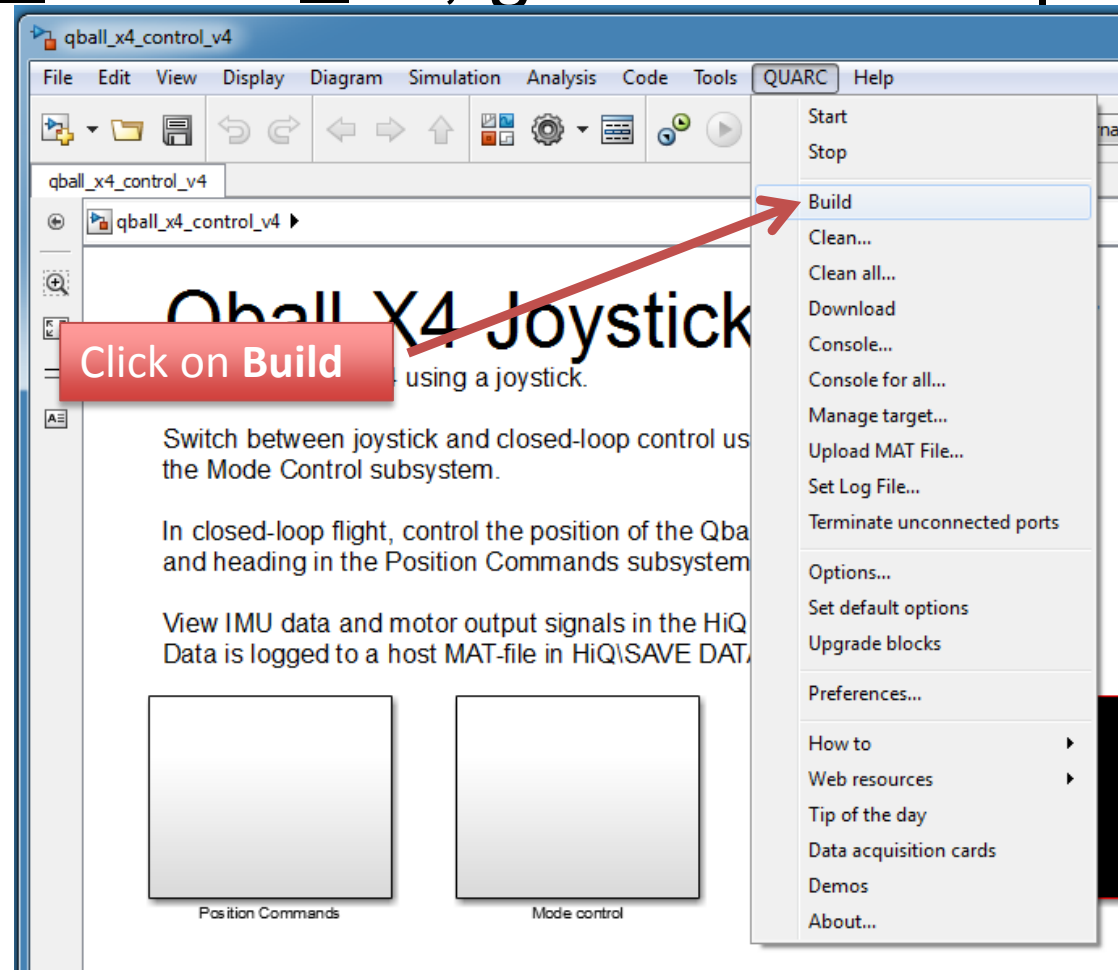
MATLAB Prompt

- The following message should be shown in the MATLAB Command Window:

```
### Created executable qbot_drive.rt-linux_verdex
### Downloading qball_x4_control_v4 to target 'tcpip://182.168.1.205:17000' ...
### Model qball_x4_control_v4_drive has been downloaded to target
    'tcpip://182.168.1.205:17000'
```
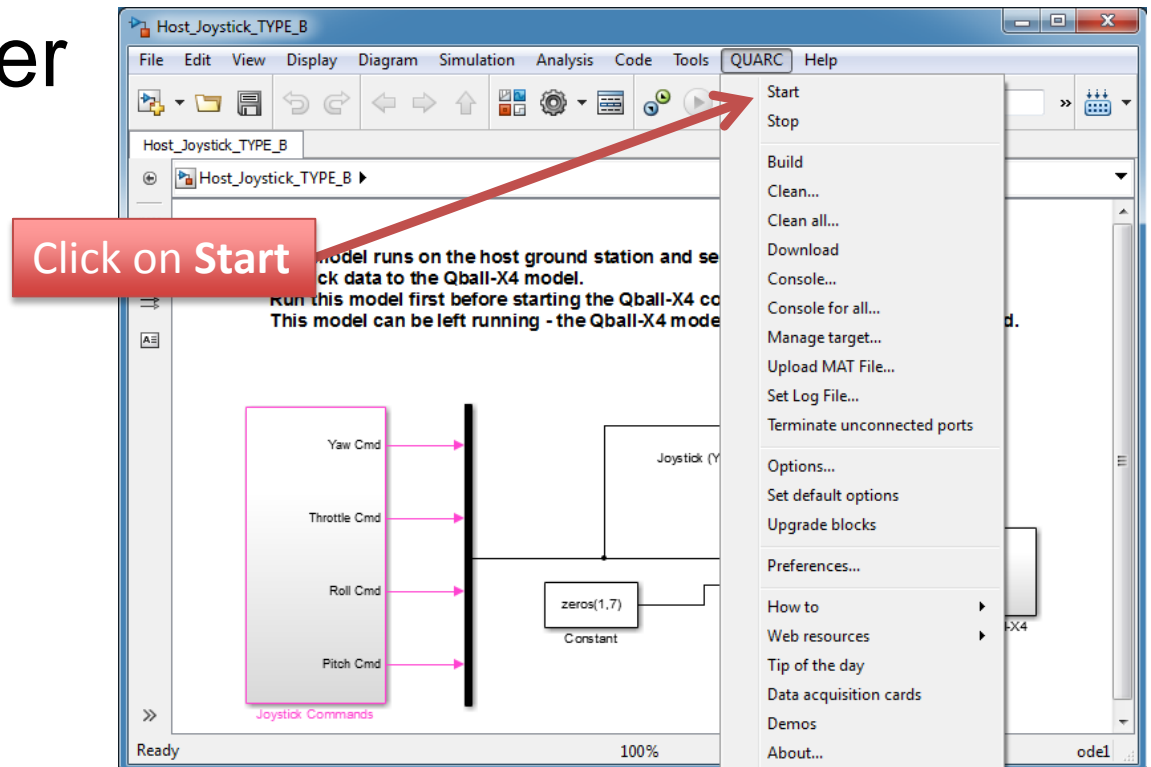

Did it download?
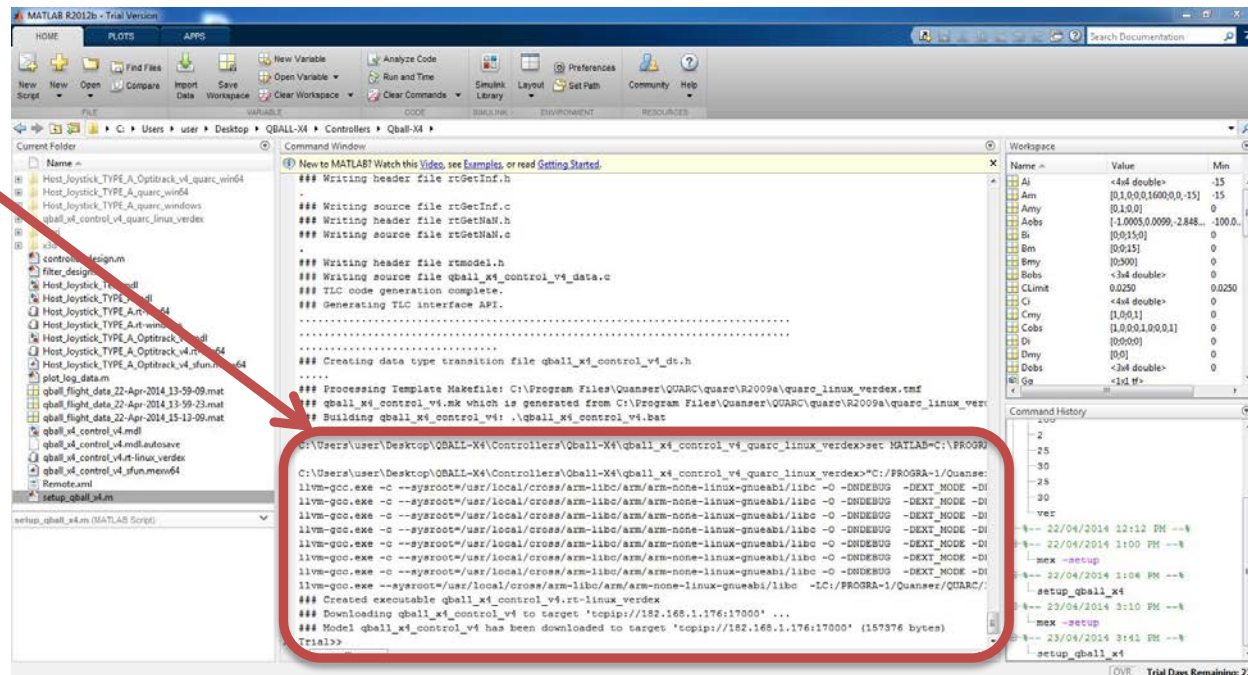
Did it download?

- If the "target downloaded to…" message was **NOT seen** in the MATLAB prompt then go [here](#).

Not downloaded to Qball.

Run HOST Controller

- In *Host_Joystick_Type_B*, go to *QUARC | Start*

- Always start this controller BEFORE the Qball controller

Run Qball Controller

- In *qball_x4_control*, go to *QUARC | Start*
- Always start this controller AFTER the HOST PC controller
- Beeping should stop

-- If you don't start this after the HOST, you will get communication error prompts
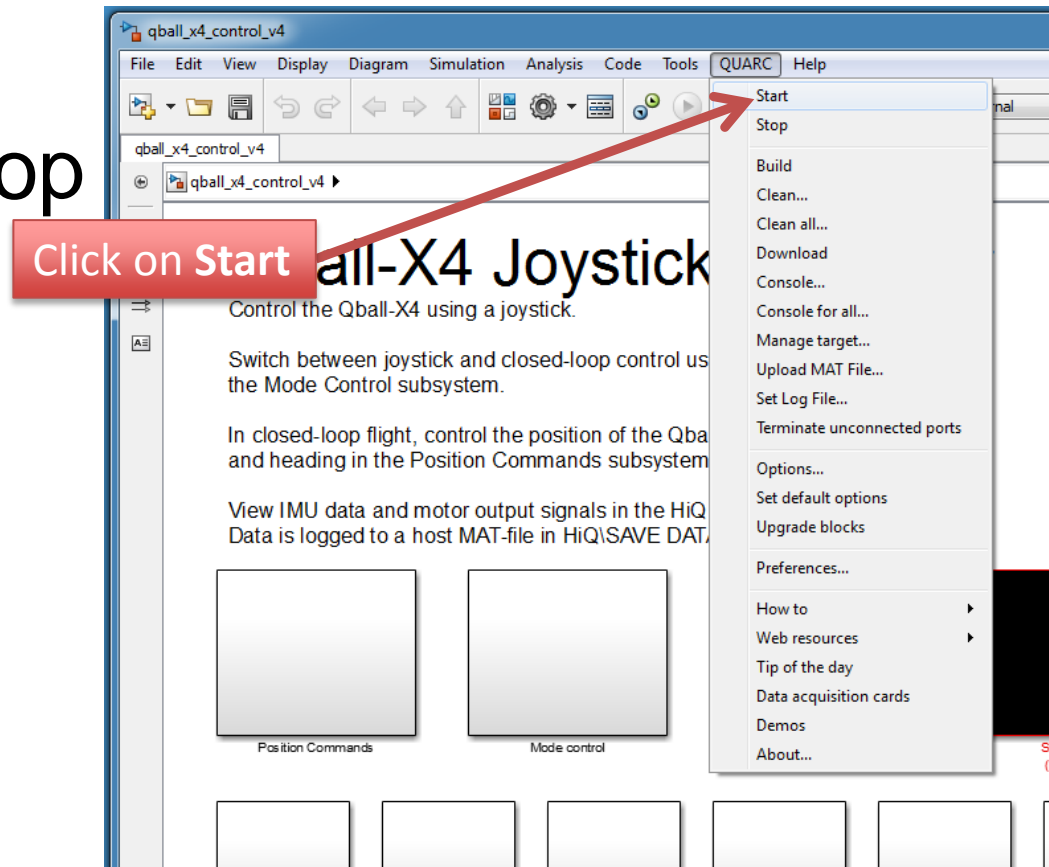
Testing Sonar

- Select the *qball_x4_control_v4* controller
- Go into the *HiQ* subsystem and double-click on the *Sonar* scope

Double-click on *sonar* scope
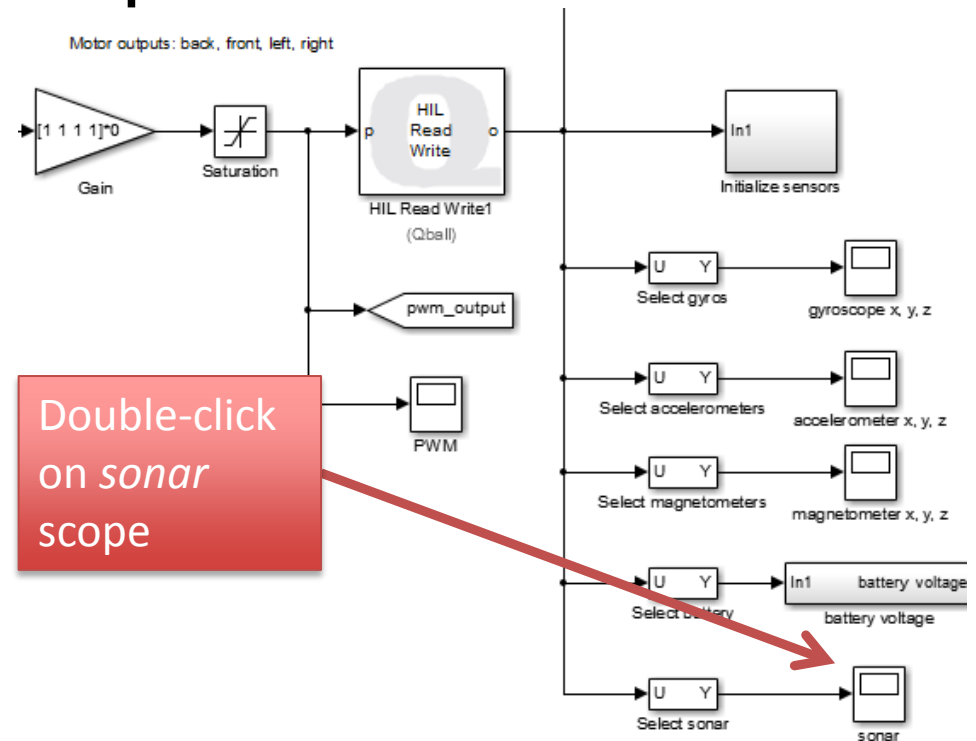
Testing Sonar

- Sonar shows the height measurement
  - Note: range about 0.2 m to 7.6 m
- Manually lift up the Qball by the edges (as shown [here](#))
- Is the *Sonar* scope showing the measurement?

Should see this response when lifting up Qball

QUANSER
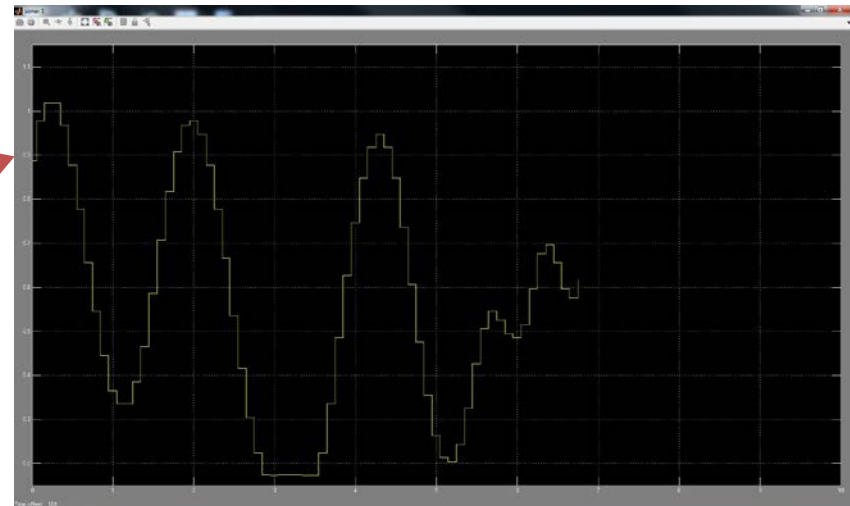
Sonar Working?

1. If the sonar is reading properly, then place the Qball back down

2. Stop both controllers:

   1. In *qball_x4_control_v4* controller, go to *QUARC | Stop*

   2. Similarly, stop the *Host_Joystick_Type_B* controller.
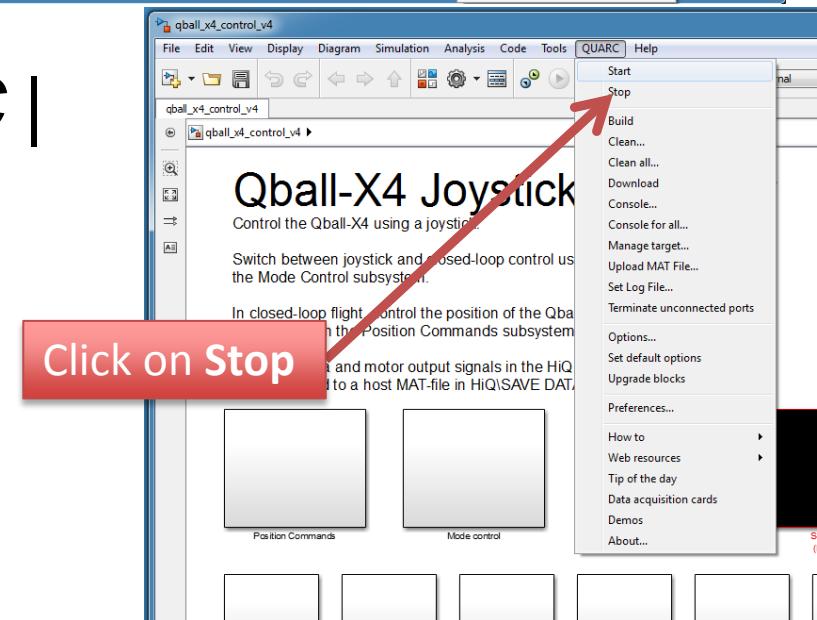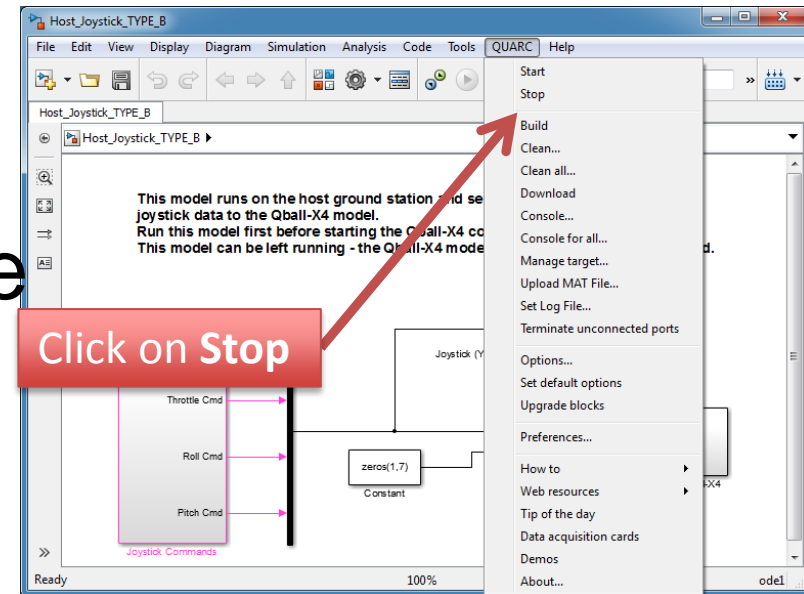
Step 5) Flying the Qball

1. Turn ON automated height control (using sonar)
2. Enable the motors
3. Fly the Qball

Turn ON Height Control

- Go to the *Mode Control* subsystem in the *qball_x4_control_v4*
- Turn ON the *height_mode* switch
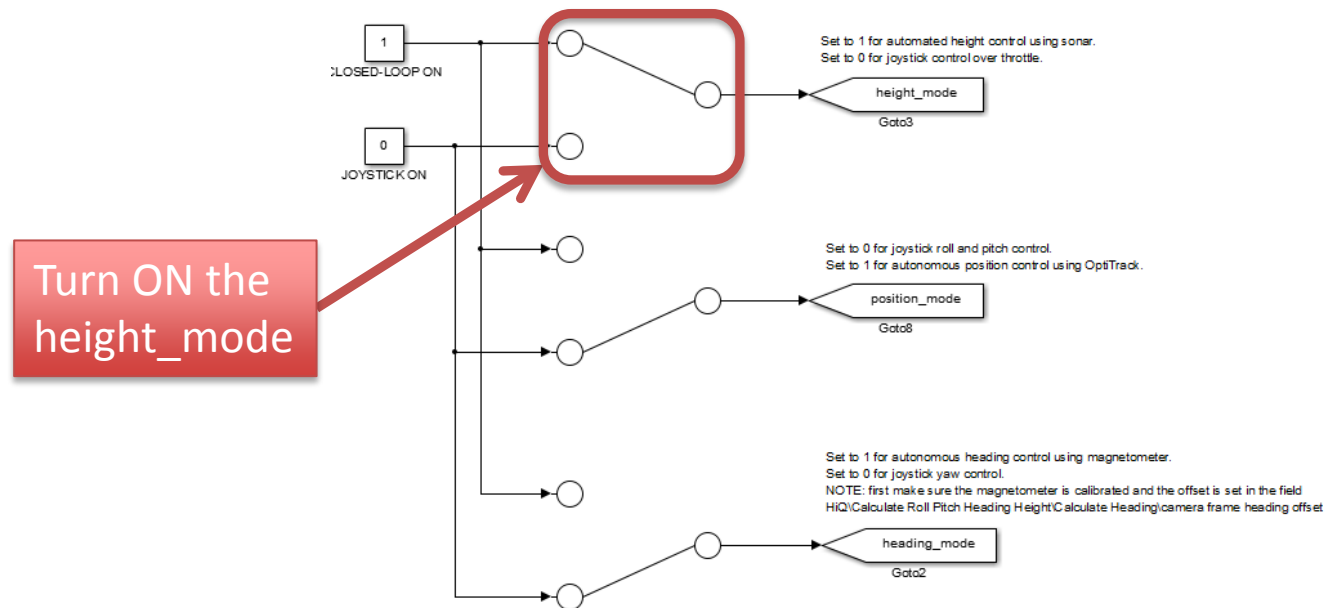
Enable the Motors

- In *qball_x4_control_v4*, set the *Gain* block in the *HiQ* subsystem back to [1 1 1 1]*1

Motor outputs: back, front, left, right

Enable the motors again
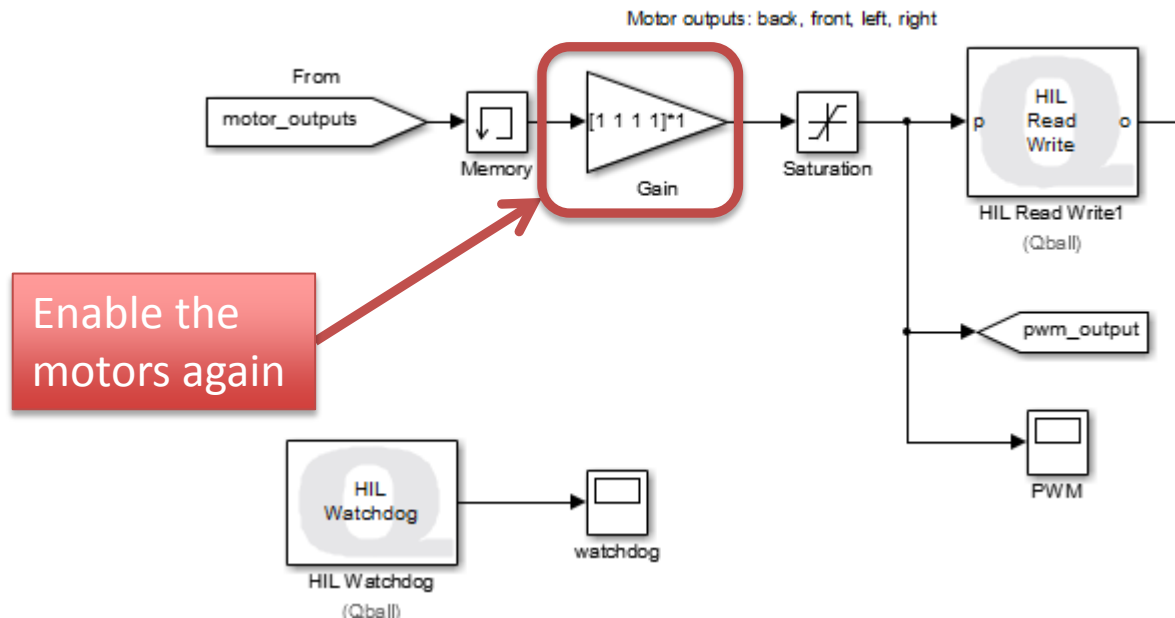
Run the Controllers

- Run the controllers following the same procedure:
  - Run *Host_Joystick_Type_B* (i.e. go to QUARC | Start)
  - Run *qball_x4_control_v4*
    - Note: always run the qball controller AFTER the host controller

Controlling the Qball

- You have control of the pitch and yaw
- Height control is automated
- Make **slow** movements – Qball is very sensitive to the commands

Go up

Pitch forward

Yaw clockwise

Roll left

Roll right

Yaw CCW

Pitch backward

Go down

FMS-Flight-Simulator
GWFSM003
MADE IN CHINA
www.gws.com.tw
www.gwsus.com

FRONT
z
x
Roll
Yaw
Pitch
y
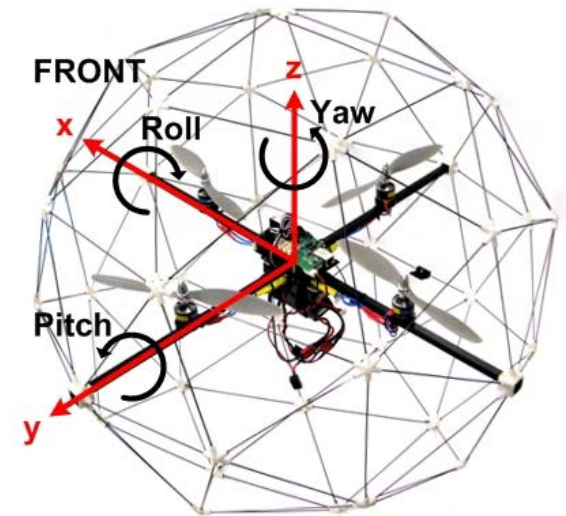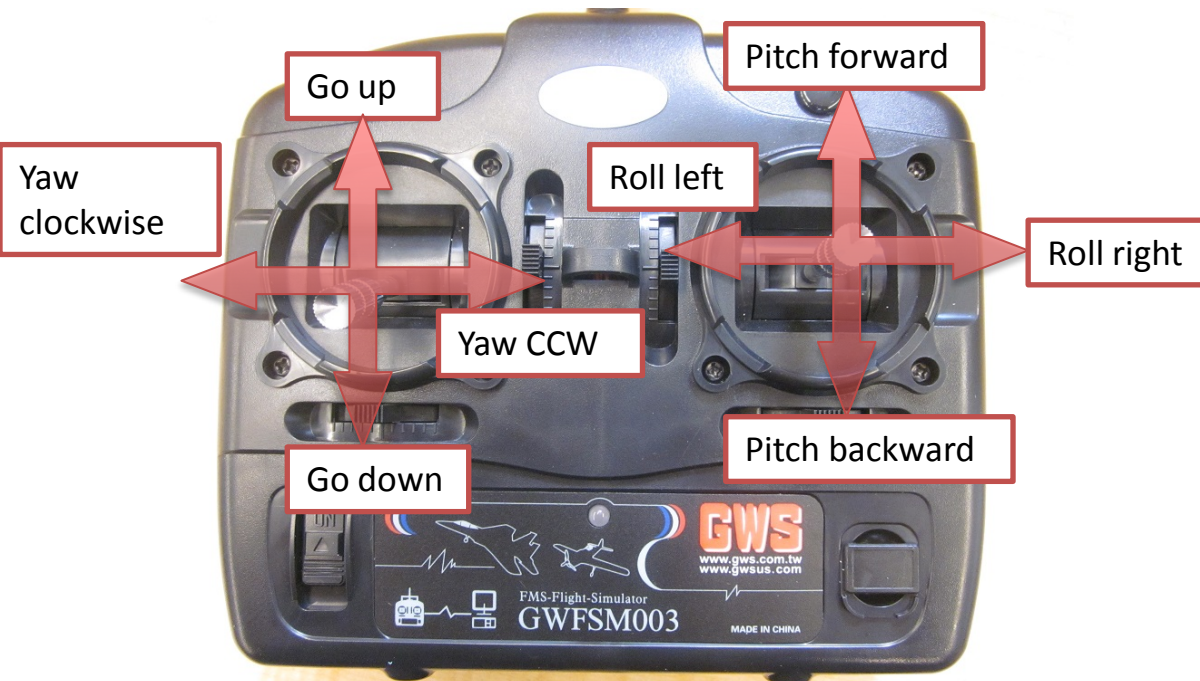
Slowly Increase Throttle

1. Slowly increase the throttle of the joystick
2. Propellers should eventually start spinning and Qball will start lifting
3. Most of control done with RIGHT pitch/roll joystick control

Slowly begin to bring up the throttle

Control mostly done w/pitch/roll joystick control

Keep Tail Towards You

- Try to keep the Qball tail (marked in orange tape) towards you

- Use the yaw controller on the joystick

Adjust yaw to keep tail pointing towards you

Stopping the Qball

1. Bring joystick throttle DOWN to land Qball
2. Stop the *qball_x4_control_v4* controller
3. Stop the *Host_Joystick_Type_B* controller

Bring throttle DOWN to land the Qball

Common Download Issues

- Are you still connected to the GSAH network?

- Go back to the "**ping test**" to confirm that you can "talk to" the Gumstix/Qbot

- Make sure you set the **correct IP and port** in *qbot_drive* (e.g. 'tcpip://182.168.1.140:17001')

- Gumstix may be TOO full

Gumstix Full

- If it cannot download due to "Not enough system resources…" – Gumstix may be full

Not downloaded to Qball.

Clear Out Gumstix

1. Go to QUARC | *Manage target…*

2. Set IP in *URI*

3. View models downloaded to target

4. Select and remove ALL models

5. Try building "qball_x4_control_v4" again
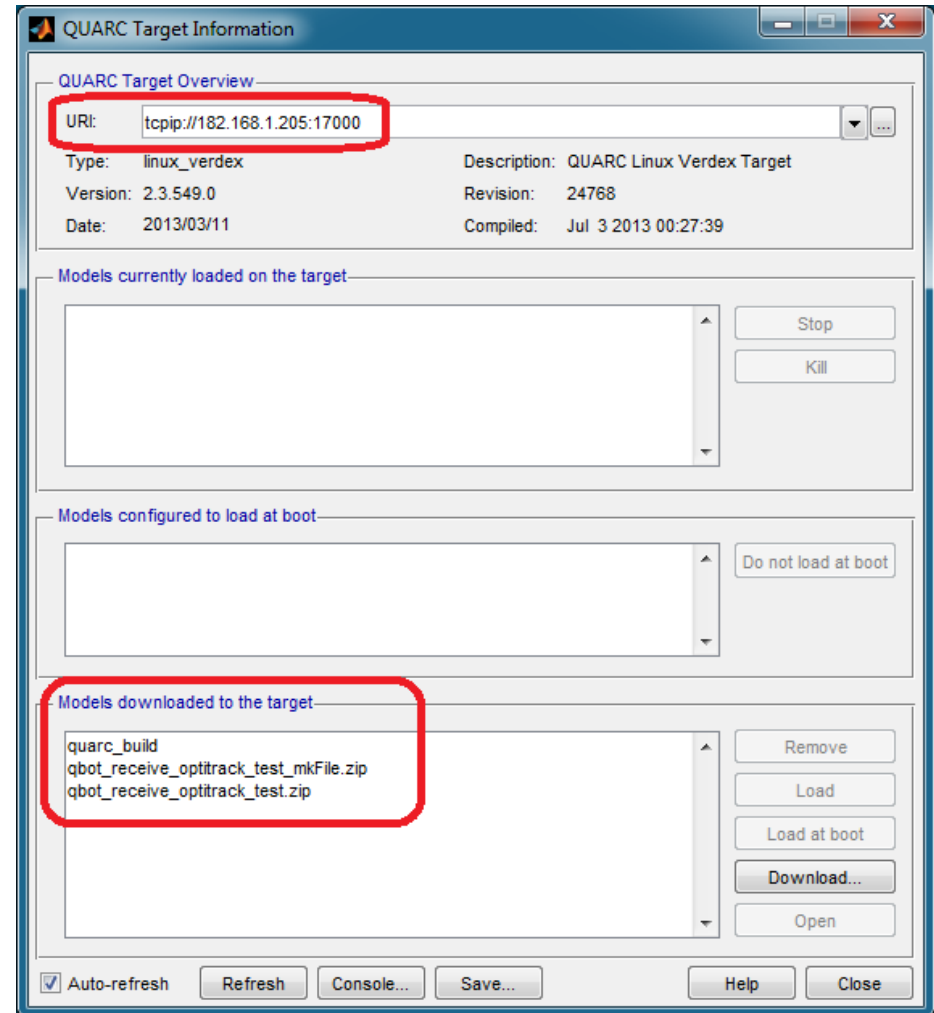
Still having issues?

- Still not downloading… go to the FAQ page at: http://www.quanser.com/FAQ

- See Section 8 in Qball User Manual

Quanser Qball-X4: User Manual

8. Troubleshooting Guide

For any issue, the first and easiest troubleshooting solution on any electronic device is to reboot the device. Turn off the Qball-X4, then turn it back on again. For troubleshooting any problem with the Qball-X4, it is always a good idea to open the QUARC console in case additional information is printed to the console by going to the QUARC menu and clicking on "Console for all…". The console must be opened after the Qball-X4 has booted and established a wifi connection. If the console is opened successfully it establishes a connection to the target and the console window has the title "QUARC Console for * at tcpip://182.168.1.xxx:17000", where xxx corresponds to the IP address of the Qball-X4.

If you are still unable to resolve the issue after reading through this section, contact tech@quanser.com for further assistance.

8.1. The Qball has crashed! What should I do?

First, make sure that the model is stopped and the power is turned off. Do not approach the Qball if the model is still running or the propellers are turning. Upon stopping the Qball model, a saved data MAT-file is created on the host PC in the current directory. Make a

Contact Technical Support

- If you are still having issues, contact technical support at: http://www.quanser.com/ContactUs