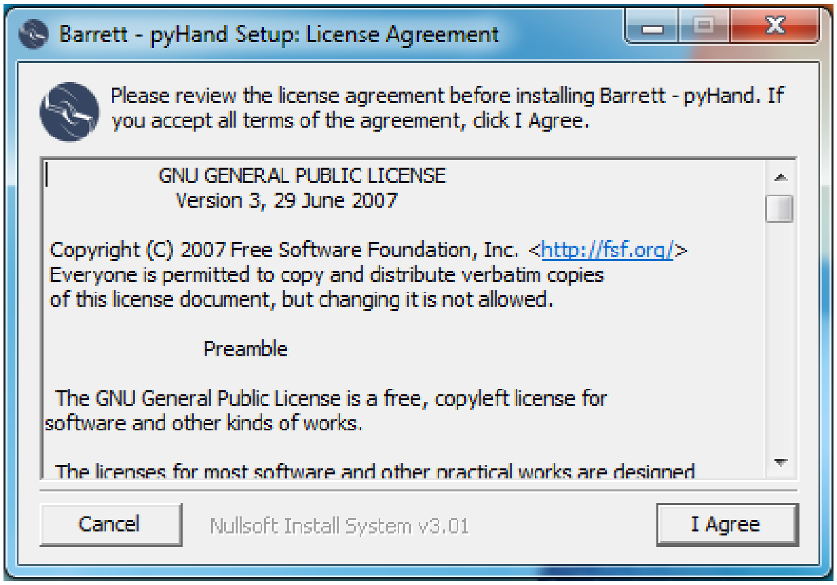
Barrett Technology Inc.
pyHand 2.0

Last Revised: August 10, 2017

Table of Contents

1 Installation

1.1 Windows



Barrett - pyHand Setup: License Agreement

Please review the license agreement before installing Barrett - pyHand. If you accept all terms of the agreement, click I Agree.

```
                GNU GENERAL PUBLIC LICENSE
                   Version 3, 29 June 2007

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                            Preamble

  The GNU General Public License is a free, copyleft license for
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  The licenses for most software and other practical works are designed
```

Figure 1: Barrett Technology pyHand Installer.

Note: If your Windows root directory is not "/C:", please use the Manual Installer.

Automatic Installation:

To install pyHand, open the "install" folder. Inside the "install" folder, there will be an executable named "Install_pyHand.exe". Run this file by double clicking on it.

The installer will take you through two steps. The first step will install the Peak-System drivers. Installing the Peak-System drivers will also trigger the pyHand installer to add the Peak-System DLL files to your system folders. The second step will install the pyHand program. A working copy of pyHand will have been installed and a desktop shortcut will have been created for you.

Manual Installation:

Manual installation requires 3 steps: Step 1, Install the Peak-System drivers. Step 2, Add the Peak-System DLL files to system folders. Step 3, Install pyHand.

Step 1
To install the Peak-System drivers, locate the "install" folder. Inside the install folder, there is another folder "Setup_Files". Inside the "Setup_ Files" folder, there is an installer file "PeakOemDrv.exe". Run it by double clicking on it. This installer will work on both 32 and 64 bit systems. Follow the on screen instructions.

Step 2
Add the Peak-System DLL files to system folders. In order for the CAN bus to work, these DLL files need to be located in the correct place. The steps will varry slightly depending on 32-bit versus 64-bit architecture. The DLL files can be found in the "Setup_Files" folder. The 32-bit DLL file can be found inside the folder "32", and the 64-bit DLL file can be found in the folder "64". If the host machine is running 32-bit Windows, the 32-bit DLL file needs to be copied into the "System32" folder, usually located "C:\Windows\System32". The 32-bit DLL files have now been moved. If the host machine is running 64-bit Windows, The 32-bit DLL needs to be copied into the "SysWOW64" folder, usually located at the path "C:\Windows\SysWOW64", and the 64-bit DLL needs to be copied into the "System32" folder, usually located at the path "C:\Windows\System32". Once you have copied the DLL files to the system folders, you are ready to install pyHand.

Step 3
To install pyHand navigate to the "install" directory. Inside this directory there is a file labeled "Install_pyHand.exe". Run this file by double clicking it, and follow the on screen instructions. Be sure to decline to install the Peak-System drivers. After completing the installer, you will have a working copy of pyHand installed on your computer and a shortcut will have been placed on your desktop.

1.2 Linux

Open a terminal prompt and extract pyHand by running:

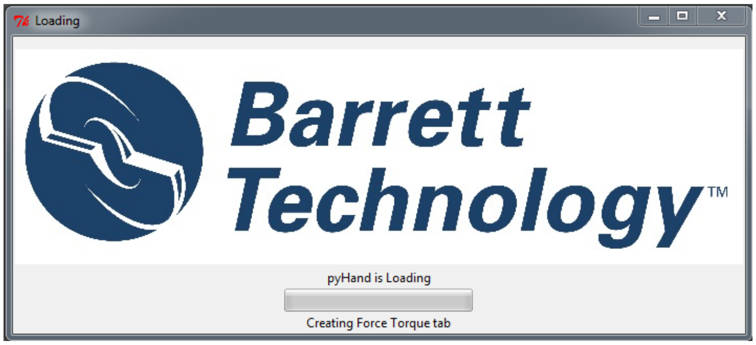
```
tar -xvf pyHand_file_name pyHand
```

Once you have extracted pyHand you are ready to run it. To run pyHand start by changing your working directory into your "pyHand" directory (ex. cd pyHand). Then run:

```
sudo ./pyHand
```

2 Getting Started

Make sure all physical connections to the hand are properly secured, the hand is plugged in, and turned on before double clicking the desktop shortcut to launch pyHand.



pyHand is Loading

Creating Force Torque tab

Figure 2: pyHand Loading screen.

As pyHand starts, the loading screen shown in Figure 2 is displayed. Your hand will not move until you click buttons that trigger motion in pyHand. When loading is complete, pyHand will open.

3 Status Bar

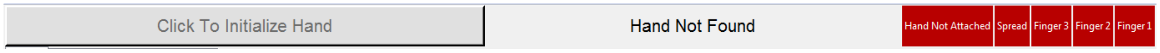


Figure 3: Status bar with hand disconnected.

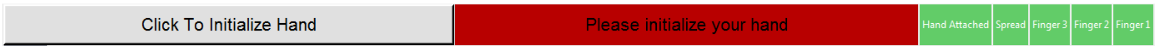


Figure 4: Status bar with hand connected but not initialized.

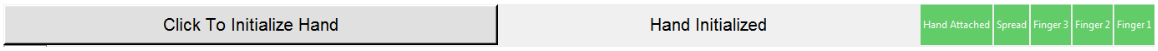
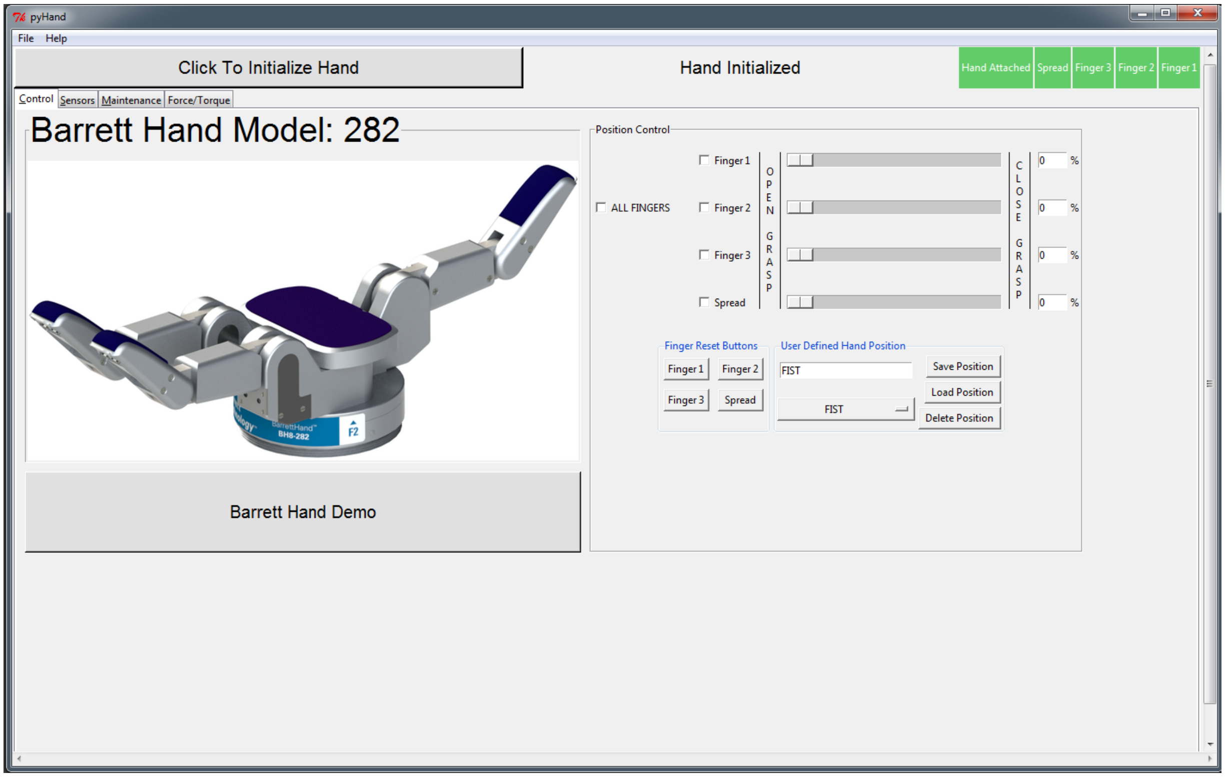


Figure 5: Status bar with hand connected and initialized.

The status bar displays if pyHand is connected to a hand and if it is initialized. When pyHand starts it may briefly display "Hand Not Found" before it connects to the hand. Once pyHand is connected to a hand you will need to initialize it with the "Click To Initialize Hand" button in order to enable many of the features on the Position Control Tab.

4 Position Control Tab



Hand Initialized

□ ALL FINGERS

□ Finger 1: 0 %

□ Finger 2: 0 %

□ Finger 3: 0 %

□ Spread: 0 %

User Defined Hand Position: FIST

FIST

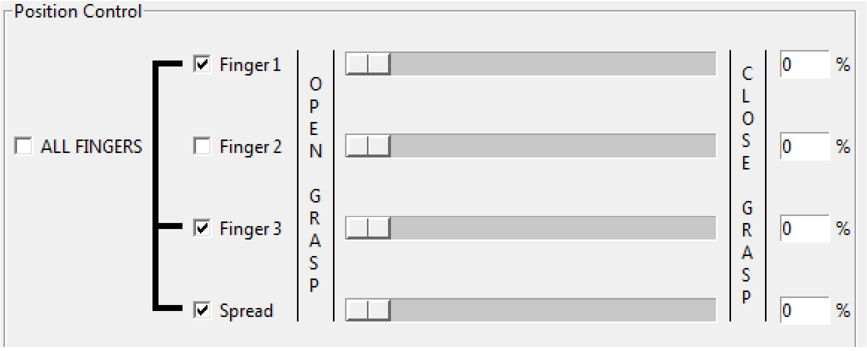
Figure 6: Position Control Tab.

This tab's primary purpose is manipulation of the Barrett Hand.

4.1 Demo

This button starts and stops a demonstration routine highlighting the hand's dexterity.

4.2 Position Control



□ ALL FINGERS

☑ Finger 1 — 0 %

□ Finger 2 — 0 %

☑ Finger 3 — 0 %

☑ Spread — 0 %

Figure 7: Position Control tools.

4.2.1 Checkboxes

These checkboxes allow the user to select joints; If multiple joints are selected, those joints will move simultaneously. The checkbox marked “ALL FINGERS” toggles the selection of all three fingers, when depressed the checkboxes will return to the configuration in use before the “ALL FINGERS” box was checked.

4.2.2 Linking Visual

The bars next to the checkboxes provide a visual representation of selected and linked fingers.

4.2.3 Sliders

The sliders allow the user to manipulate the hand’s joints.

Note: The kinematic model of the Barrett Hand is not taken into account in pyHand. As a result, joint collisions are possible. Please use caution when manipulating joints. If a collision occurs, a joint may become unresponsive. It may be fixed by resetting the joint or initializing the hand.

Note: Using an entry box to adjust a joint will only move the associated joint and slider even if multiple joints are in a linked state.

4.2.4 Entryboxes

Entryboxes allow the user to input positions. Once the user inputs a position and hits enter, both the slider and the joint will move to the input.

4.3 Finger Reset

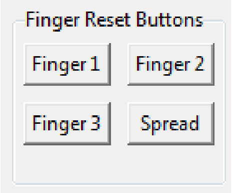
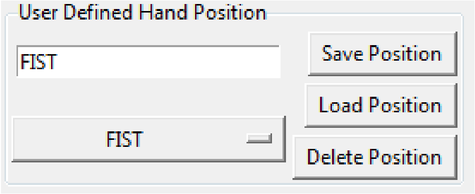


Figure 8: Reset individual joints.

These buttons reset the individual joints.

4.4 Load/Save Positions



FIST

FIST

Figure 9: Load Save Options

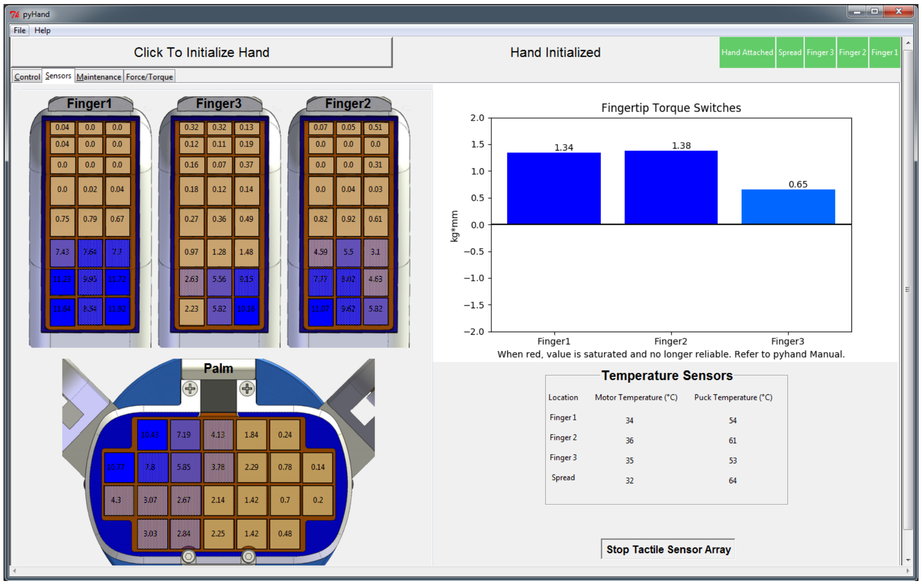
To save a position, type a name in the entry box under “User Defined Hand Position” and press ”Save Position”.

To load a position, select the desired position via the drop down menu. Click the ”Load Position” button. Once pressed, the joints will move to the selected position.

To delete a position, select the position via the drop down menu and click the ”Delete Position” button.

Note, some positions are built-in and cannot be deleted.

5 Sensor Tab



Finger1

0.04	0.0	0.0
0.04	0.0	0.0
0.0	0.0	0.0
0.0	0.02	0.04
0.75	0.79	0.67
7.43	7.64	7.7
11.23	9.95	11.72
11.64	8.54	11.92

Finger3

0.32	0.32	0.13
0.12	0.11	0.19
0.16	0.07	0.37
0.18	0.12	0.14
0.27	0.36	0.49
0.97	1.28	1.48
2.63	5.56	9.15
2.23	5.82	10.16

Finger2

0.07	0.05	0.51
0.0	0.0	0.0
0.0	0.0	0.31
0.0	0.04	0.03
0.82	0.92	0.61
4.59	5.5	3.1
7.77	8.02	4.63
11.07	9.62	5.82

Palm

	10.43	7.19	4.13	1.84	0.24	
10.77	7.8	5.85	3.78	2.29	0.78	0.14
4.3	3.07	2.67	2.14	1.42	0.7	0.2
	3.03	2.84	2.25	1.42	0.48	

When red, value is saturated and no longer reliable. Refer to pyhand Manual.

Temperature Sensors

Location	Motor Temperature (°C)	Puck Temperature (°C)
Finger 1	34	54
Finger 2	36	61
Finger 3	35	53
Spread	32	64

Figure 10: Second Tab of pyHand: Sensor Tab.

This tab displays sensor data from the Barrett Hand. Some of the sensors described are optional equipment.

5.1 Temperature Sensors

The temperature sensor data is always displayed. A warning will be displayed when a temperature is outside normal operating range (above 75 °C)

5.2 Fingertip Torque Switches

The Fingertip Torque Switch values, if installed, are shown on a bar graph.

5.2.1 Fingertip Torque Switch Data

The Fingertip Torque Switch data is converted to Newton-meters using the following polynomial fit, derived from experimental data:

$$f(x) = p_1 x^3 + p_2 x^2 + p_3 x + p_4 \tag{1}$$

Where f(x) is torque in Newton-meters and x is motor controller value.

$p_1 = 2.754 * 10^{-10}$, $p_2 = -1.708 * 10^{-6}$, $p_3 = 37.64 * 10^4$, $p_4 = -2.85$.

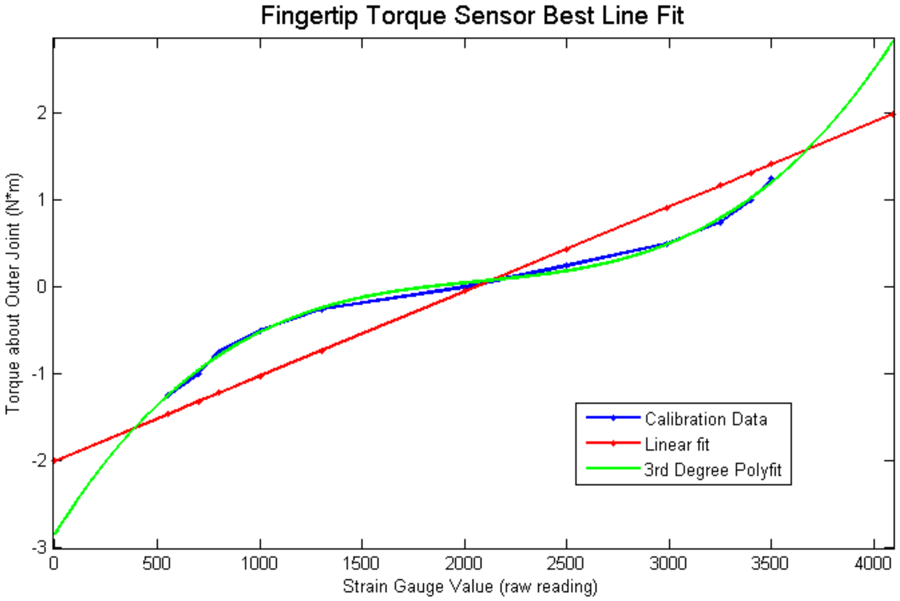
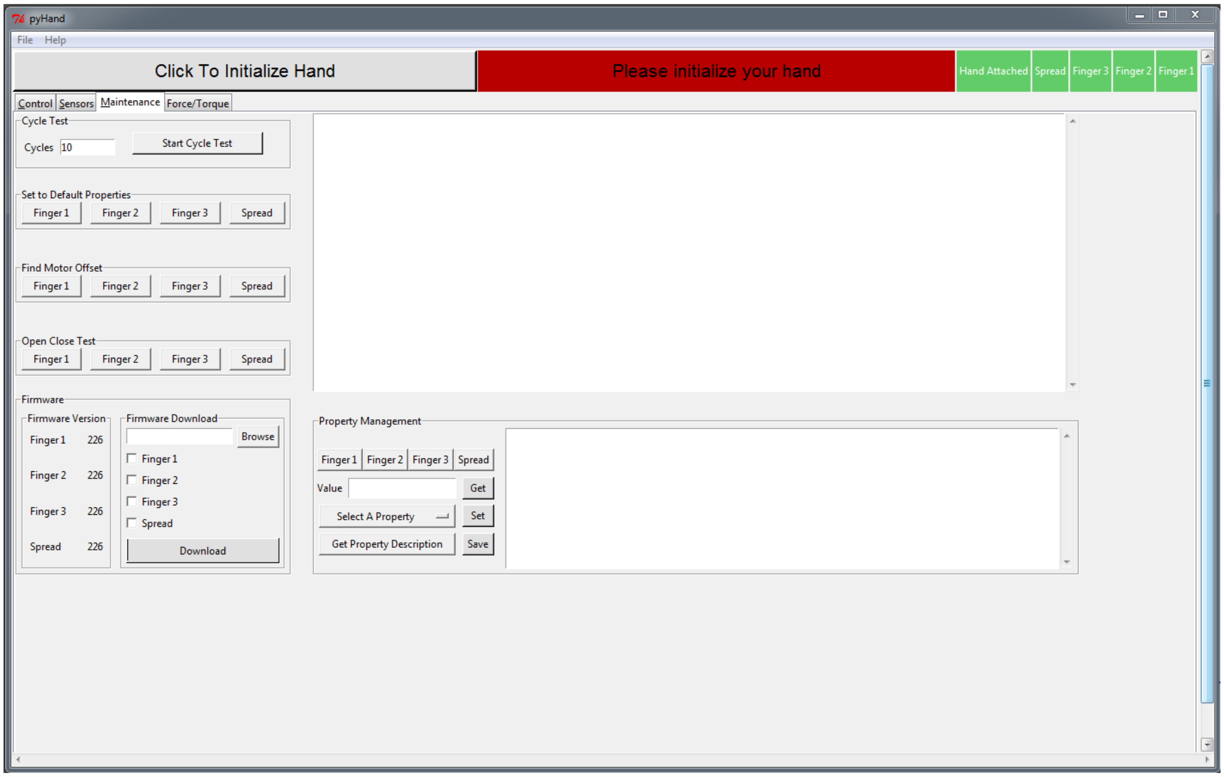


Figure 11: This figure shows the data of the Fingertip Torque Switch sample plotted against a linear and the polynomial fit. We obtain our saturation points for the Fingertip Torque Switches at the intersection points of the linear and polynomial fit.

5.3 Tactile Sensing Arrays

To display tactile sensor data, press the “Start Tactile Sensor” button on the bottom right of the Sensor Tab. When pressed, the Fingertip Torque Switch update rates are reduced. As the pressure on a cell increases, the background color of the cell darkens.

6 Maintenance Tab



Please initialize your hand

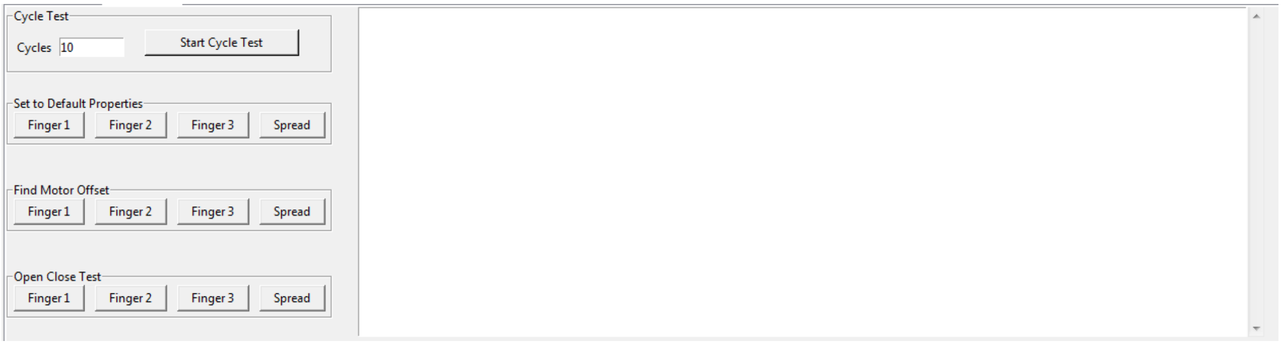
Cycles 10

Finger 1	226
Finger 2	226
Finger 3	226
Spread	226

Figure 12: The Maintenance tab.

This tab allows users to perform hand maintenance.

6.1 Cycle Test



Cycles 10

Figure 13: The cycle test, Set to Default Properties, Find Motor Offset, Open Close Test, and output text field.

Using trapezoidal control, the cycle test opens and closes the hand.

6.2 Default Properties

These buttons set and save a list of default properties, returning the selected joint to factory configuration.

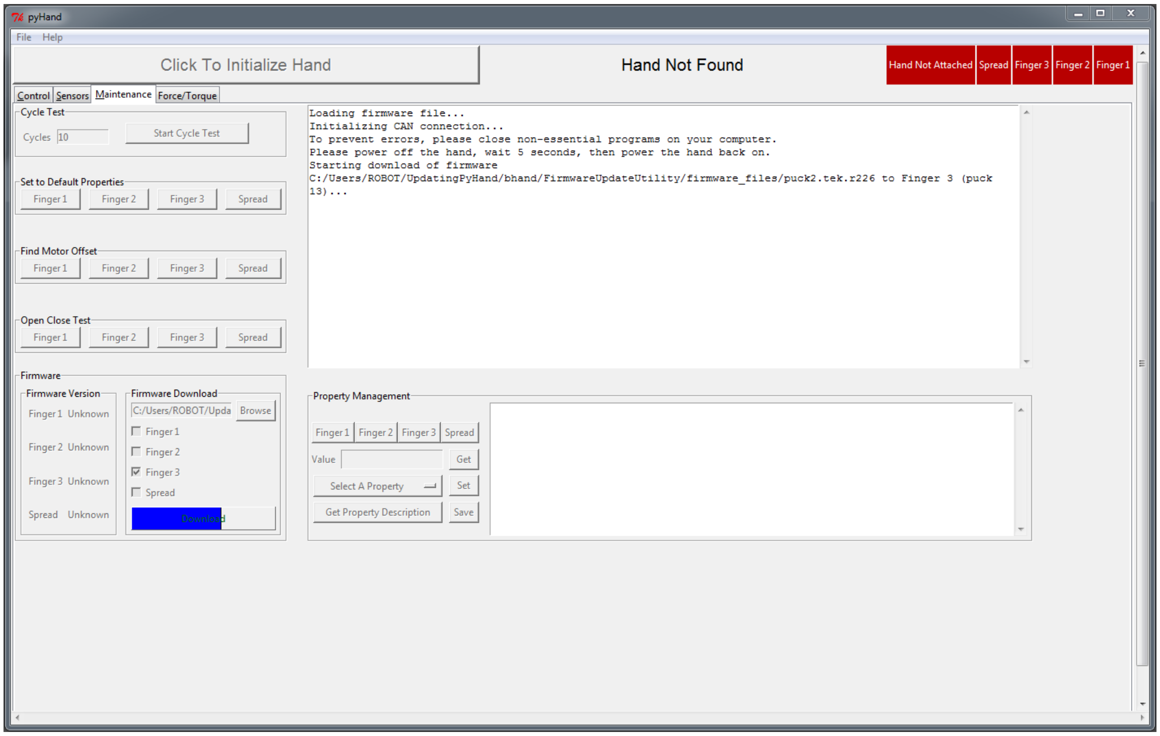
6.3 Motor Offsets

This test calibrates the offset for the motor current levels and position encoder readings. Warning: The motor offset test can cause permanent damage to the hand. Only use the motor offset test when instructed by Barrett personnel.

6.4 Open\Close Test

This test opens and closes the desired joint three times.

6.5 Firmware



Cycles 10

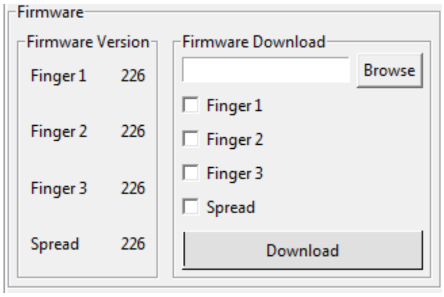
Finger 1 Unknown
Finger 2 Unknown
Finger 3 Unknown
Spread Unknown

C:/Users/ROBOT/Upda

□ Finger 1
□ Finger 2
☑ Finger 3
□ Spread

```
Loading firmware file...
Initializing CAN connection...
To prevent errors, please close non-essential programs on your computer.
Please power off the hand, wait 5 seconds, then power the hand back on.
Starting download of firmware
C:/Users/ROBOT/UpdatingPyHand/bhand/FirmwareUpdateUtility/firmware_files/puck2.tek.r226 to Finger 3 (puck
13)...
```

Figure 14: Firmware download process



Finger 1 226
Finger 2 226
Finger 3 226
Spread 226

□ Finger 1
□ Finger 2
□ Finger 3
□ Spread

Figure 15: Firmware frame

Firmware Version The firmware version is displayed in the bottom left-hand corner of your screen.

Firmware Download Click “Browse” and navigate to where the new firmware is located on your disk. Then click on the finger which you would like to update the firmware on. Then click “Download”. To download firmware, you need to run pyHand as an admin. The download button will provide onscreen instructions on how to download firmware.

6.6 Property Management

The property management can individually get, set, or save properties. Multiple joints can be selected, allowing simultaneous get, set, and save of properties.

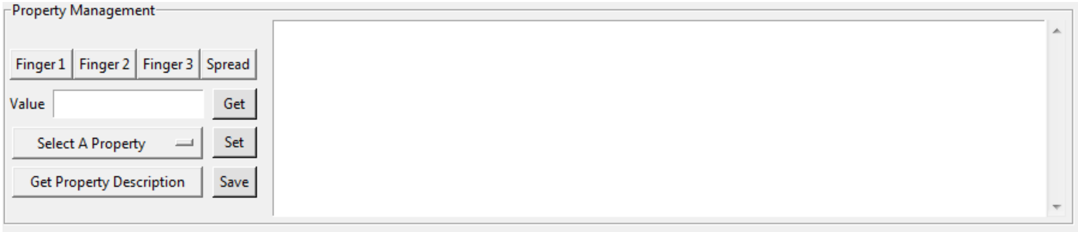
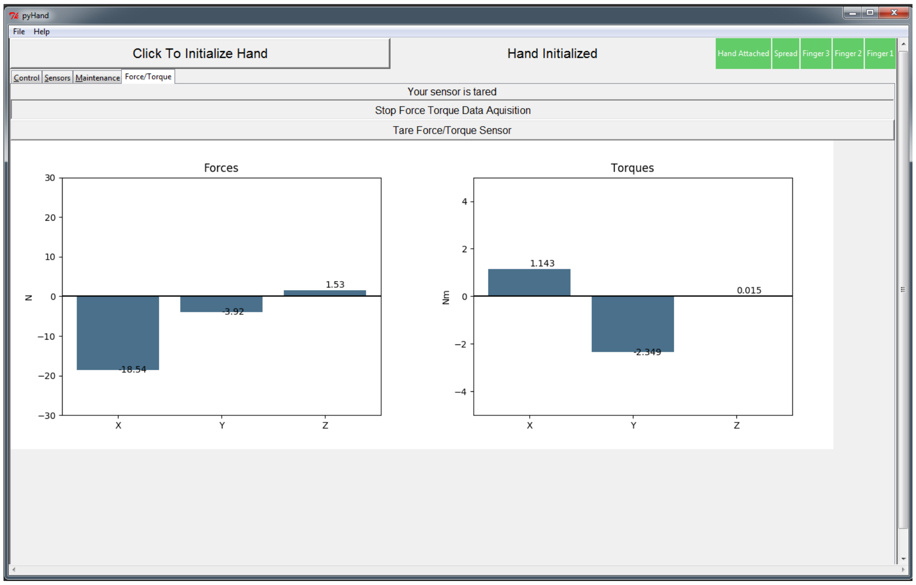


Figure 16: Property management and output text field.

7 Force-Torque Sensor Tab



Hand Initialized

Your sensor is tared

Figure 17: The Force Torque Tab.

This tab displays data from the Barrett Technology Force Torque Sensor. The forces and torques in each of the three Cartesian axes are shown. The Force Torque Sensor may saturate, causing invalid data. It is recommended to tare the sensor any time saturation occurs.

8 Troubleshooting

Known Issues:

1. pyHand displays "Hand Not Found" in the status bar

Cause:
These issues may be caused by a poor connection between the hand and the computer. Or the Peak-System Drivers are not correctly installed, or the DLL files are not in the proper

location.

Solution:
Physically disconnect and reconnect all of the connections between the hand and the computer, ensuring that they are all secure. Turn on the hand, wait 30 seconds.

If the problem persists ensure that the Peak-System Drivers are correctly installed, and that the DLL files are in the correct place. Read the Manual Installation instructions to re-install the Peak-System drivers and to confirm that the DLL files are in the correct location.

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2. pyHand's window says "Not Responding or your computers screen freezes during a Firmware download"

Cause:
The firmware download needs to run at a high system priority. If you try to authorize an application to run as admin or if you have to many programs open, your computer may freeze for a few moments.

Solution:
Wait for pyHand to become responsive again.

---

3. pyHand becomes unresponsive after clicking a button, or pyhand's window says "Not Responding"

Cause:
Some button clicks may send many messages to the hand, and the communication between the computer and the hand can sometimes take a noticeable amount of time. During the communication time, pyHand is unresponsive.

Solution:
Wait for pyHand to become responsive again.

9 Contact Us

Contact Barrett Technology Support

support@barrett.com
Barrett Technology Support Wiki
http://support.barrett.com/wiki/Hand/280