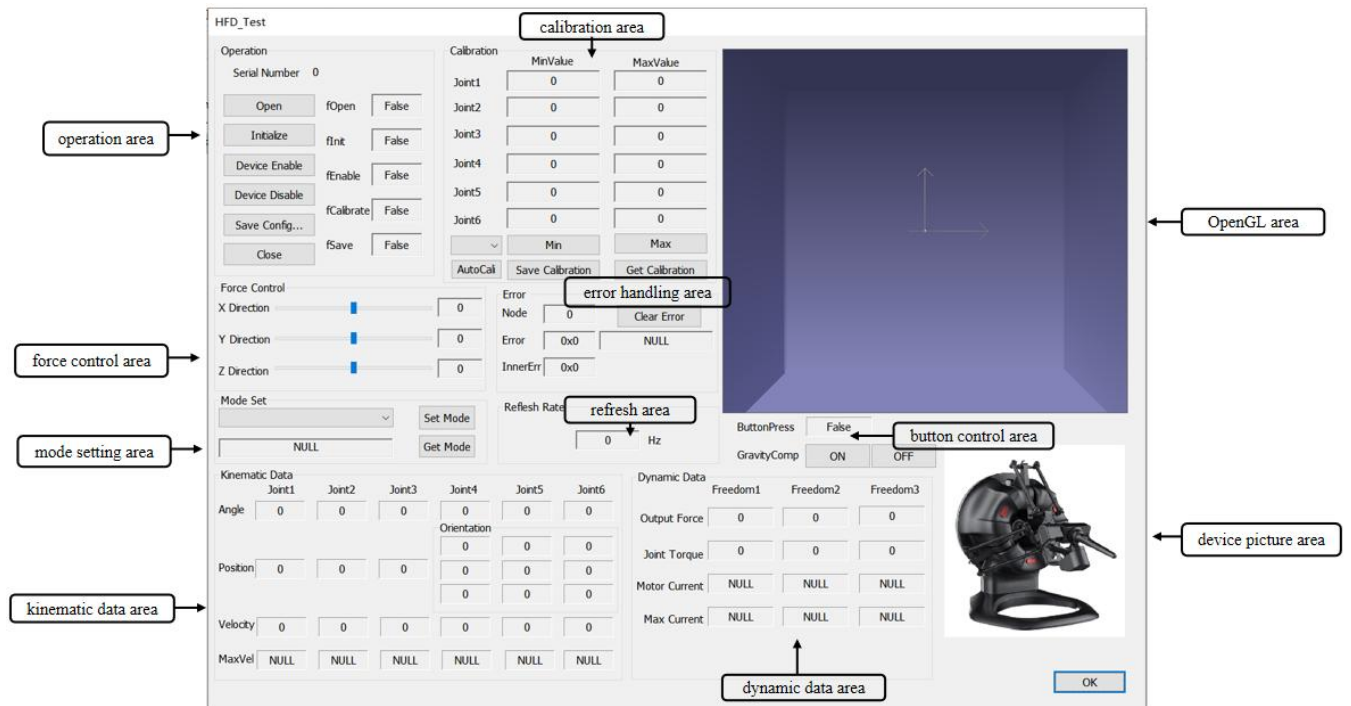


HFD_Test Software User Manual



Version 1.2

2023.11



HFD_Test Software Interface

The HFD_Test software interface is divided into 10 sections:

- 1. Operation Area(Operation)**
- 2. Calibration Area (Calibration)**
- 3. Force Control Area (Force Control)**
- 4. Mode Setting Area (Mode Set)**
- 5. Error Display Area (Error)**
- 6. Refresh Rate Display Area (Refresh Rate)**
- 7. Kinematic Data Display Area (Kinematic Data)**
- 8. Dynamic Data Display Area (Dynamic Data)**
- 9. OpenGL Scene Area**
- 10. Device Image Area**

Step 1: Open the Device

HFD_Test

Operation

Open

fOpen

True

Initialize

fInit

False

Device Enable

fEnable

False

Device Disable

fCalbrate

False

Save Config...

fSave

False

Close

fQkStop

NULL

Quick Stop

fQkStop

NULL

Calibration

MinValue

MaxValue

Joint1

0

0

Joint2

0

0

Joint3

0

0

Joint4

0

0

Joint5

0

0

Joint6

0

0

▼

Min

Max

AutoCal

Save Calibration

Get Calibration

Force Control

X Direction

0

Y Direction

0

Z Direction

0

Mode Set

▼

Set Mode

NULL

Get Mode

Refresh Rate

0

Hz

Error

Node

0

Clear Error

Error

0x0

NULL

InnerErr

0x0

Kinematic Data

Joint1

Joint2

Joint3

Joint4

Joint5

Joint6

Angle

0

0

0

0

0

0

Position

0

0

0

0

0

0

Velocity

0

0

0

0

0

0

MaxVel

NULL

NULL

NULL

NULL

NULL

NULL

Dynamic Data

Freedom1

Freedom2

Freedom3

Output Force

0

0

0

Joint Torque

0

0

0

Motor Current

NULL

NULL

NULL

Max Current

NULL

NULL

NULL

ButtonPress

False

GravityComp

ON

OFF

OK

Click the **【Open】** button in the **Operation Area**. If successful, the **fOpen** indicator on the right will change to **True**.

Function: Establishes USB communication between the computer and the HFD-6 device for data transmission.

Step 2: Initialize the Device

HFD_Test

Operation

Open

fOpen

True

Initialize

fInit

True

Device Enable

fEnable

False

Device Disable

fCalbrate

False

Save Config...

fSave

False

Close

fQkStop

NULL

Quick Stop

fQkStop

NULL

Calibration

	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0

▼

Min

Max

AutoCal

Save Calibration

Get Calibration

Force Control

X Direction

0

Y Direction

0

Z Direction

0

Mode Set

Set Mode

NULL

Get Mode

Refresh Rate

9795

Hz

Error

Node

0

Clear Error

Error

0x0

NULL

InnerErr

0x0

Kinematic Data

	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	117.743	-144.955	-184.039	56.389	13.793	57.466
				Orientation		
				0	0	0
Position	0	0	0	0	0	0
				0	0	0
Velocity	0	0	0	0	0	0
MaxVel	NULL	NULL	NULL	NULL	NULL	NULL

Dynamic Data

	Freedom1	Freedom2	Freedom3
Output Force	0	0	0
Joint Torque	0	0	0
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL

ButtonPress

False

GravityComp

ON

OFF

OK

Click the **【Initialize】** button in the **Operation Area**. If successful, the **fInit** indicator will change to **True**.

Function: Configures device parameters, starts refresh threads, and sets initial values.

Step 3: Device Calibration

The device is pre-calibrated at the factory. For routine use, click **【Get Calibration】** in the **Calibration Area**.

The screenshot shows the HFD_Test software interface. The 'Calibration' section is highlighted, showing a table for Joint1 through Joint6 with MinValue and MaxValue fields. The 'Get Calibration' button is highlighted with a red box. The 'Operation' section includes buttons for Open, Initialize, Device Enable, Device Disable, Save Config..., Close, and Quick Stop. The 'Force Control' section includes sliders for X, Y, and Z Direction. The 'Mode Set' section includes a dropdown menu and buttons for Set Mode and Get Mode. The 'Kinematic Data' section includes a table for Joint1 through Joint6 with Angle, Position, Velocity, and MaxVel fields. The 'Dynamic Data' section includes a table for Freedom1, Freedom2, and Freedom3 with Output Force, Joint Torque, Motor Current, and Max Current fields. A 3D model of the device is shown on the right side of the interface.

Joint	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0

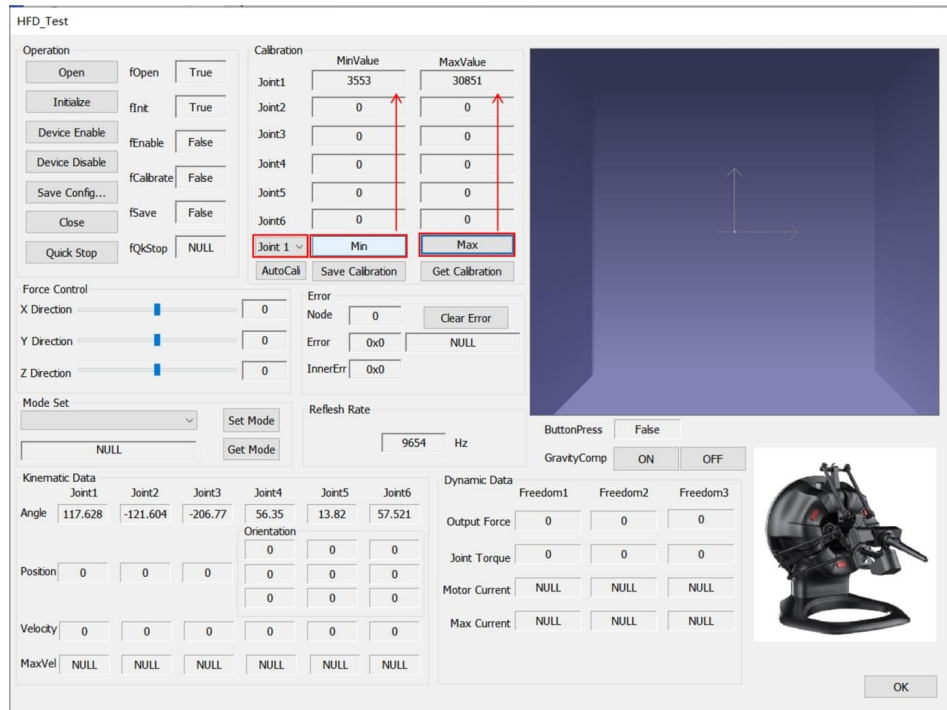
Joint	Angle	Position	Velocity	MaxVel
Joint1	135.618	-0.231	0	NULL
Joint2	123.363	3.069	0	NULL
Joint3	122.424	68.033	0	NULL
Joint4	-108.328	-0.671	0	NULL
Joint5	45	-0.558	0	NULL
Joint6	105.993	0.487	0	NULL

Freedom	Output Force	Joint Torque	Motor Current	Max Current
Freedom1	0	0	NULL	NULL
Freedom2	0	0	NULL	NULL
Freedom3	0	0	NULL	NULL

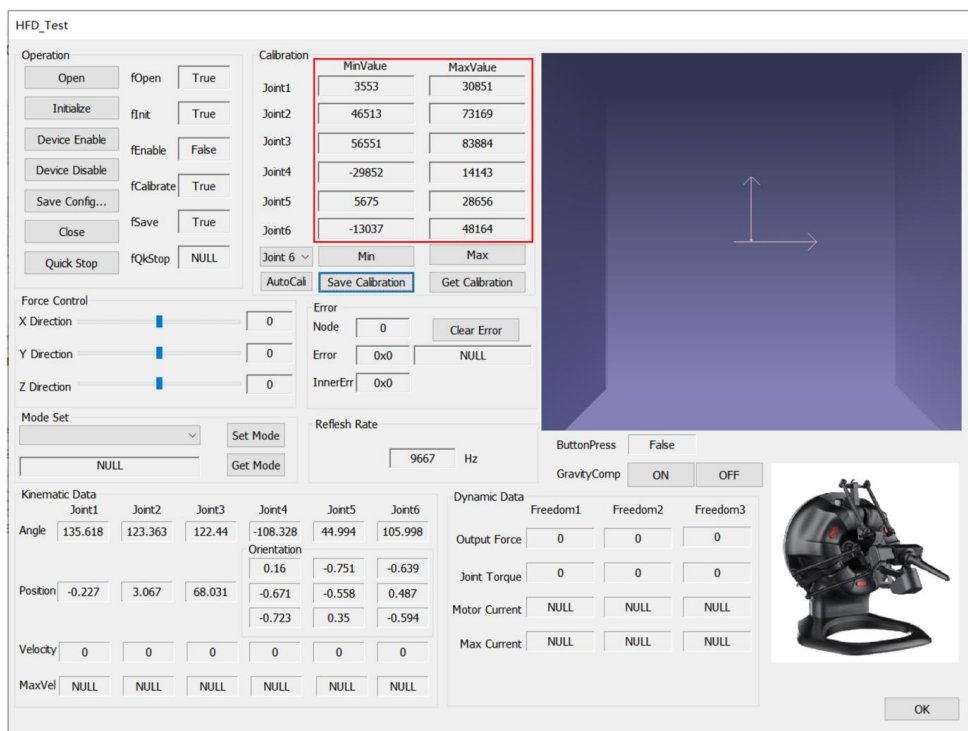
If the device has not been used for a long time or has been transported, it may cause the encoder to read data with offset. Therefore, it is necessary to calibrate the device again and save the calibration data to the chip.

Recalibration (if needed):

1. Select a joint (Joint1–Joint6).
2. Rotate the joint to its minimum or maximum position.
3. Click **【Min】** or **【Max】** to record encoder readings.
4. Repeat for all joints.



Complete the calibration data acquisition from Joint1 to Joint6 in sequence



Click **Save Calibration** to save data. The **fCalibrate** indicator will change to **True**.

Note: After calibration, the OpenGL scene will display the end-effector movement. , At the same time, the kinematic data display area and the refresh rate display area will display some internal data of the device; Because the device has not yet been enabled at this time and damping has been set, moving the end of the device will feel quite awkward;

Step 4: Mode Setting

HFD_Test

Operation

Open fOpen True

Initialize fInit True

Device Enable fEnable False

Device Disable fCalbrate True

Save Config... fSave False

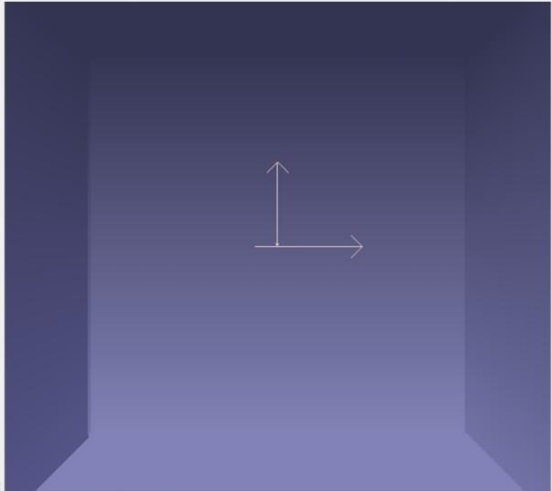
Close fQkStop NULL

Quick Stop fQkStop NULL

Calibration

	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0
Joint 6 ▾	Min	Max

AutoCal Save Calibration Get Calibration



Force Control

X Direction 0

Y Direction 0

Z Direction 0

Mode Set

Force Mode (selected)

Position Mode

Velocity Mode

Set Mode

Get Mode

Refresh Rate 9653 Hz

Error Node 0 Clear Error

Error 0x0 NULL

InnerErr 0x0

ButtonPress False

GravityComp ON OFF

Dynamic Data

	Freedom1	Freedom2	Freedom3
Output Force	0	0	0
Joint Torque	0	0	0
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL

OK

Kinematic Data

	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	135.624	123.363	122.418	-108.334	45	105.993
Orientation				0.16	-0.751	-0.639
Position	-0.233	3.071	68.033	-0.671	-0.558	0.487
				-0.723	0.35	-0.594
Velocity	0	0	0	0	0	0
MaxVel	NULL	NULL	NULL	NULL	NULL	NULL

1. Select **Force Mode** from the dropdown in the **Mode Setting Area**.

2. Click **【Set Mode】** to activate.

Mode Set

Force Mode (selected)

Position Mode

Velocity Mode

Set Mode

Get Mode

Function: Configures the device for force feedback output.

Step 5: Verify Mode

Operation

Open

fOpen

True

Initialize

fInit

True

Device Enable

fEnable

False

Device Disable

fCalibrate

True

Save Config...

fSave

False

Close

fQkStop

NULL

Calibration

MinValue

MaxValue

Joint1

0

0

Joint2

0

0

Joint3

0

0

Joint4

0

0

Joint5

0

0

Joint6

0

0

Joint 6

Min

Max

AutoCal

Save Calibration

Get Calibration

Force Control

X Direction

0

Y Direction

0

Z Direction

0

Mode Set

Force Mode

Set Mode

Profile Torque Mode

Get Mode

Refresh Rate

9581

Hz

Error

Node

0

Clear Error

Error

0x0

NULL

InnerErr

0x0

Dynamic Data

Freedom1

Freedom2

Freedom3

Output Force

0

0

0

Joint Torque

0

0

0

Motor Current

NULL

NULL

NULL

Max Current

NULL

NULL

NULL

Knematic Data

Joint1

Joint2

Joint3

Joint4

Joint5

Joint6

Angle

135.624

123.363

122.413

-108.328

45

105.993

Orientation

0.16

-0.751

-0.639

-0.671

-0.558

0.487

Position

-0.234

3.072

68.034

-0.723

0.351

-0.594

Velocity

0

0

0

0

0

0

MaxVel

NULL

NULL

NULL

NULL

NULL

NULL

ButtonPress

False

GravityComp

ON

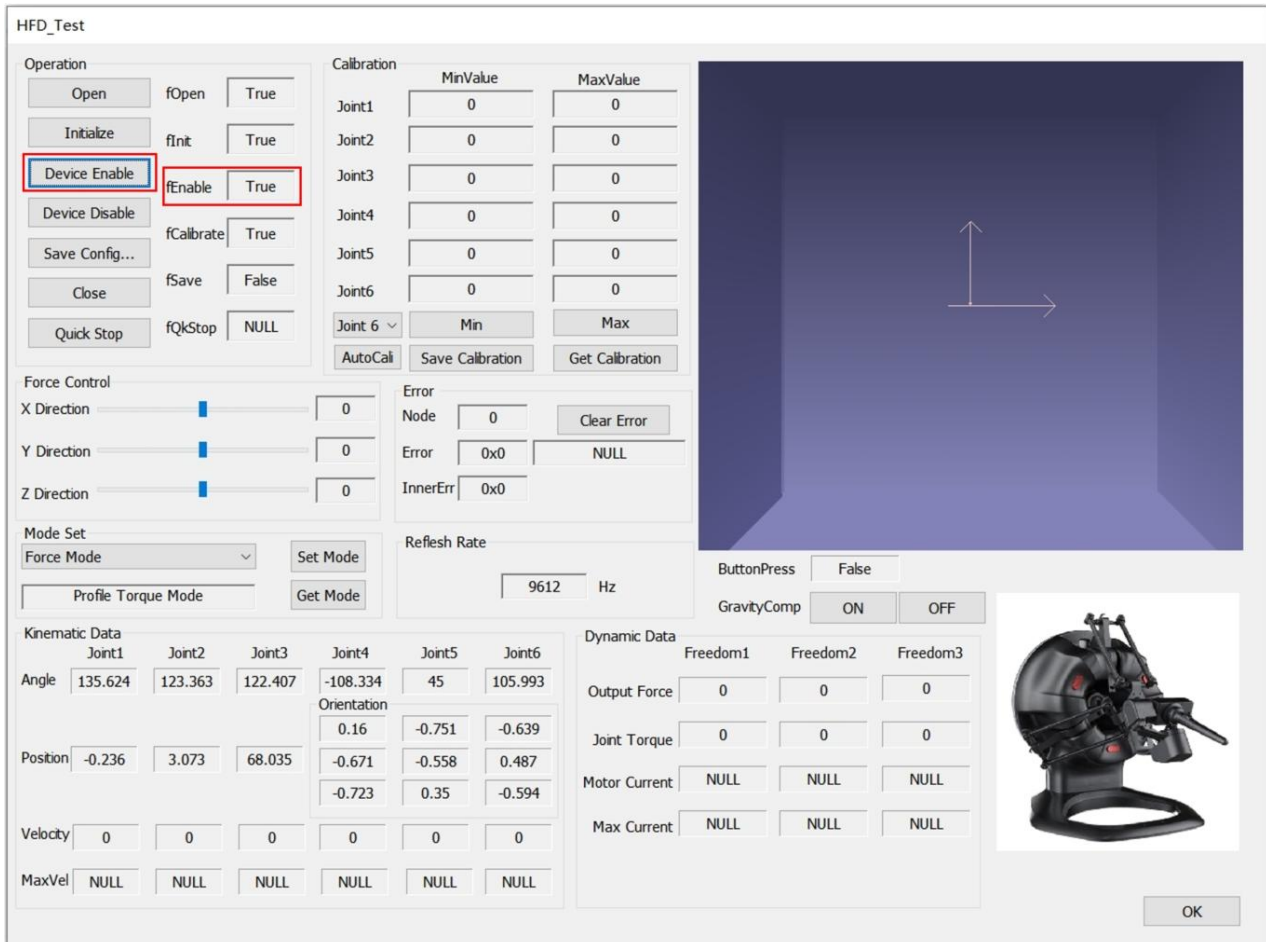
OFF

OK

Click **【Get Mode】** to confirm **Profile Torque Mode** is displayed.

Step 6: Enable the Device

Click **【Device Enable】** in the **Operation Area**. If successful, the **fEnable** indicator changes to **True**.



Function: Switches the device from damping mode to force feedback output mode. At this point, it is possible to set the desired feedback force output and feel the corresponding magnitude and direction of the feedback force at the end of the handle. However, as the device has not yet activated gravity compensation, its own weight will influence the feedback force.

Step 7: Activate Gravity Compensation

HFD_Test

Operation

Open fOpen True

Initialize fInit True

Device Enable fEnable True

Device Disable

Save Config... fCalibrate True

Close fSave False

Quick Stop fQkStop NULL

Calibration

	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0
Joint 6	Min	Max

AutoCal Save Calibration Get Calibration

Force Control

X Direction 0

Y Direction 0

Z Direction 0

Mode Set

Force Mode Set Mode

Profile Torque Mode Get Mode

Refresh Rate 9612 Hz

Error

Node 0 Clear Error

Error 0x0 NULL

InnerErr 0x0

Kinematic Data


	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	135.624	123.363	122.407	-108.334	45	105.993
Orientation				0.16	-0.751	-0.639
Position	-0.236	3.073	68.035	-0.671	-0.558	0.487
				-0.723	0.35	-0.594
Velocity	0	0	0	0	0	0
MaxVel	NULL	NULL	NULL	NULL	NULL	NULL

Dynamic Data

	Freedom1	Freedom2	Freedom3
Output Force	0	0	0
Joint Torque	0	0	0
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL

ButtonPress False

GravityComp ON OFF



OK

Click **ON** next to **GravityComp** to enable. The device will hover freely. Click **OFF** to disable the gravity compensation.

Function: Compensates for device weight to eliminate interference in force output.

Step 8: Force Output Control

WARNING: Hold the handle to prevent sudden movements during testing.

HFD_Test

Operation

Open fOpen True

Initialize fInit True

Device Enable fEnable True

Device Disable fCalbrate True

Save Config... fSave False

Close fQkStop NULL

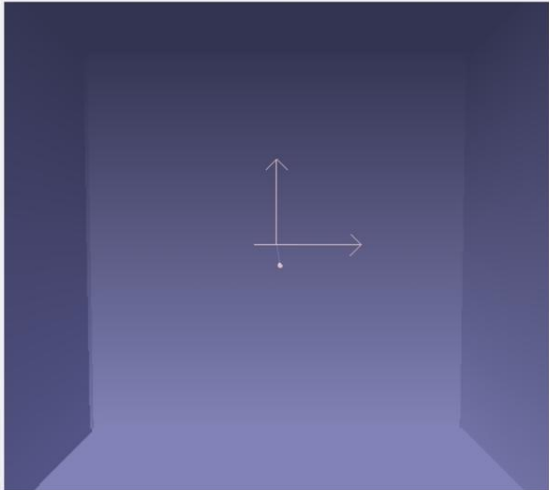
Quick Stop fQkStop NULL

Calibration

	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0

Joint 6 ▾ Min Max

AutoCal Save Calibration Get Calibration



Force Control

X Direction 3

Y Direction 0

Z Direction 0

Error

Node 0 Clear Error

Error 0x0 NULL

InnerErr 0x0

Mode Set

Force Mode ▾ Set Mode

Profile Torque Mode Get Mode

Refresh Rate

9057 Hz

ButtonPress False


GravityComp ON OFF

Kinematic Data

	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	52.748	66.437	69.31	-9.693	40.858	42.964
Orientation				0.972	0.229	0.032
Position	2.647	-17.039	135.08	-0.127	0.646	-0.752
				-0.193	0.727	0.657
Velocity	0	0.005	0.006	0.005	0	0
MaxVel	NULL	NULL	NULL	NULL	NULL	NULL

Dynamic Data

	Freedom1	Freedom2	Freedom3
Output Force	3	0	0
Joint Torque	-10.886	-332.373	-12.308
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL



OK

Force Control

X Direction 2

Y Direction 0

Z Direction 0

In the Force Control section, drag the sliding blocks in the **X Direction**, **Y Direction**, and **Z Direction** directions to output force in the X, Y, and Z directions on the device. Among them, dragging the slider to the left outputs feedback force in the negative direction of the corresponding axis;

X direction: Right: horizontal force to the right; **Left:** horizontal force to the left;

Y direction: Right: vertical force upward; **Left:** vertical force downward;

Z-direction: Right: outward force ; **Left:** inward force ;

Step 9: Disable Gravity Compensation

HFD_Test

Operation

Open fOpen True

Initialize fInit True

Device Enable fEnable True

Device Disable fCalbrate True

Save Config... fSave False

Close fQkStop NULL

Quick Stop fQkStop NULL

Calibration

	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0
Joint 6	Min	Max

AutoCal Save Calibration Get Calibration

Force Control

X Direction 0

Y Direction 0

Z Direction 0

Mode Set

Force Mode Set Mode

Profile Torque Mode Get Mode

Refresh Rate 9612 Hz

Error

Node 0 Clear Error

Error 0x0 NULL

InnerErr 0x0

GravityComp ON OFF

Dynamic Data

	Freedom1	Freedom2	Freedom3
Output Force	0	0	0
Joint Torque	0	0	0
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL

Kinematic Data

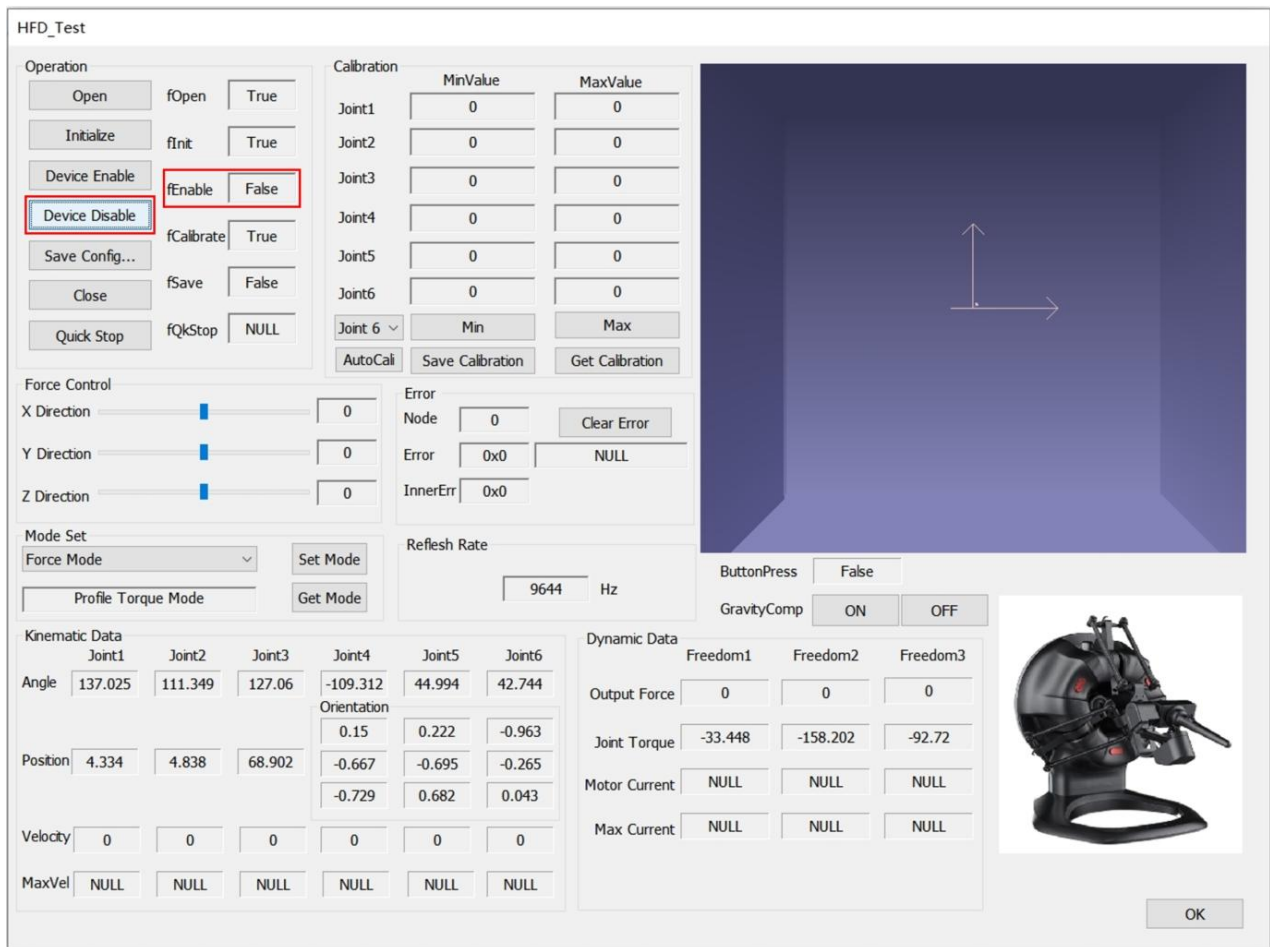
	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	135.624	123.363	122.407	-108.334	45	105.993
Orientation				0.16	-0.751	-0.639
Position	-0.236	3.073	68.035	-0.671	-0.558	0.487
				-0.723	0.35	-0.594
Velocity	0	0	0	0	0	0
MaxVel	NULL	NULL	NULL	NULL	NULL	NULL

OK

Click **【OFF】** next to **GravityComp** to deactivate gravity compensation.

Function: turn off the gravity compensation of the device after use, so that the device is in a natural state.

Step 10: Disable the Device



Click **【Device Disable】** in the **Operation Area**. The **fEnable** indicator changes to **False**.

Function: The main function of disabling the device is set the device to damping state from the enabled state, disable the feedback force output function of the device, and prepare for the subsequent shutdown of the device.

Step 11: Close the Device

HFD_Test

Operation

Open

fOpen

False

Initialize

fInit

False

Device Enable

fEnable

False

Device Disable

fCalbrate

False

Save Config...

fSave

False

Close

fQkStop

NULL

Quick Stop

fQkStop

NULL

Calibration

	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0
Joint 6 ▾	Min	Max

AutoCal

Save Calibration

Get Calibration

Force Control

X Direction

0

Y Direction

0

Z Direction

0

Mode Set

Force Mode ▾

Set Mode

NULL

Get Mode

Refresh Rate

0

Hz

Error

Node

0

Clear Error

Error

0x0

NULL

InnerErr

0x0

Kinematic Data

	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	0	0	0	0	0	0
				Orientation		
				0	0	0
Position	0	0	0	0	0	0
				0	0	0
Velocity	0	0	0	0	0	0
MaxVel	NULL	NULL	NULL	NULL	NULL	NULL

Dynamic Data

	Freedom1	Freedom2	Freedom3
Output Force	0	0	0
Joint Torque	0	0	0
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL

ButtonPress

False

GravityComp

ON

OFF

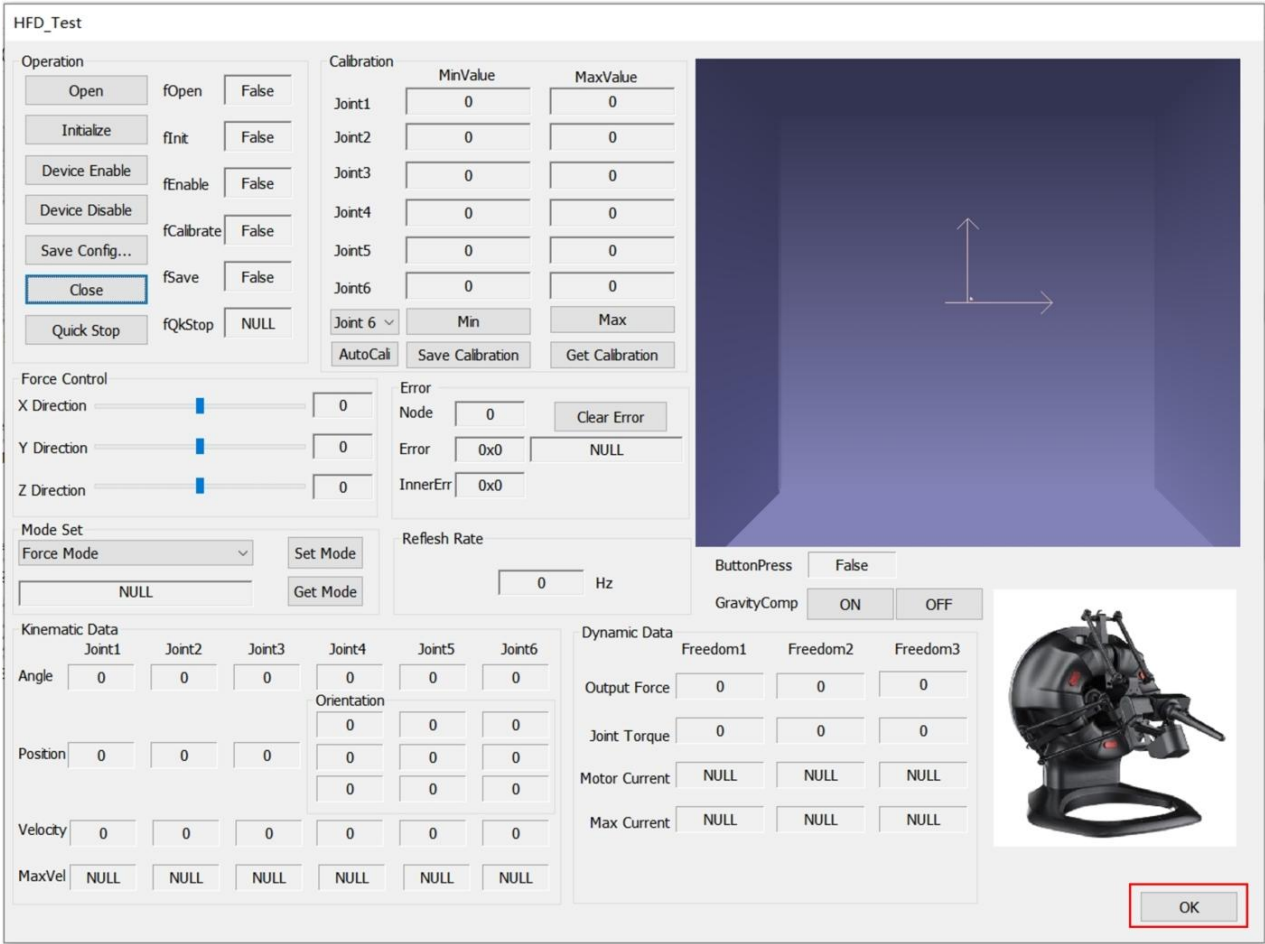
OK



Click **【Close】** in the **Operation Area** to terminate USB communication

Function: The main function of close the device is to end threads in the software, clear relevant flag bits, and terminate USB communication between the device and the computer.

Step 12: Exit the Software



Click **【OK】** at the bottom-right to exit.

Kinematic Data Display Area

HFD_Test

Operation

Open fOpen True

Initialize fInit True

Device Enable fEnable False

Device Disable fCalbrate True

Save Config... fSave False

Close fQkStop NULL

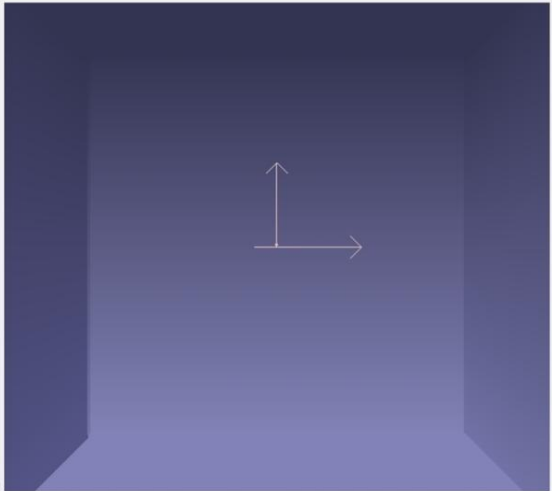
Quick Stop fQkStop NULL

Calibration

	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0

Joint 6 ▾ Min Max

AutoCal Save Calibration Get Calibration



Force Control

X Direction 0

Y Direction 0

Z Direction 0

Mode Set

Force Mode ▾ Set Mode

Profile Torque Mode Get Mode

Refresh Rate 9581 Hz

Error

Error Node 0 Clear Error

Error 0x0 NULL

InnerErr 0x0

ButtonPress False


GravityComp ON OFF

Kinematic Data

	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	135.624	123.363	122.413	-108.328	45	105.993
Orientation						
				0.16	-0.751	-0.639
Position	-0.234	3.072	68.034	-0.671	-0.558	0.487
				-0.723	0.351	-0.594
Velocity	0	0	0	0	0	0
MaxVel	NULL	NULL	NULL	NULL	NULL	NULL

Dynamic Data

	Freedom1	Freedom2	Freedom3
Output Force	0	0	0
Joint Torque	0	0	0
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL



OK

Kinematic Data

	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	0.891	75.387	68.748	25.38	45	-167.124
Orientation						
				0.638	0.275	-0.718
Position	-4.944	-100.427	111.665	0.303	-0.948	-0.094
				-0.707	-0.157	-0.689
Velocity	0	0	0	0	0	0
MaxVel	0	0	0	0	0	0

Kinematic Data

	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	0.891	75.387	68.748	25.385	45	-167.124
Orientation						
				0.638	0.275	-0.718
Position	-4.943	-100.427	111.668	0.303	-0.948	-0.094
				-0.707	-0.157	-0.689
Velocity	0	0	0	0	0	0
MaxVel	0	0	0	0	0	0

Kinematic Data						
	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	0.891	75.387	68.748	25.388	45	-167.127
Position	-4.943	-100.427	111.668	Orientation		
				0.638	0.275	-0.718
				0.303	-0.948	-0.094
Velocity	0	0	0	0	0	0
MaxVel	0	0	0	0	0	0

Kinematic Data						
	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	35.042	59.957	35.46	8.686	6.674	-74.641
Position	-29.787	-17.872	162.475	Orientation		
				0.981	-0.15	-0.115
				0.15	0.244	0.957
Velocity	-8.2	35.102	39.158	2.746	2.746	10.986
MaxVel	0	0	0	0	0	0

Kinematic Data display area, where each column represents information about each rotation axis Joint, consisting of six rotation axes: Joint1, Joint2, Joint3, Joint4, Joint5, and Joint6;

【Angle】 : Joint rotation angle.

【Position】 : End-effector coordinates (X, Y, Z).

【Orientation】 : 3×3 orientation matrix.

【Velocity】 : Translational (V_x, V_y, V_z) and rotational speeds.

【MaxVel】 : Maximum joint speed (currently inactive).

Dynamic Data Display Area

HFD_Test

Operation

Open fOpen True

Initialize fInit True

Device Enable fEnable True

Device Disable fCalbrate True

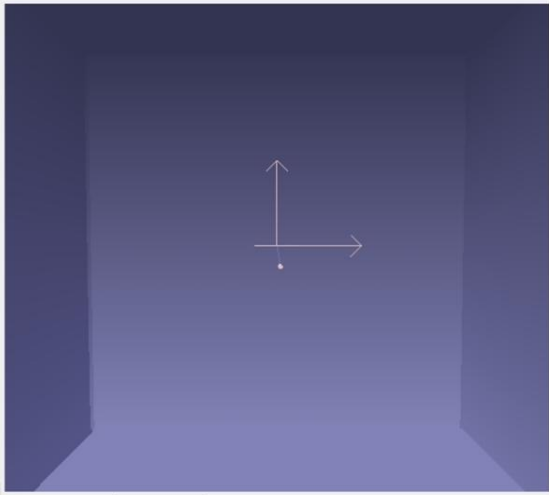
Save Config... fSave False

Close fQkStop NULL

Calibration

	MinValue	MaxValue
Joint1	0	0
Joint2	0	0
Joint3	0	0
Joint4	0	0
Joint5	0	0
Joint6	0	0
Joint 6 ▾	Min	Max

AutoCal Save Calibration Get Calibration



Force Control

X Direction 3

Y Direction 0

Z Direction 0

Mode Set

Force Mode ▾ Set Mode

Profile Torque Mode Get Mode

Refresh Rate 9057 Hz

Error Node 0 Clear Error

Error 0x0 NULL

InnerErr 0x0

ButtonPress False


GravityComp ON OFF

Kinematic Data

	Joint1	Joint2	Joint3	Joint4	Joint5	Joint6
Angle	52.748	66.437	69.31	-9.693	40.858	42.964
				Orientation		
				0.972	0.229	0.032
Position	2.647	-17.039	135.08	-0.127	0.646	-0.752
				-0.193	0.727	0.657
Velocity	0	0.005	0.006	0.005	0	0
MaxVel	NULL	NULL	NULL	NULL	NULL	NULL

Dynamic Data

	Freedom1	Freedom2	Freedom3
Output Force	3	0	0
Joint Torque	-10.886	-332.373	-12.308
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL



OK

Dynamic Data			
	Freedom1	Freedom2	Freedom3
Output Force	2	0	0
Joint Torque	505.643	-391.92	-74.583
Motor Current	NULL	NULL	NULL
Max Current	NULL	NULL	NULL

Displays data for Freedom1–Freedom3:

【Output Force】 : X/Y/Z-axis force values;

【Joint Torque】 : Torque on the first three axes;

【Motor Current】 : Motor current values (inactive);

【Max Current】 : Peak motor current (inactive);