



USER**GUIDE**

# AXIS**NEURON**

# Table of Contents

_____	1. Overview	4
	Welcome to Perception Neuron	4
_____	2. QuickStart	5
	2.1 Equipment: Brief Introduction	5
	2.2 Capture Motion Data	5
	2.3 Attention	13
_____	3. Software Interface Introduction	14
	3.1 Guide	15
	3.2 Menu Bar	16
	3.2.1 File	16
	3.2.2 Window	20
	3.2.3 Tools	26
	3.2.4 Help	26
_____	4. Connection and Calibration	28
	4.1 USB Connection	29
	4.2 Wireless Connection	31
	4.3 Multiple Equipment Connection	34
	4.4 Posture Calibration	34
_____	5. Sensor Wear Combination Mode	41
	5.1 Wear Combination Mode introduction	42
	5.1.1 Full Body Mode	43
	5.1.2 Single Arm Mode	45
	5.1.3 Upper Body Mode	46
	5.1.4 Lower Body Mode	48
	5.2 Standby Device	49
	5.3 Attention	51

_____	6. Data Editing	52
	6.1 Model Alignment	53
	6.2 Body Size Manager	54
	6.3 Parameters	57
	6.4 Smooth Factor	59
	6.5 Data Visualizer	60
	6.6 Contact Editing	61
	6.7 Body Size Measure	65
_____	7. Offline Recording and Prop Function	71
	7.1 Offline Recording	72
	7.2 Offline Data Import	74
	7.3 Prop Function	77
_____	8. File Export and Data Transmission	82
	8.1 File Export	83
	8.1.1 BVH File Export	83
	8.1.2 FBX File Export	83
	8.1.3 3ds Max Biped File Export	84
	8.1.4 Calculation File Export	84
	8.1.5 High-Precision BVH File Export	85
	8.1.6 Multi-Character File Export	86
	8.2 Data Transmission	86
	8.2.1 BVH	87
	8.2.2 Action	91
	8.2.3 Calculation	92
	8.2.4 IP Selected	94
_____	9. Third-Party Software Support	99
	9.1 Autodesk Motion Builder	101
_____	10. Equipment: Maintenance	106
	10.1 Device Firmware Upgrade	107
	10.2 Neuron Device Calibration	112
_____	11. Appendix	120

# Welcome to Perception Neuron

PERCEPTION NEURON is the world's most versatile, adaptable and affordable motion capture system offering user-friendly technology for various applications.

PERCEPTION NEURON can be used for different applications in the fields of VFX, game interaction, virtual reality, sports analysis, medical analysis and real-time stage performance among others.




1. **VFX:** Motion recording and replaying; BVH and FBX format output supported for Maya, MotionBuilder, Blender, etc.
2. **VR / Game interaction:** Seamless integration with HMD with opensource game engine demos; Gesture control library included; Bring 'yourself' into the virtual world.
3. **Sports / Medical Analysis:** Get all orientation, position, and raw acc and gyro data flow in real-time; free 'Data-Visualizer' for data plotting and recording/comparison.
4. **Stage performance:** Real-time data stream output; Wireless data transmission.

# 2. QuickStart

The Perception Neuron motion capture system needs to communicate with the Axis Neuron software. Axis Neuron can receive and process the motion data and export it to a third-party software. It is also possible to do synchronous broadcasting with a third-party software. In addition, you can get the high-quality motion data which is compatible with most professional film effects and game development tools.

**Are you ready?** The following content is designed to quickly get you up and running with Axis Neuron.

## 2.1 Equipment: Brief Introduction

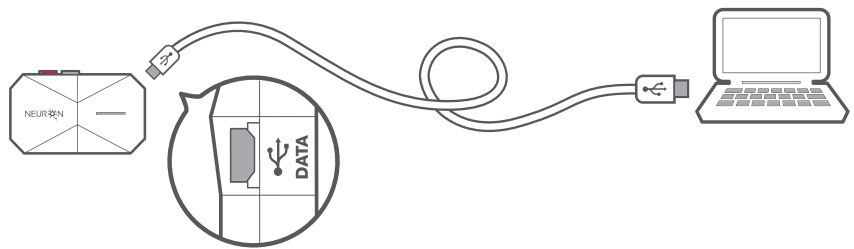
PERCEPTION NEURON SENSOR	HUB	STRAP
<p>Perception Neuron uses an IMU sensor (Inertial Measurement Unit) composed of accelerometer, gyroscope and magnetometer.</p> 	<p>The Hub compiles and synchronizes all motion data and broadcasts it to the computer via USB or Wifi.</p> 	<p>The strap is worn on the body and contains the Perception Neuron sensor. The back label tells you where it should be worn.</p> 

# 2.2 Capture Motion Data

1.

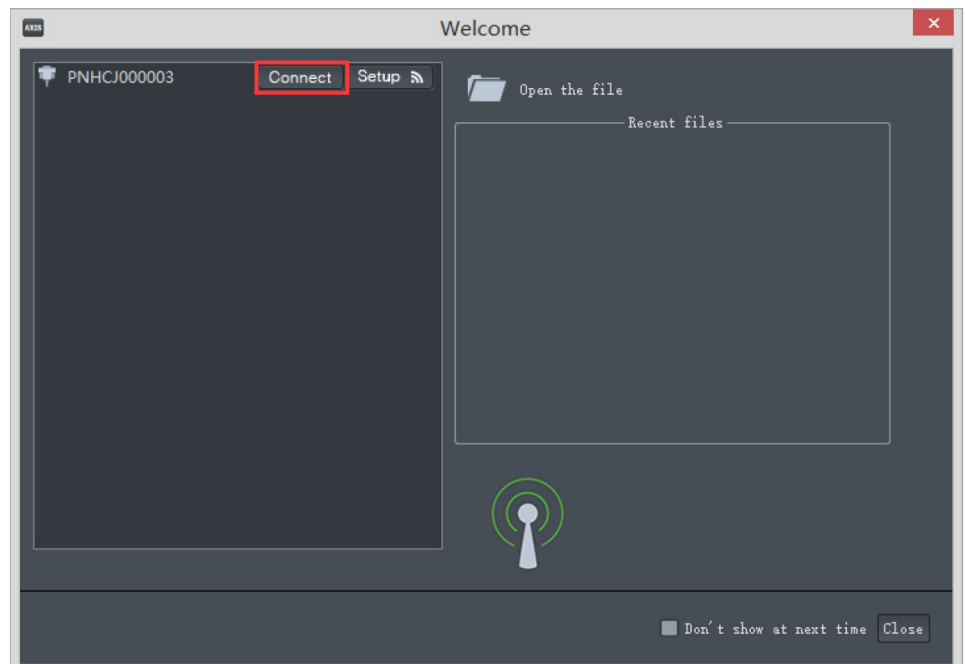
After properly fitting the straps and sensors, launch Axis Neuron. Let's begin recording our first motion data.

Connect the Hub to the computer with the USB data cable (black). One side of the USB cable connects to the Hub's data port and the other side connects to an open USB port on the computer.



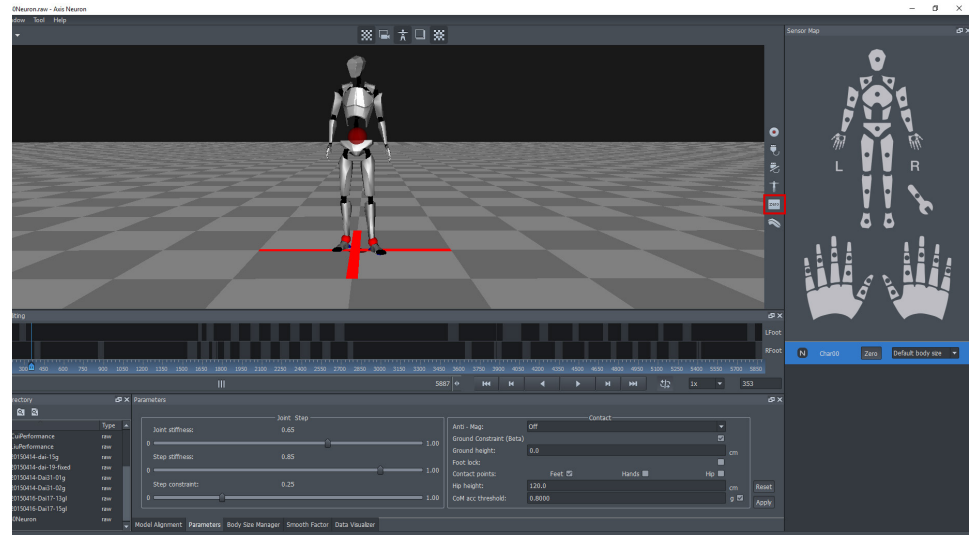
If the Hub was recognized successfully, the Hub ID will be shown in the device list in the left panel of the Welcome window. Click the Connect button to connect the Hub with the computer.

2.



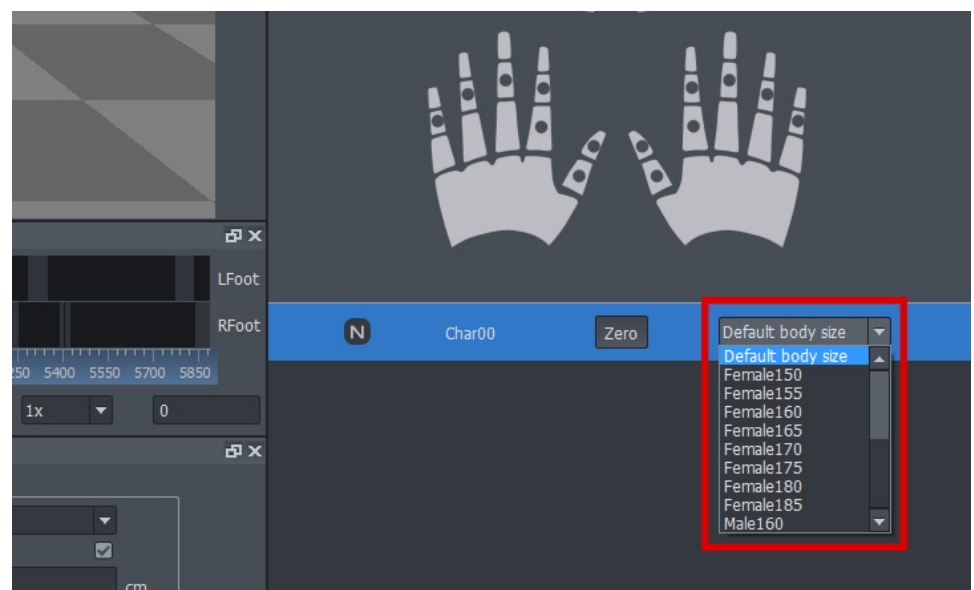
3.

After successfully establishing a connection with the Hub, click the zero button to move the model to the origin of the coordinate system (keep steady and do not move during this procedure.)



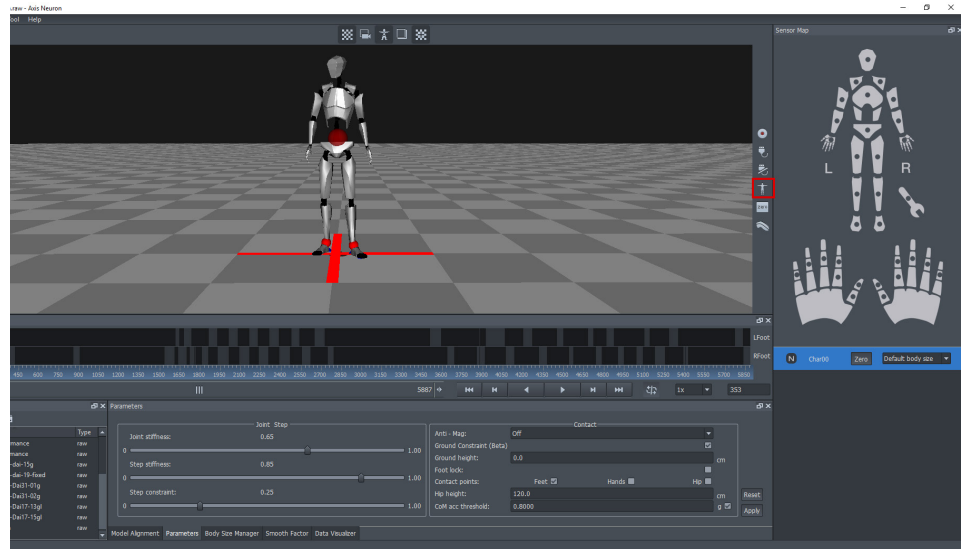
Choose a body size for the model in the Body Dimension list to ensure a more accurate capture.

4.



# 5.

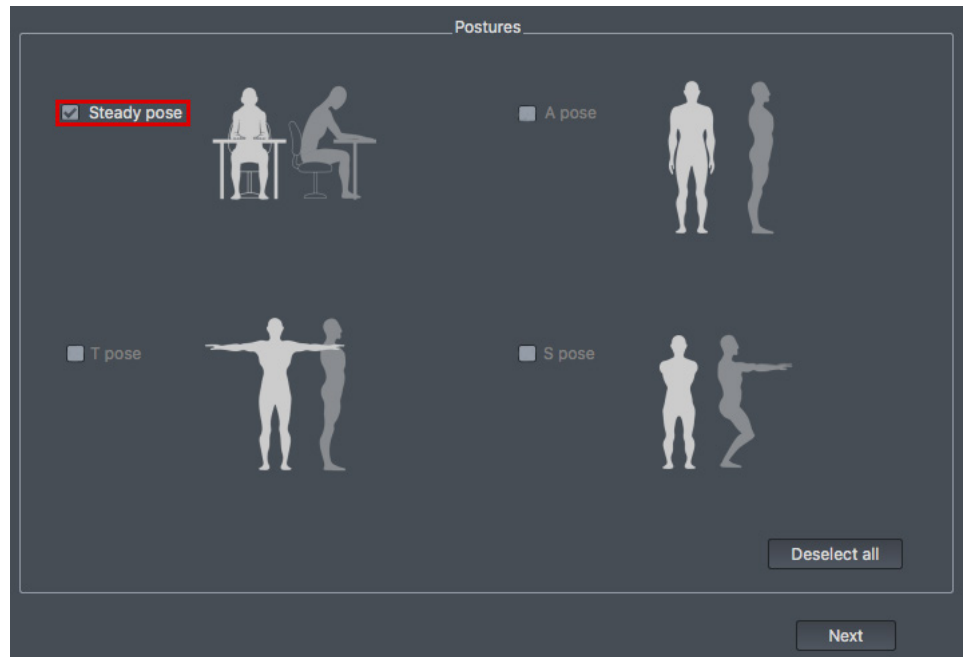
Click the Calibrate button to perform the posture calibration. This calibration step helps Axis Neuron understand the placement and orientation of the sensors on the actor to increase the accuracy of the motion data.



# 6.

Click **Deselect all** and select only the Steady Pose option. During the calibration you must keep all sensors and straps steady (no special requirement to the posture). Try to sit down, put your hands on a table and then click **Next**. The Steady Pose calibration removes bias errors brought by the connection between Perception Neuron Sensors and the socket.

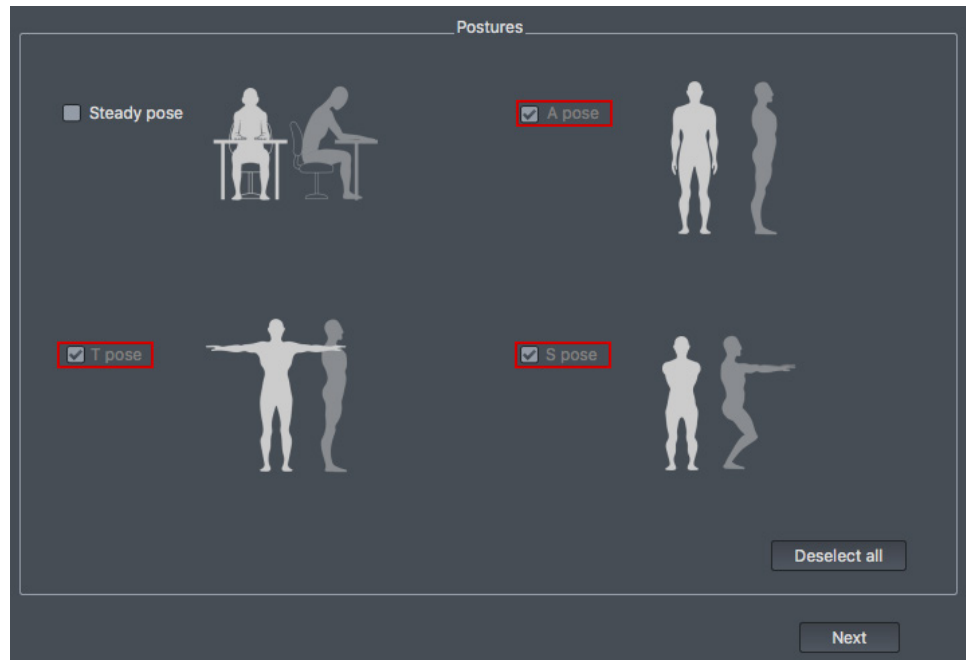
Perform this pose only once until you reposition the Perception Neuron sensor, or introduce new sensors.





## 7.

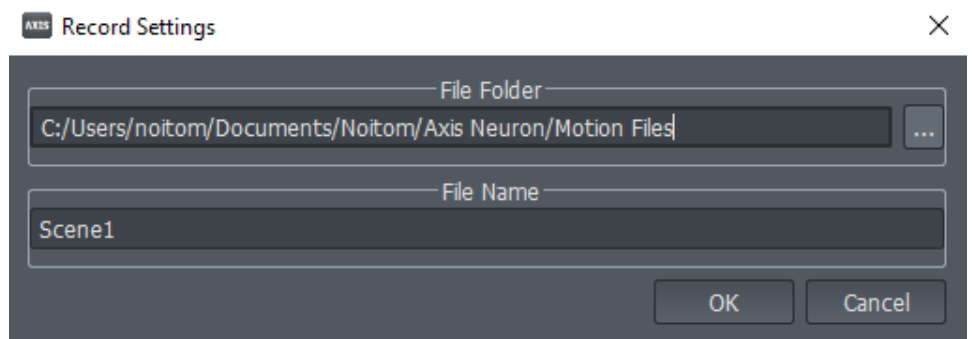
After successfully completing the Steady Pose, reopen the Posture Calibration window and check the remaining pose(s) that need to be calibrated then click Next to start calibration. (Available poses depend on the working mode selected in the Sensor Map).



## 8.

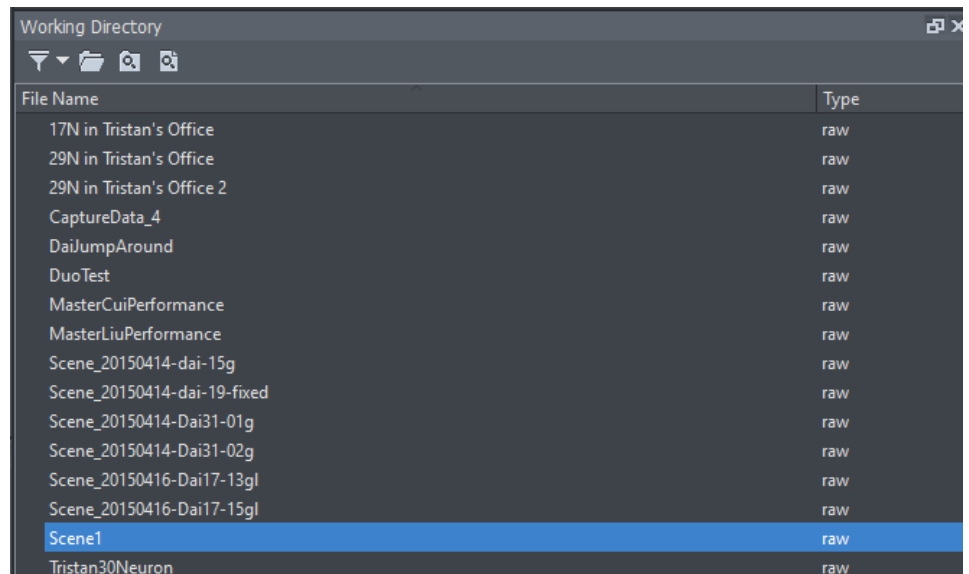
You can start recording after the posture calibration is complete. Click the Record button then choose a path for saving the recorded data and the record File Name in the pop up window.

(The motion data is then recorded immediately after you click on the OK button).



To stop recording click on the **Record** button again. The recorded file will now appear in the Working Directory window.

9.



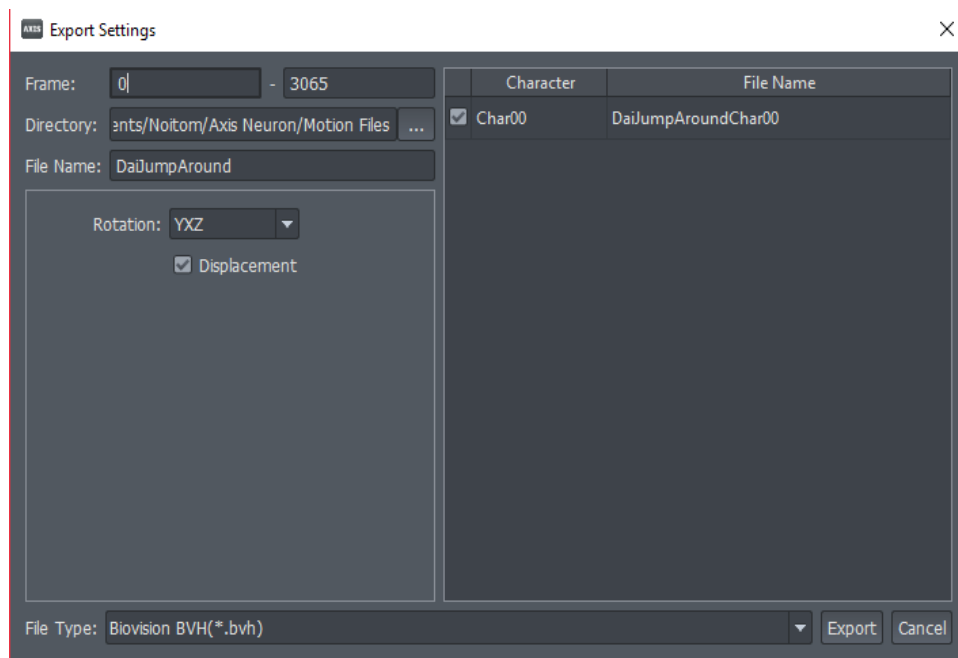
Once recording has ended the motion data is now ready for review. Select the recorded file generated in the **Working Directory** window and click the Play button. You will see the motion you recorded on the Axis Neuron viewport.

10.





Export your motion data by clicking **File> Export**. On the Export settings window click **Export** after you have selected the desired file format. For this example we chose the default recorded file <bvh> format.



## 2.3 Caution & Tips

### 1. Environment

It is strongly suggested to use your Perception Neuron system in an environment with little to no magnetic field. Otherwise the sensors will be adversely influenced making the motion captured data extremely imprecise. Avoid electric motors, loudspeakers, transformers, and furniture.

#### KEEP AWAY FROM MAGNETIC SOURCE



KEEP **10-100 CM** (DEPENDING ON THE STRENGTH OF THE SOURCE) AWAY FROM MAGNETIC SOURCE.



PERMANENT  
MAGNET



COMPUTER /  
KEYBOARD / MOUSE



SPEAKER



HEADPHONE



POWER BOX



GENERATOR /  
ELECTRIC MOTOR



TELEVISION



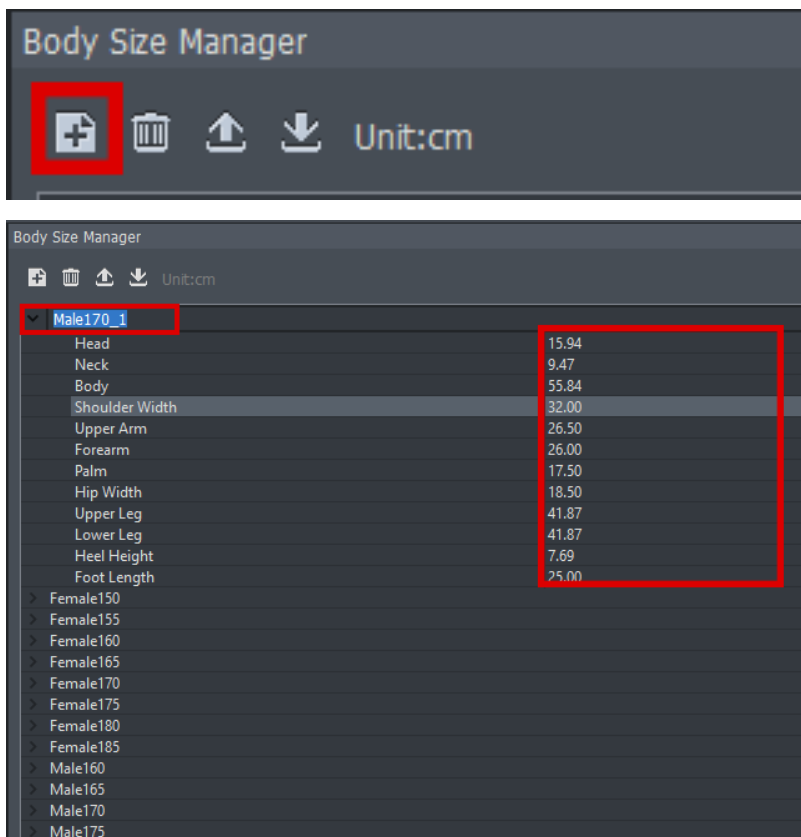
REFRIGERATOR

Perception Neuron should NOT be used in a environment with strong magnetic interferences. Using the system in such an environment introduces significant errors to the motion capture results. Exposing Neurons to such an environment for a long time will cause sensor magnetization.

The container that comes with the Neurons is made of special material which can effectively isolate magnetic field and therefore prevent sensor magnetization. Neurons should be placed in this container during transportation, long-term storage, or when situated in any environment with magnetic interferences.

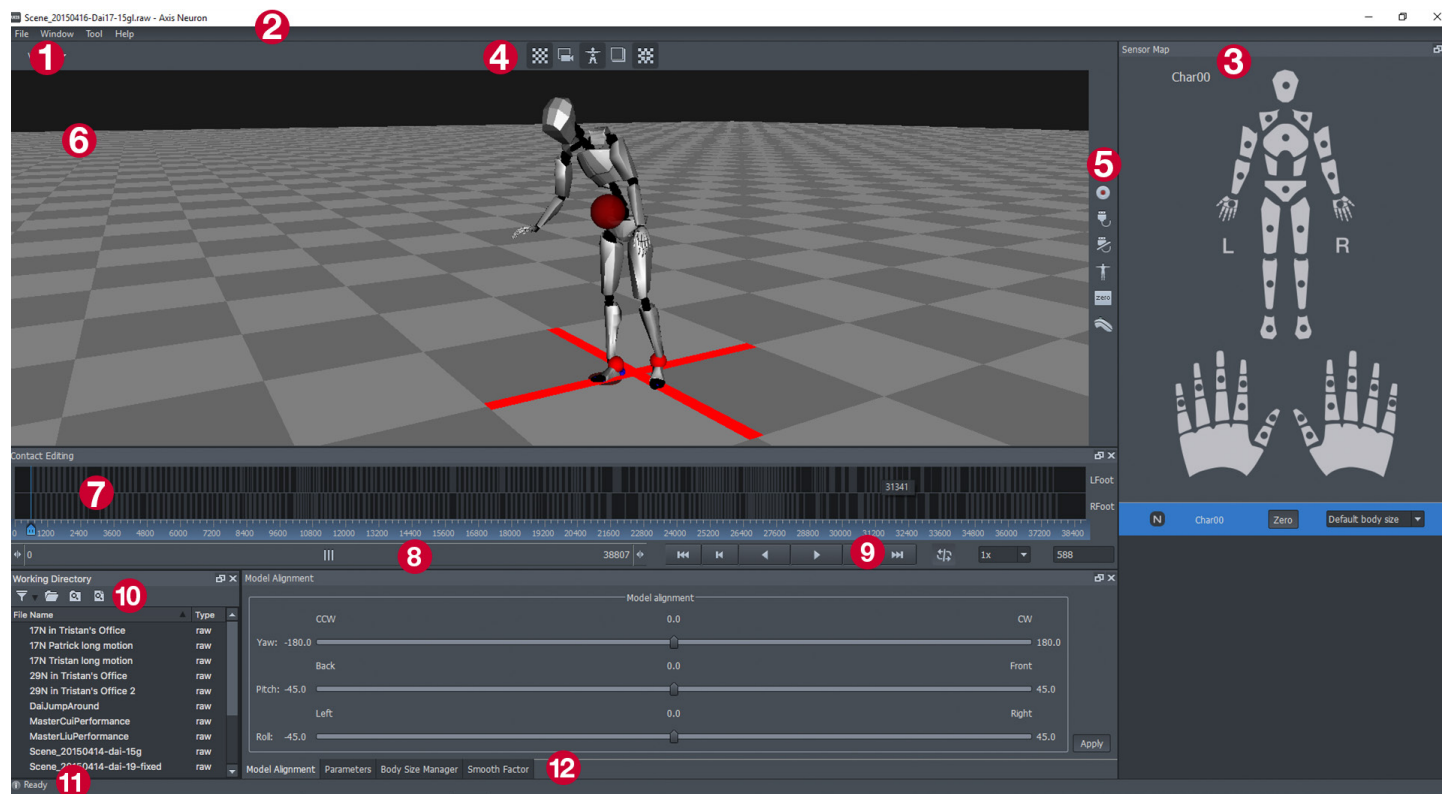
## 2. Improving precision

Accurate skeletal measurement and size can improve the precision of the motion data. If you want to achieve more accurate data, measure your actor's specified body parts and input this data into the Body Size Manager before recording. The measuring will be introduced in a later chapter.

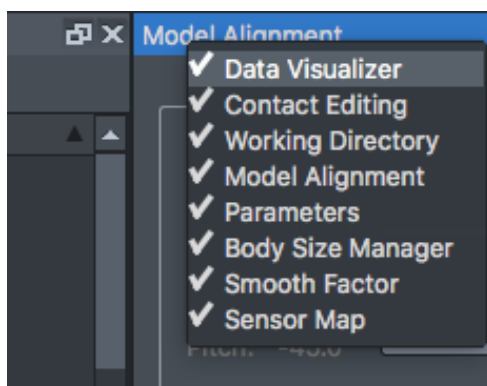


# 3. Software Interface Introduction

# 3.1 Guide



1. **Menu Bar** - File, Window, Tools, and Help access.
2. **Title** - Display name of the current active file.
3. **Sensor Map** - Displays the data transmission signal strength from the sensors.
4. **Scene View Navigation** - Toggle view for the grid, center of gravity, shadow, origin reference. Parent camera to the actor.
5. **Motion Capture Bar** - Record, Connect, Disconnect, Calibrate, Zero.
6. **Viewport** - View playback or live motion data on this window.
7. **Contact Editing** - This area contains tools to clean up contact points.
8. **Range Settings** - You can set the frame range of the animation.
9. **Play Controller** - Basic control of playing.
10. **Working Directory** - Displays a list of captured files from a user specified folder.
11. **Status Bar** - Show status.
12. **Editing Panel** - The parameters and other functional settings panel.



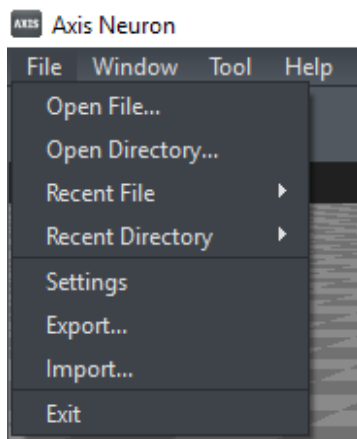
### Interface Tips:

1. To show or hide any panel navigate to Window -> Panels or right click the title bar of any panel and then check the one you want to see.
2. To reset the current layout navigate to Window -> Layout and there are several default layouts available.
3. Move any panel to anywhere you want by dragging the title bar of the panel. By double clicking on the title bar of the panel you can toggle the panel view between floating mode and docking mode.

## 3.2 Menu Bar

### 3.2.1 File

Options available include **Open File**, **Open Directory**, **Settings**, **Export** and **Exit**



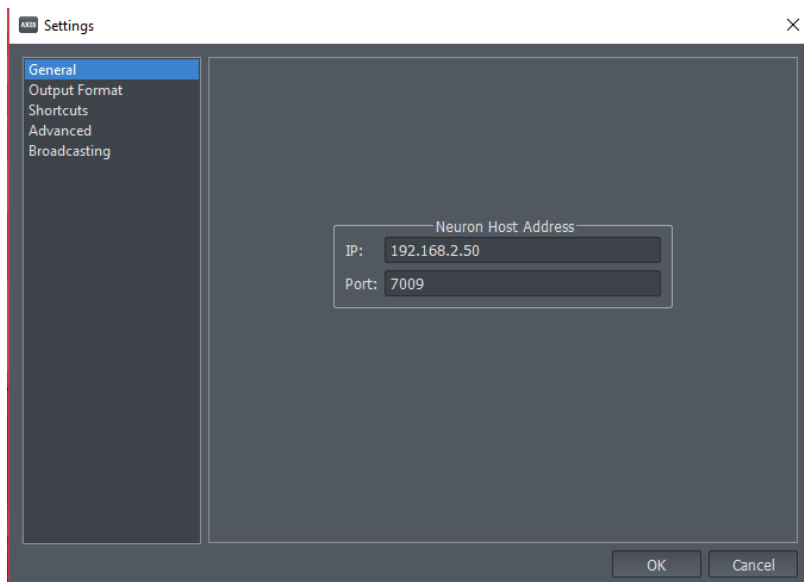
1. **Open File:** Open an existing file (.raw format)
2. **Open Directory:** Displays files from a folder location.
3. Recent File & Recent Directory display recently opened files and folders.



## 2. Settings

### 2.A General:

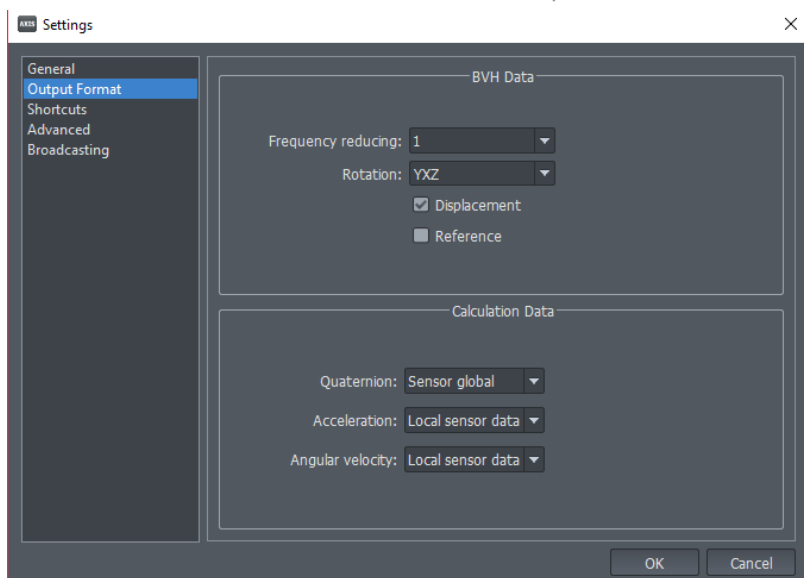
Displays the Host IP and Port.



### 2.B Output Format:

#### BVH Data

**Displacement:** Checking this box will affect the real-time model, the Data Visualizer panel, and the real-time data broadcast. BVH data with displacement will include 6 floats for each and every 59 bones: 3 for the displacements (X Y Z) and 3 for rotation data (Default rotation order is Y X Z). For the BVH data without displacement, except the root node (Hip) having displacement and rotation, other bones will only stream rotation data. There are some third-party softwares (e.g 3ds Max) that do not support bone displacement. Disabling the displacement in the data stream will result in the legs not being straight because of no displacement data present.



**Frequency reducing:** Change the frequency frame output for streaming. By default the value is set to 1, data will stream every frame per second. The user can choose to stream half of the motion data by selecting 1/2.

**Rotation:** Select the desired World Space Axis for streaming.

**Reference:** In order to translate or rotate the entire skeleton without changing the data of the bones in the skeleton, a new node, regarded as the parent node of the root node, could be added in the BVH data structure.

#### Calculation Data

For Calculation Data, the data of each bone has a total of 16 float data points consisting of position (X Y Z with global coordinate), velocity (X Y Z with global coordinate), sensor quaternion (W X Y Z with global coordinate), sensor accelerated velocity (X Y Z with module's coordinate) and gyro (X Y Z with module's coordinate). The user can choose between local or global data stream for the output.

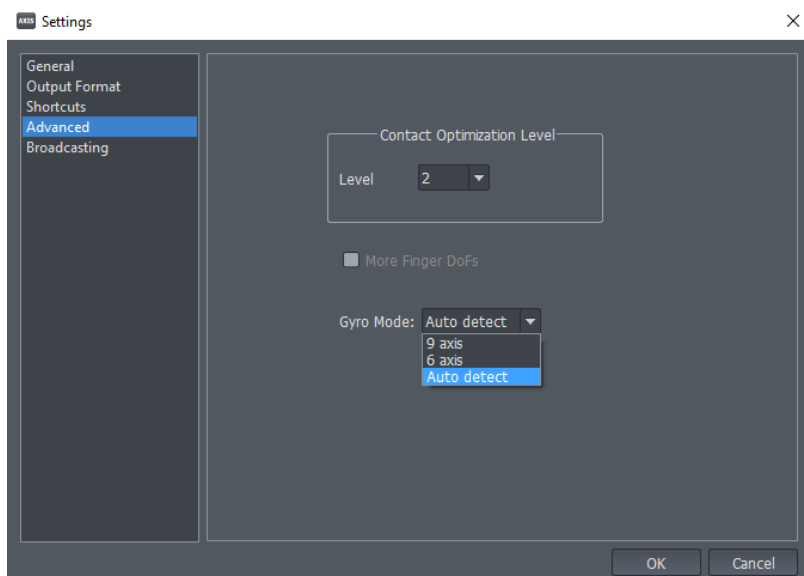
#### 2.C Advanced:

**Contact Optimization Level:** This option calculates auto-optimization on the original contact relationship data. The default value is 2.

#### Gyro Mode:

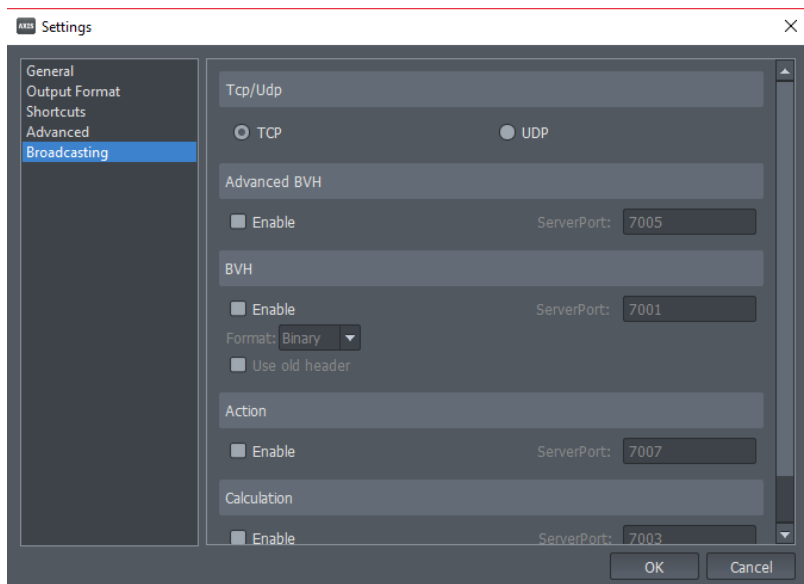
Auto detect: According to different magnetic field environments, this option will automatically adjust the working mode (9-Axis or 6-Axis). When the system detects a high-intensity magnetic field, the LEDs of the sensors will always be on and the gyro will switch to 6-Axis mode. It will not calculate the magnetic data to assure that the motion capture data won't be influenced by the high-intensity magnetic field. When the actor moves to a low-intensity magnetic field environment, the gyro will switch back to 9-Axis mode and the LEDs of the Perception Neuron Sensors will be in their normal state again.

Manual mode: you can adjust the gyro mode manually by choosing 6 or 9 axis.



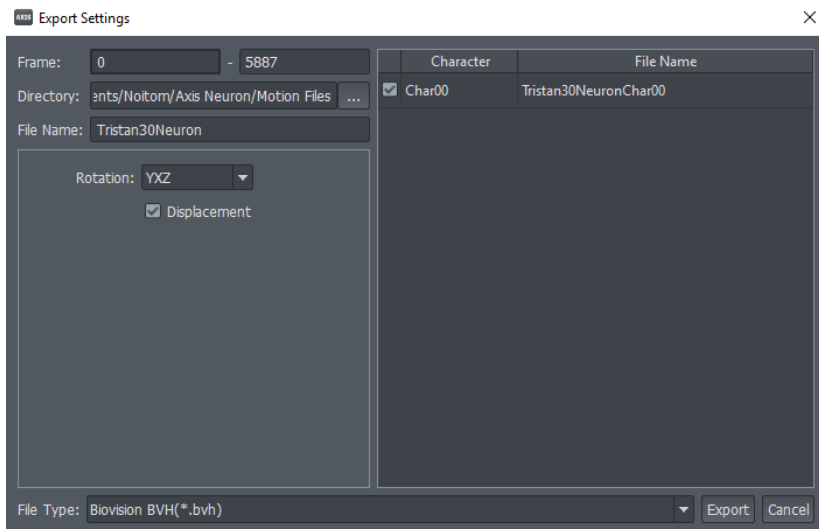
## 2.D Broadcasting:

Choose the Internet Protocol and the file format.



## 3. Export:

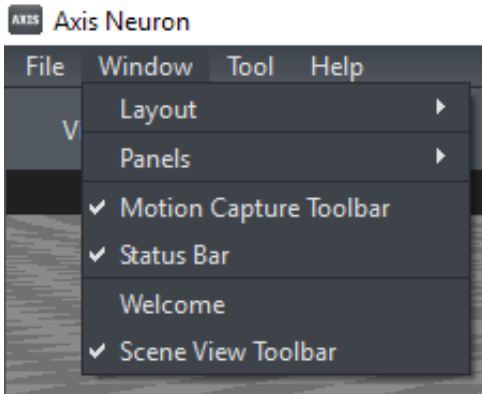
Provides options for exporting data from Axis Neuron.



- **Rotation:** The rotation order of the Euler angle based on the 3D software you wish to export to. The default order is YXZ.
- **Displacement:** Determines if the exported file contains displacement data.
- **Character List:** Choose which character to export when working in Multiplay Mode.

## 3.2.2 Window

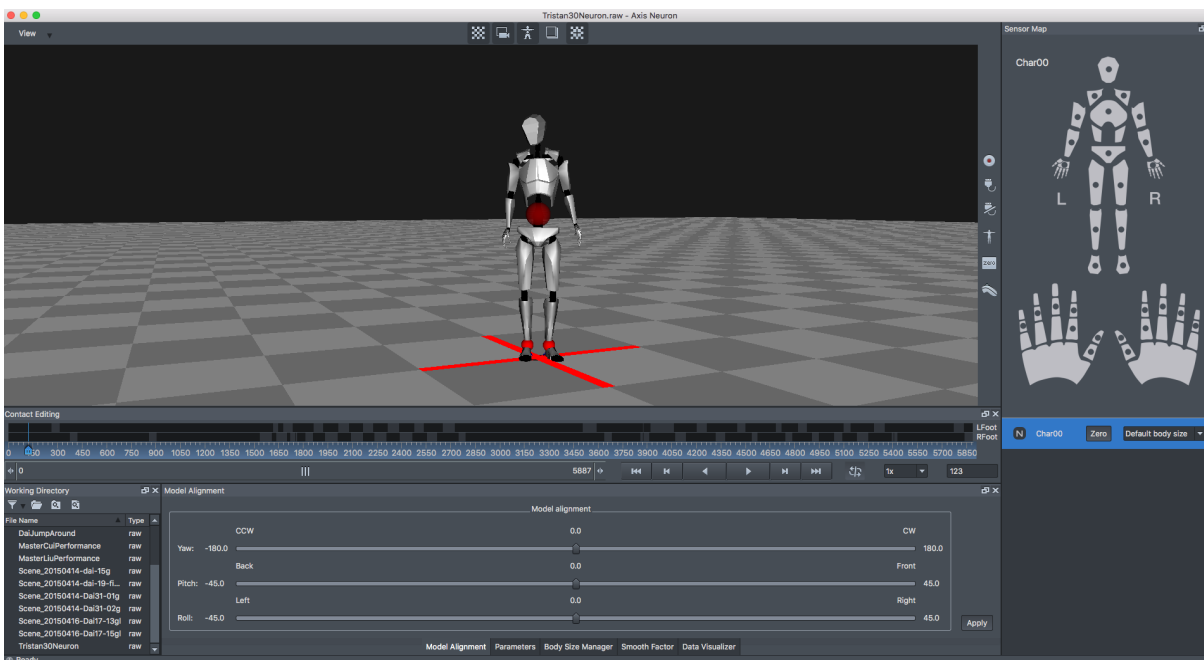
The layout can be adjusted through this menu and panels can be shown or hidden .



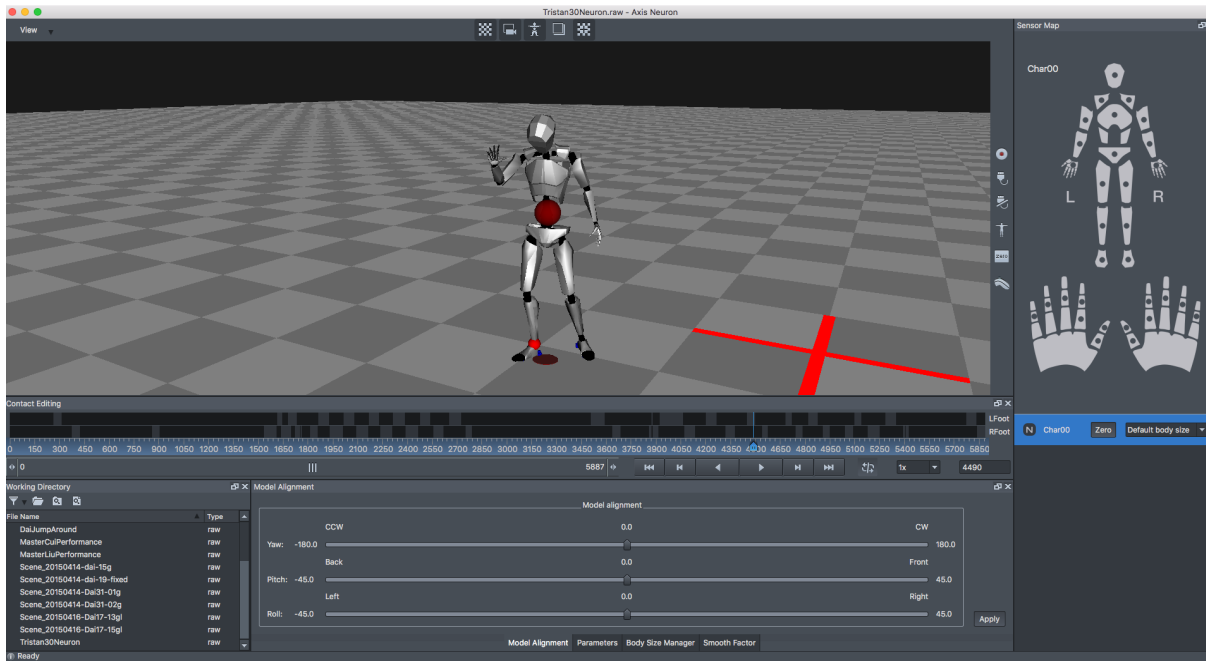
### 1. Layout

There are several layouts that you can choose. They are **Full Fuction mode**, **Editing mode**, **Capture mode**, **Replay** and **Demo mode**. Additionally, you can make a custom layout by choosing **New Layout**.

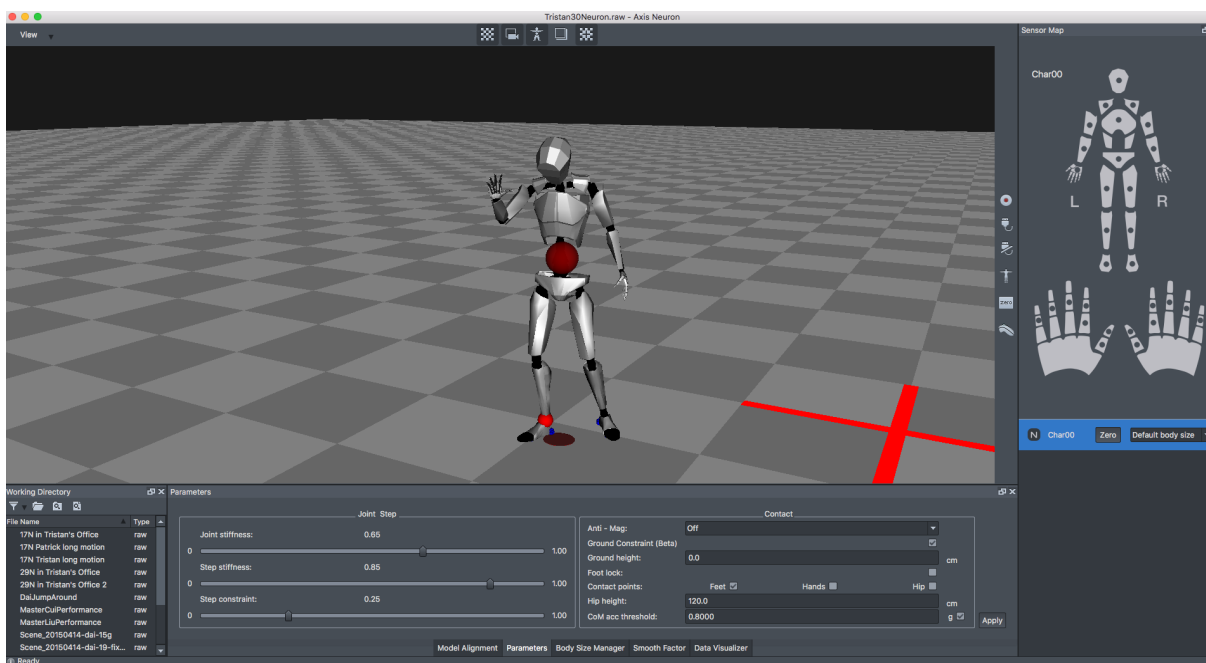
- Full Function - Displays all windows needed for recording and editing.



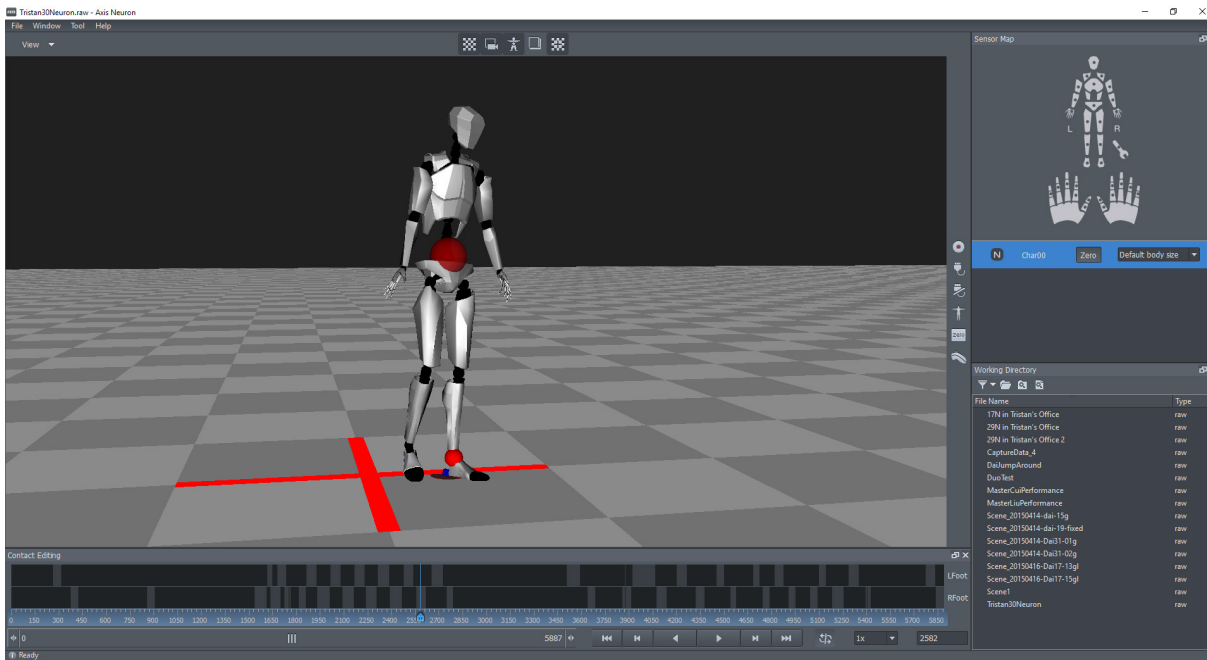
- Editing layout - Similar to Full Function with slightly different window space configuration.



- Capture layout - Closes the Contact editing window as this is not needed during the capture phase.

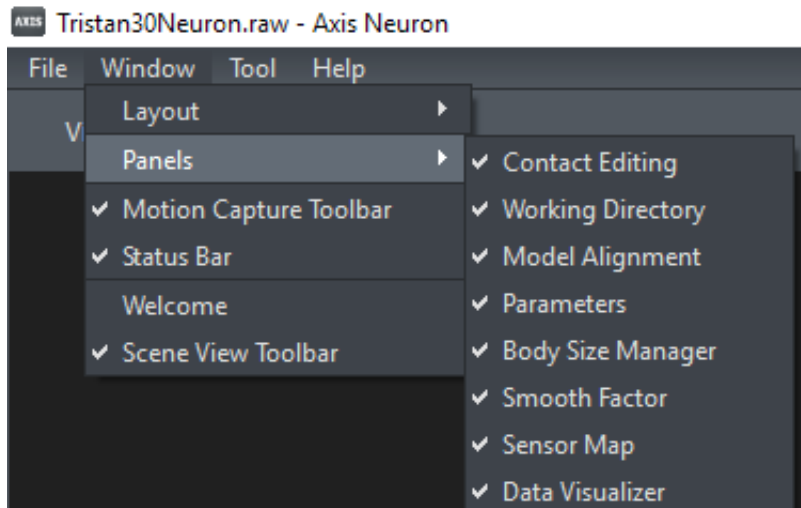


- **Replay and Demo** - Maximizes the viewport window screen space.



## 2. Panels:

Show or hide specific panel.



## 3. Motion Capture Toolbar:

Show or hide the Motion Capture Toolbar. Following are the descriptions of the operations shown in the Motion Capture Toolbar.



- **Record:** When this button is clicked, the Record settings dialog will pop up. You can change the storage path and file name here. When you click “ok”, the red light will blink and Recording will start. Click “Record” again and the recording will stop. The new raw file will show in the Working Directory.



- **Connect:** Before you start recording, you need to connect the suit to the Axis Neuron software. Once you click this button, you can choose the device you want to connect from the equipment list. Multiple devices (suits) will be available if you are using more than one suit.



- **Disconnect:** Clicking this button will disconnect the device(s) from Axis Neuron.



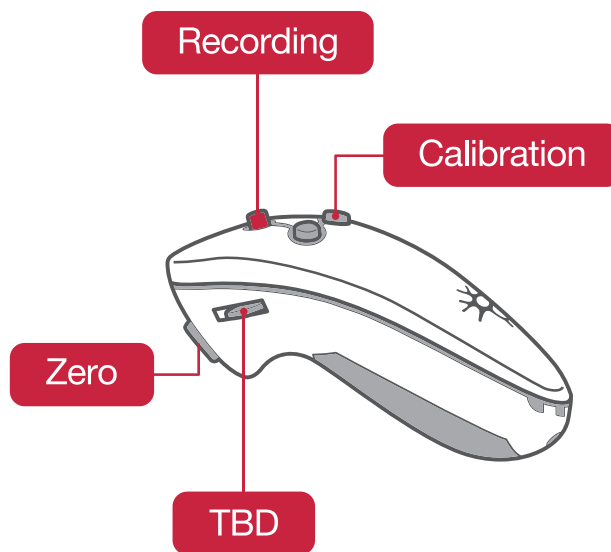
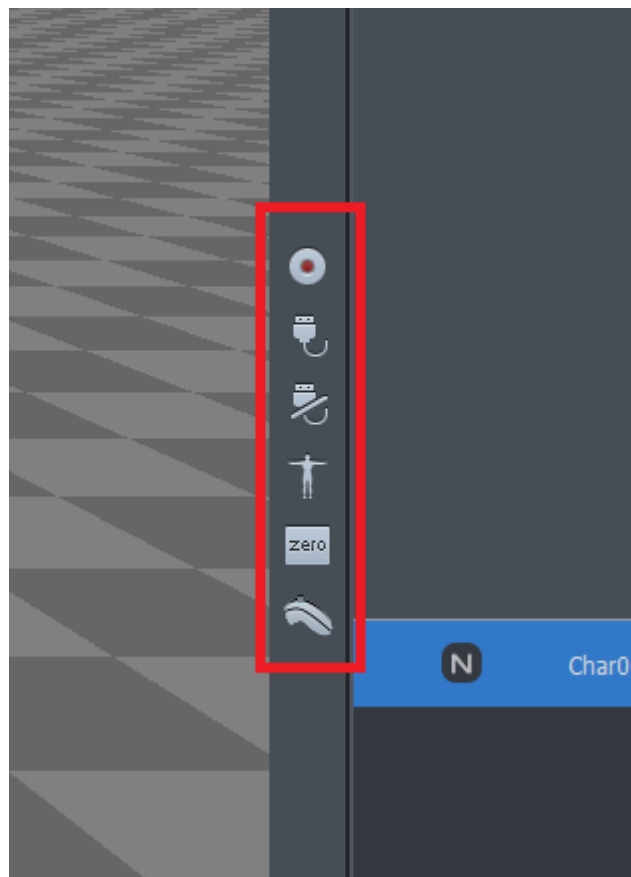
- **Calibrate:** This button will start the pose calibration process to improve capture accuracy.



- **Eliminate error:** This button will align the actor with the origin of the Workspace. When the sensors capture a lot of out-of-range motions, the sensor accuracy may become imprecise. Click Zero to minimize these errors. After clicking the button, the Keep Steady radar will display and the actor should remain steady during this period.

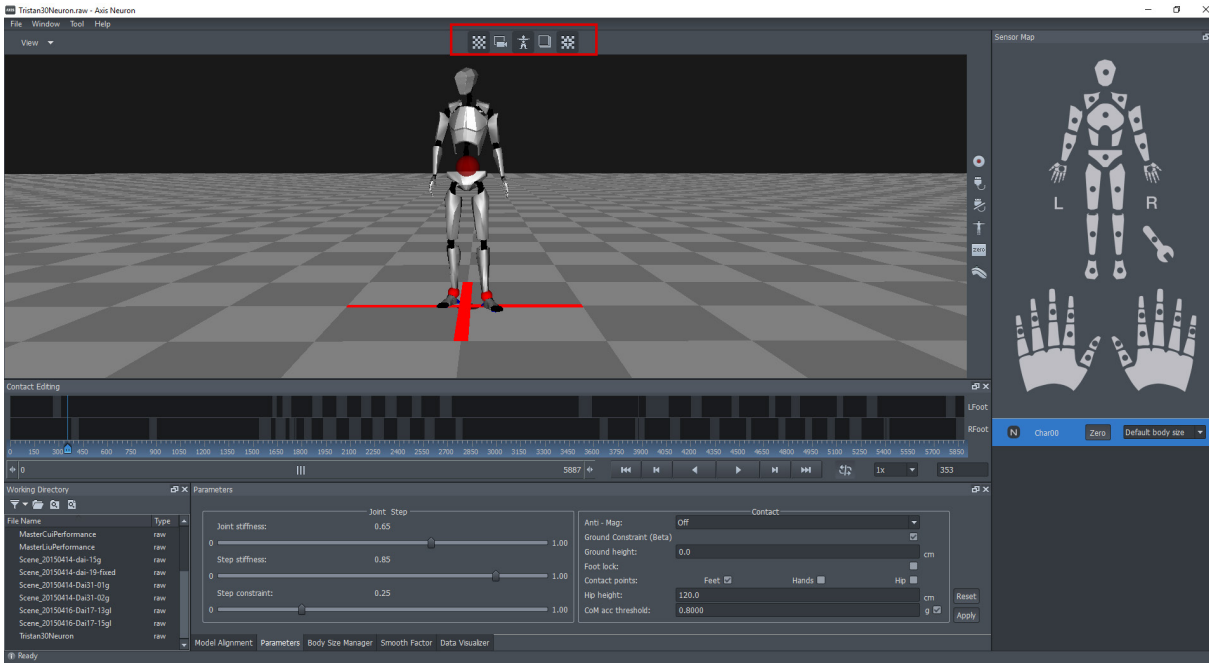


- **Shutter:** The Shutter is the remote controller. Clicking this button will open the shutter function. Clicking it again will close this function. Before using the Shutter, please plug the receiver into an open USB port.



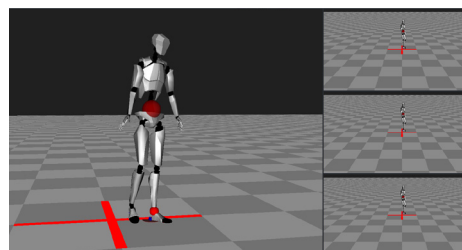
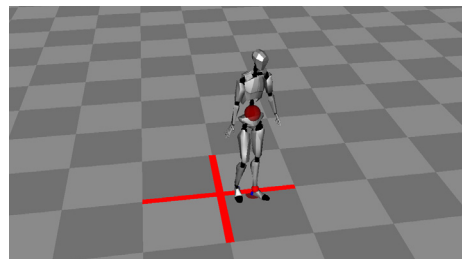
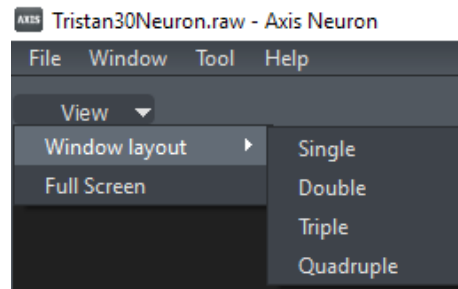
- The red button means Record.
- The R button means Calibrate.
- The L button means Eliminate error.

#### 4. Scene View Toolbar: Toggle layer visibility assets on the viewport



## TIPS

- View - Various viewport layouts can be chosen from here. Each view can show any angle of the model. When setting multiple views, you can drag the separation line of the two views to resize them.
- The shortcut of full screen is Ctrl+F. Quit full screen is Ctrl+F or Esc.
- Click with the left mouse button on the view that you want to be active. Pressing and holding the left mouse button will move the camera view (pan). Pressing and holding the right mouse button will rotate the camera view (orbit). Rolling the mouse wheel will adjust the distance between the camera and the model (dolly).





## Scene View Toolbar Introduction



- **Background:** Toggle ground plane visibility.



- **Camera Track:** Parents the viewport camera position to the avatar making model remain at the center of interest.



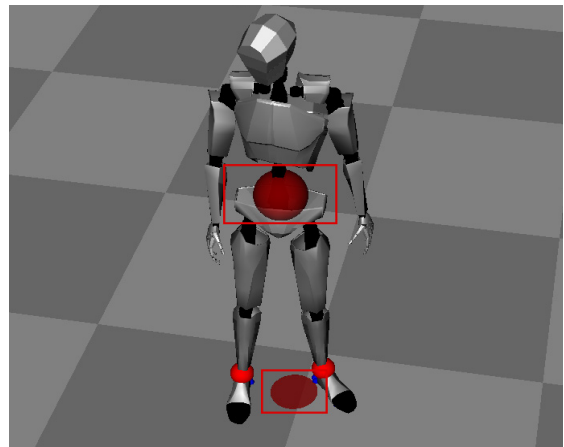
- **Center of Mass:** Displays or hides the center-of-mass of the model.



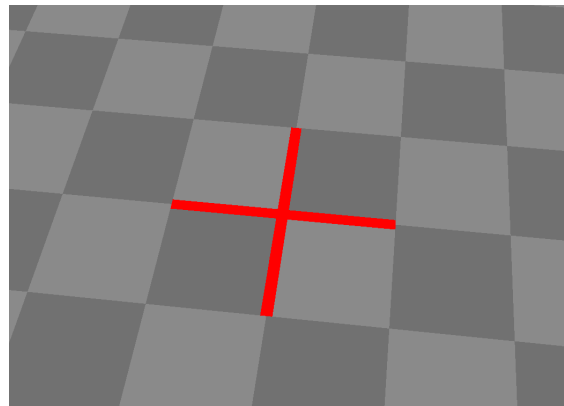
- **Shadow:** Toggle shadow visibility.



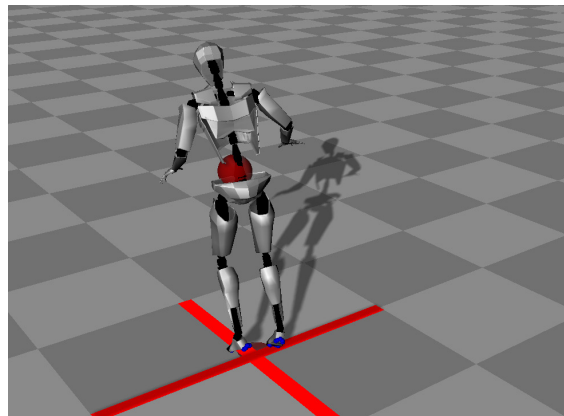
- **Origin Marker:** Shows or hides the red cross marker indicating the origin of scene.



Center of mass



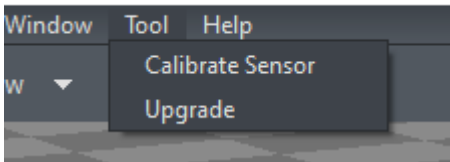
Origin Marker



Shadow

## 3.2.3 Tools

in Tristan's Office 2.raw - Axis Neuron



**Calibrate Sensor:** Calibrates the magnetized Perception Neuron sensors to eliminate accumulated errors. This operation requires that the tool cable is plugged into the hub and the hub is connected to the computer via USB.

**Upgrade:** Manually upgrade the firmware of the Hub app, Hub Boot, Perception Neuron app, or Perception Neuron boot to the latest version. Additionally the software will always auto check the version of the firmware as well.

### TIPS

- Details on the calibration process can be found in 10.2 Perception Neuron Calibration.
- The differences between Pose Calibration and Sensor Calibration:

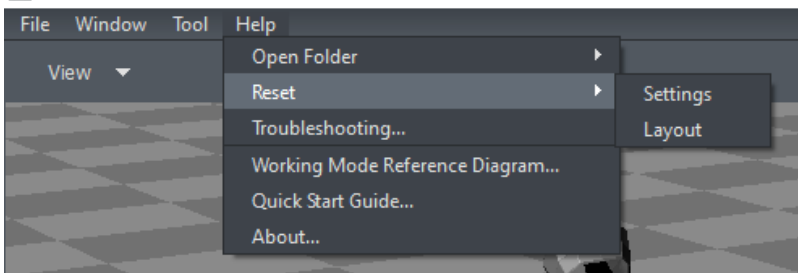
**Pose Calibration:** This calibration is for holistic posture when an actor is wearing the equipment.

**Sensor Calibration:** This calibration is for eliminating the accumulated error of the single magnetized sensor.

## 3.2.4 Help

**Open Folder:** Opens the Body Size Files or Demo File Folder.

29N in Tristan's Office 2.raw - Axis Neuron

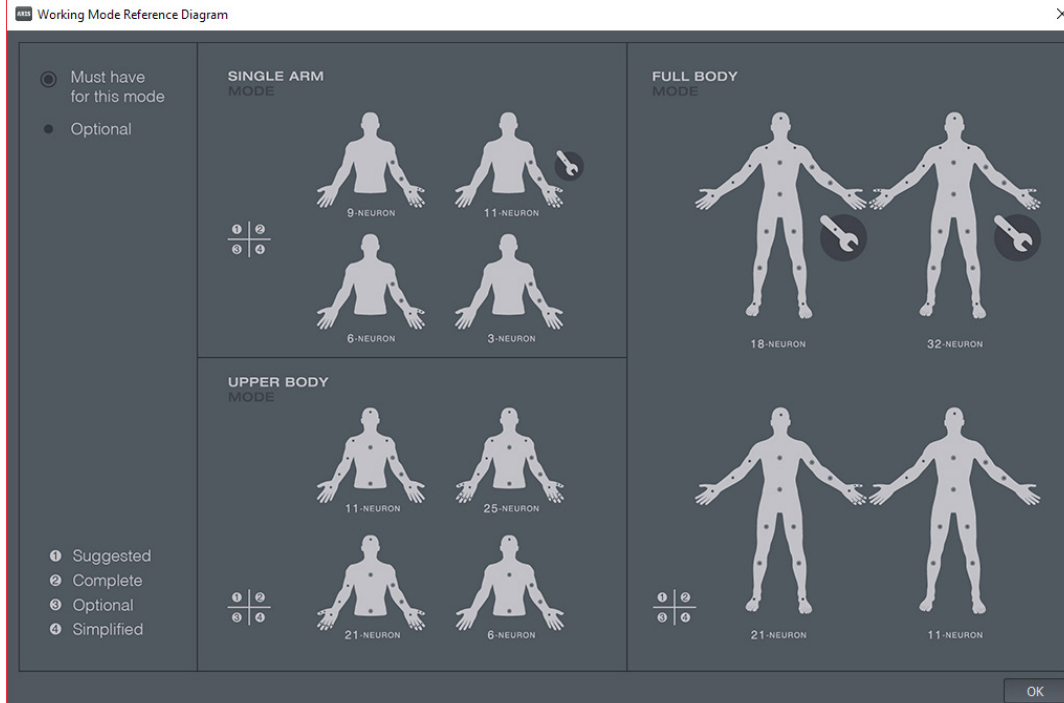


**3. Working Mode Reference Diagram:** Introduction on the motion capture wearing modes.

**Reset:** Contains options for resetting various parameter categories

- Settings: Resets all settings to their default.
- Current Character: Resets the Data parameters of the current character (including model alignment, Parameter, Body Size Manager, Smooth Factor, and Data Visualizer).
- Layout: Reset the layout.

**Working Mode Reference Diagram:** Provides reference to the motion capture wearing modes.



4.

# Connection & Calibration

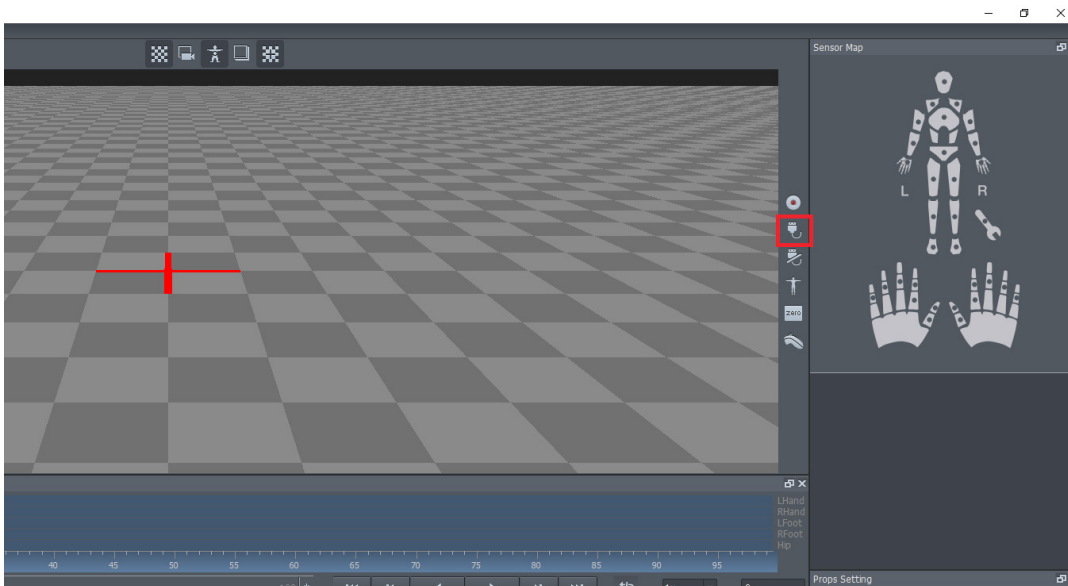
The Perception Neuron Sensors are capable of 60/120 fps sampling rate. All of the sensors will send the data to the Hub and the Hub will send the data to the computer via USB or wireless connectivity. This chapter will outline these two methods of connection and pose calibration.

## 4.1 USB connection

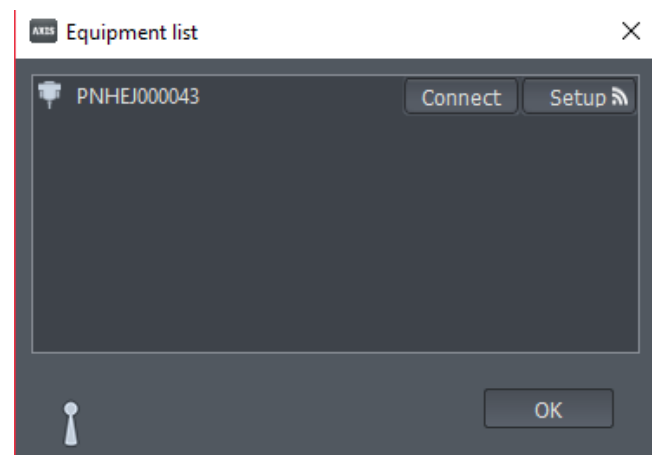
There are 2 ways to establish a connection via USB.

**Method One:** Using the Connect button in the Motion Capture toolbar and choosing the device from the Equipment List window.

1. Plug the USB cable into the Hub using the data port connection and connect the other side of the USB cable into an available USB port on the computer.
2. Click the Connect button in the Motion Capture toolbar.

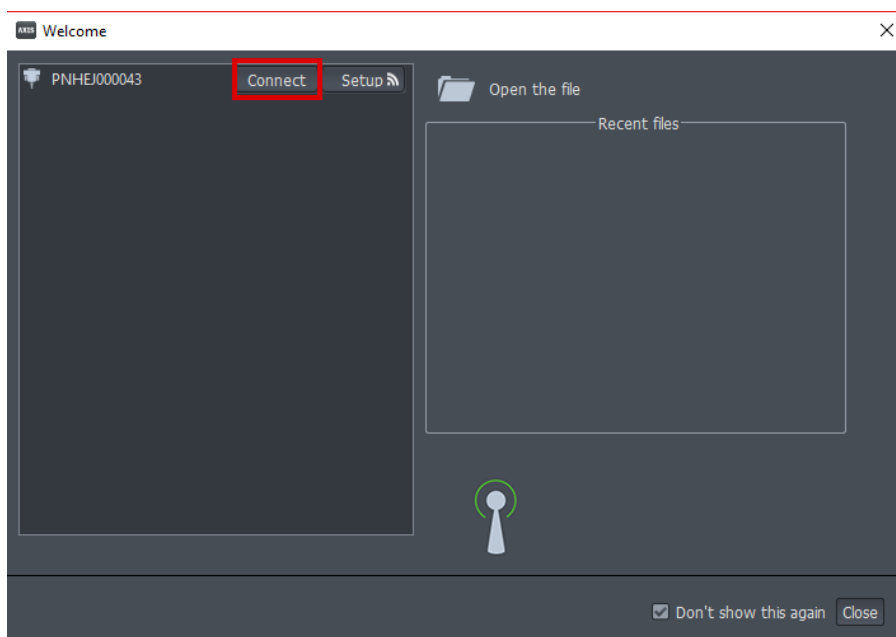


3. Click **Connect** in the Equipment list pop up Window.



**Method Two:** Using the Connect button in the Welcome window.

1. Plug the USB cable into the Hub using the Data port connection and connect the other side of the USB cable into an available USB port on the computer.
2. Click Window -> Welcome, and click Connect on the left side of the screen.



## TIPS

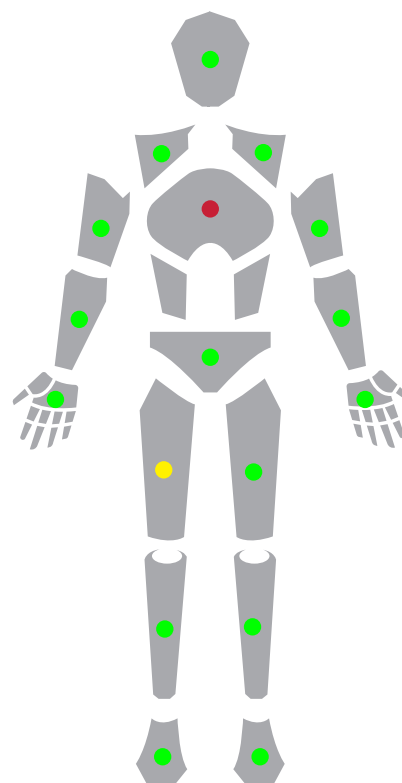
- When you create a real-time connection, the sensor map will show the transmission quality of the data.
- It is normal for sensor quality to toggle from green to yellow. However, a red constant light indicates trouble.

 BEST QUALITY

 MID QUALITY

 BAD QUALITY

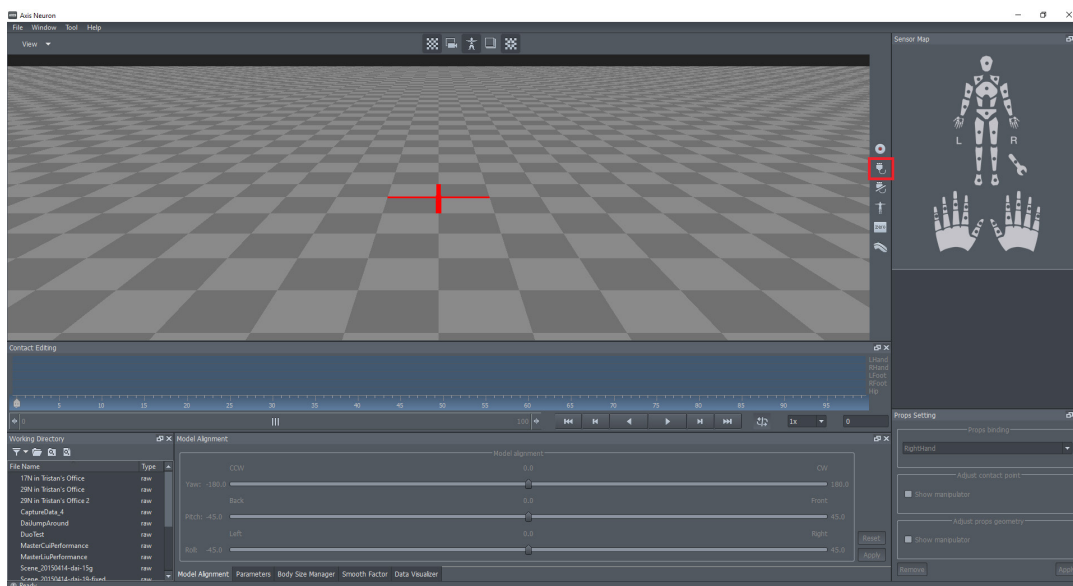
NO SIGNAL: NO DATA



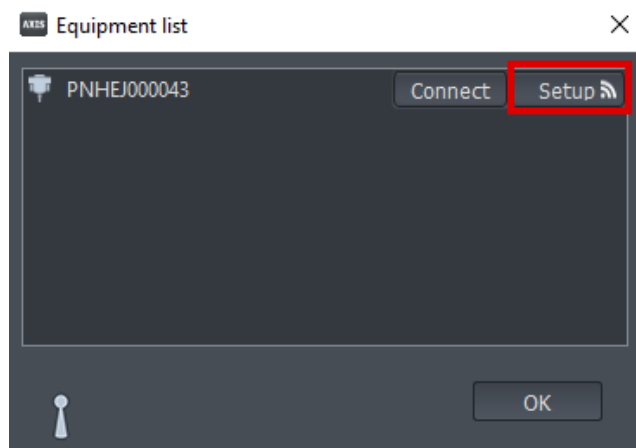
## 4.2 Wireless Connection

To establish a wireless connection to a router, Axis Neuron requires the Hub to be connected directly to the computer. The Perception Neuron Hub supports any standard 2.4G router.

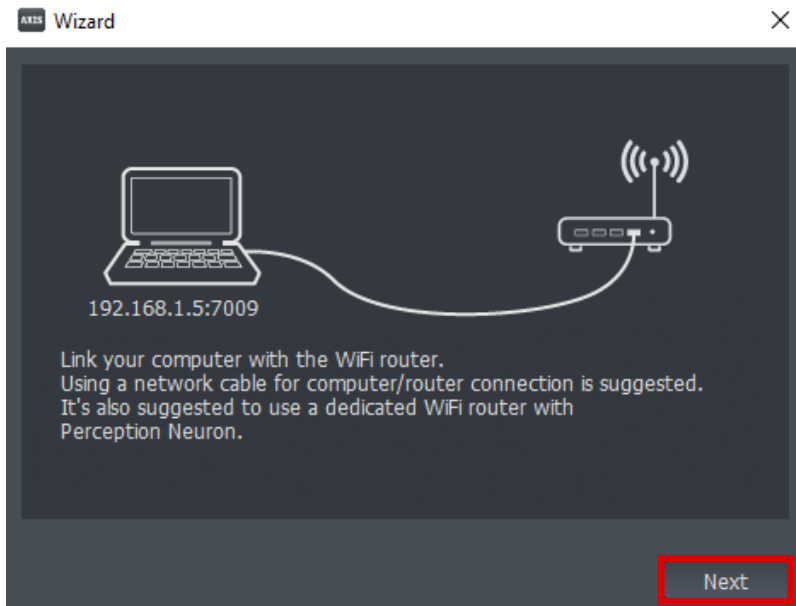
- Set up your router: Set the router's SSID and password. (The length of SSID needs to be less than 26 characters. The length of the password needs to be less than 17 characters.)
- Connect the computer to the router via an ethernet cable.
- Plug the USB cable into the Hub's data port and connect the other end of the USB cable into an available USB port on the computer.
- Click the Connect button from the Motion Capture toolbar.



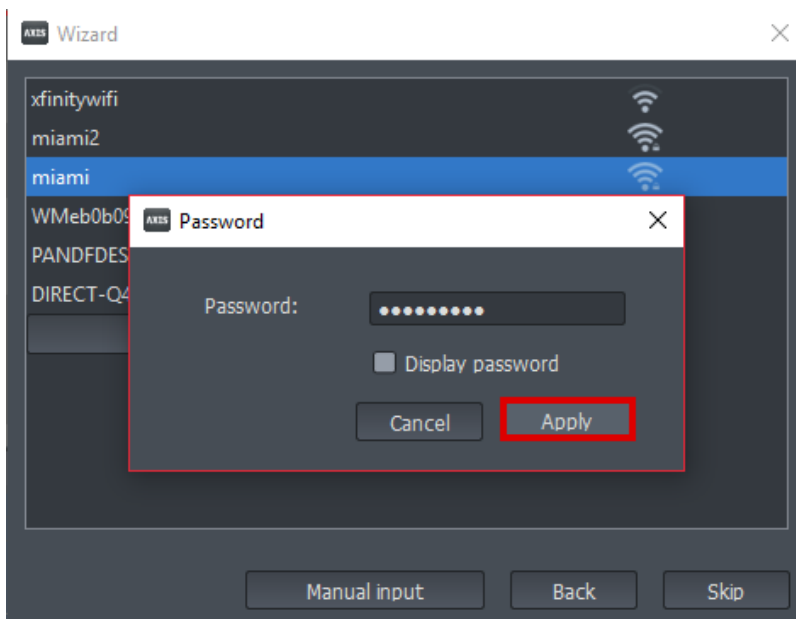
- In the Equipment list dialogue click on Setup.



- Click Next.

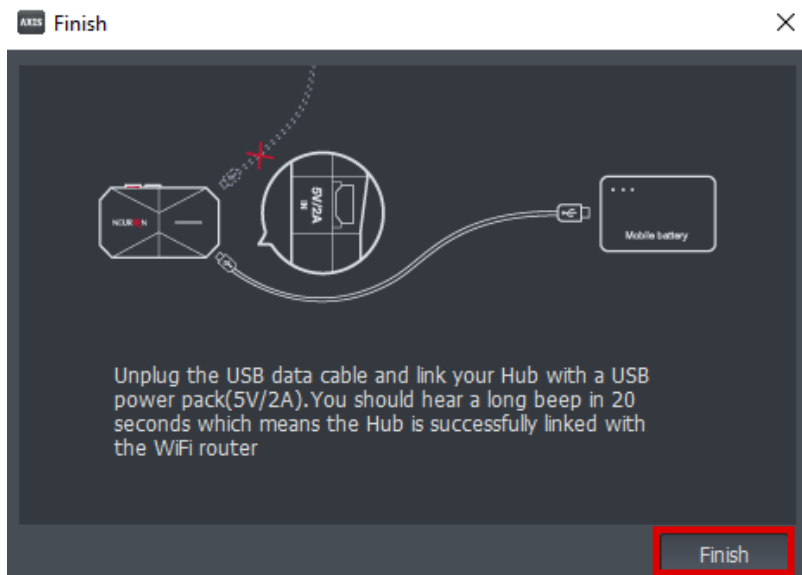


- Click the SSID you want to connect to and input the password.





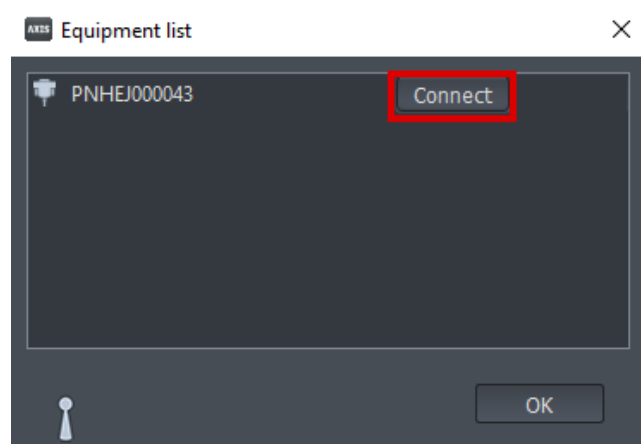
7. Unplug the USB data cable from the computer. Switch the USB cable attached to the Hub from the data port to the 5V/2A IN port on the Hub then connect the other end of the USB cable to a portable USB power supply. Click Finish to close dialog. Wait until the Hub establishes a connection with the router. This should not take more than 20 seconds. The Hub will send out a buzzing sound one time to show a successful connection.



8. Click Connect button.

## TIPS

- If the SSID you want to connect is not on the list, you can also click the Manual input to refresh the SSID manually.
- The Hub will store the SSID and password you set. So, if the Host IP doesn't change, you can skip setting the password step by clicking the Skip button.

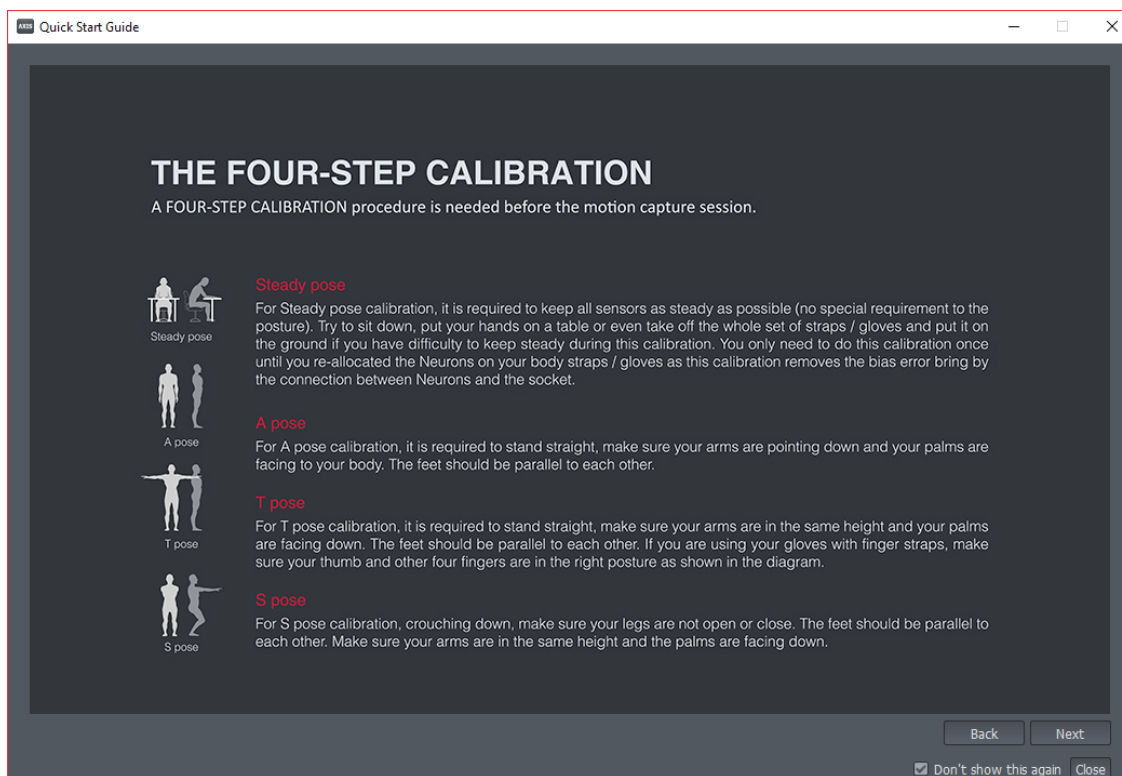


## 4.3 Multiple Equipment Connection

Axis Neuron supports up to five Perception Neuron suits connected simultaneously. The method of connection is the same as the single equipment connection. To connect multiple actors the connection must be done one at a time.

## 4.4 Posture Calibration

This four-step posture calibration process is required before you start to record motion data. Please read the following introduction about calibration carefully. You can also find this information in the Quick Start guide.



**Quick Start Guide**

### THE FOUR-STEP CALIBRATION

A FOUR-STEP CALIBRATION procedure is needed before the motion capture session.

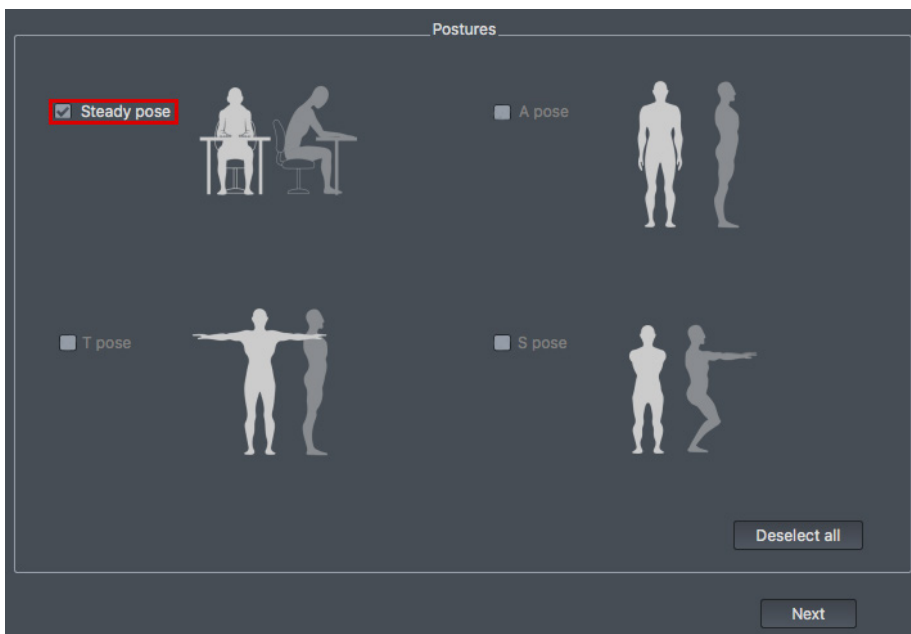
- Steady pose**  
For Steady pose calibration, it is required to keep all sensors as steady as possible (no special requirement to the posture). Try to sit down, put your hands on a table or even take off the whole set of straps / gloves and put it on the ground if you have difficulty to keep steady during this calibration. You only need to do this calibration once until you re-allocated the Neurons on your body straps / gloves as this calibration removes the bias error bring by the connection between Neurons and the socket.
- A pose**  
For A pose calibration, it is required to stand straight, make sure your arms are pointing down and your palms are facing to your body. The feet should be parallel to each other.
- T pose**  
For T pose calibration, it is required to stand straight, make sure your arms are in the same height and your palms are facing down. The feet should be parallel to each other. If you are using your gloves with finger straps, make sure your thumb and other four fingers are in the right posture as shown in the diagram.
- S pose**  
For S pose calibration, crouching down, make sure your legs are not open or close. The feet should be parallel to each other. Make sure your arms are in the same height and the palms are facing down.

Back Next

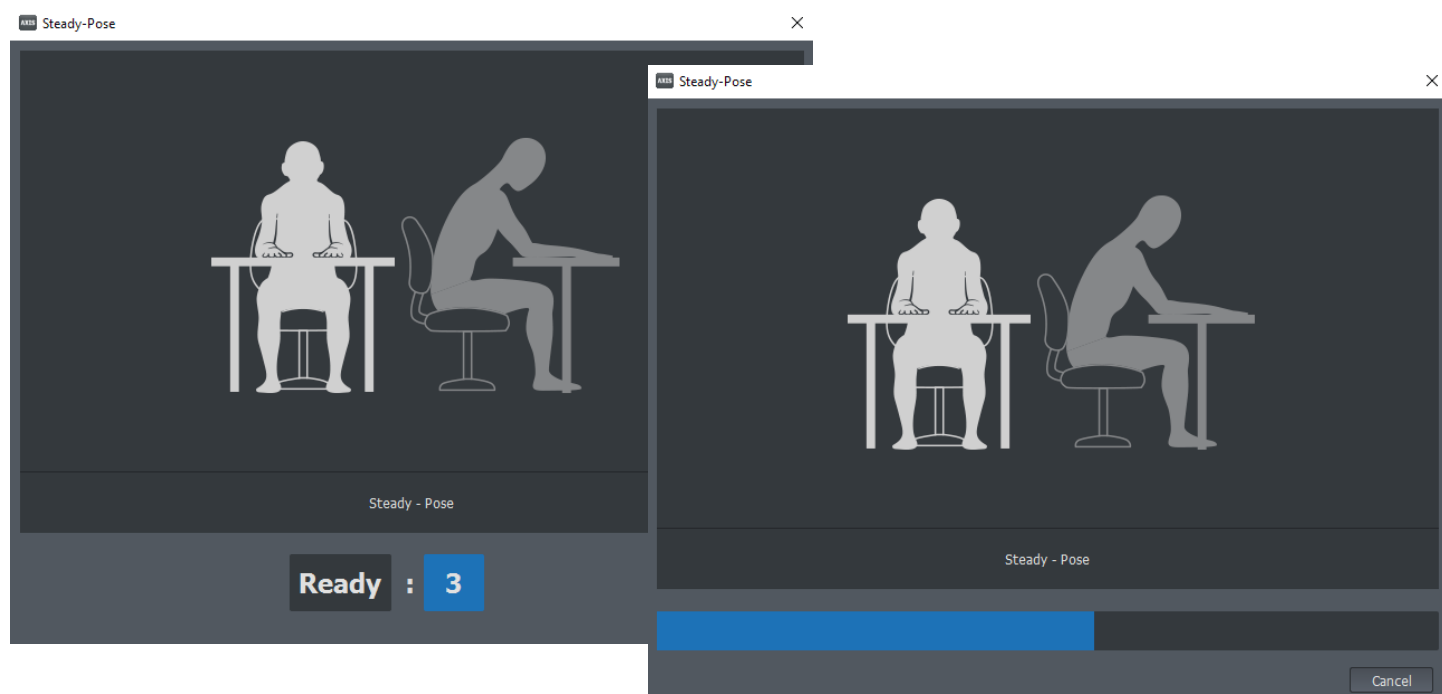
Don't show this again Close

### Steps:

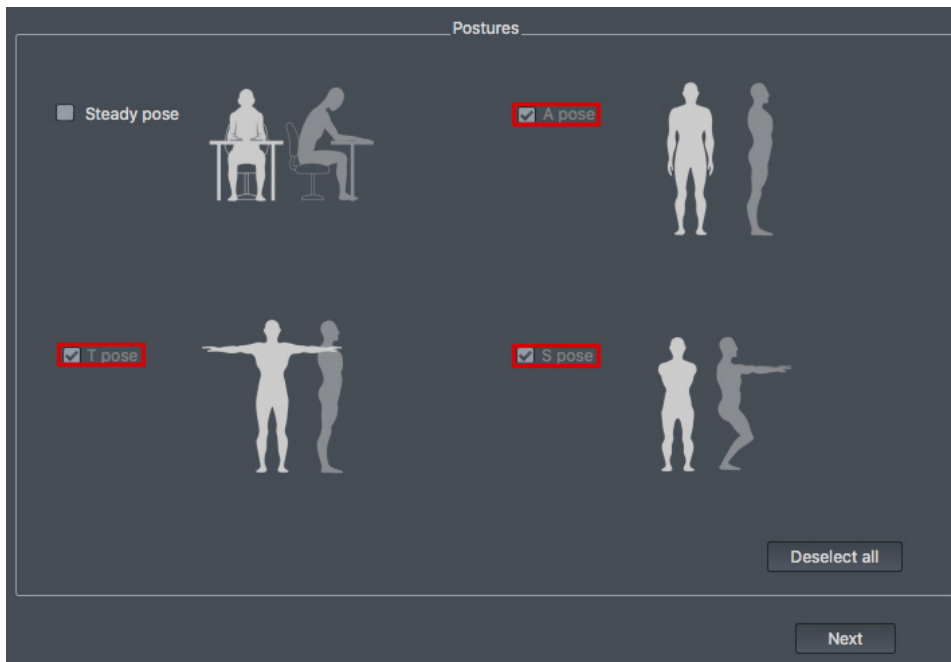
1. After connecting successfully, click the **Calibrate** button in the Motion Capture toolbar.
2. Click **Next** in the posture selection dialog then perform the **Steady** pose. A (3) second countdown will begin followed by 15 consecutive beeps during the calibration. (You only need to do this calibration once until you re-allocate the Perception Neuron sensors on your body straps/gloves as this calibration removes the bias error brought by the connection between the sensors and the socket).



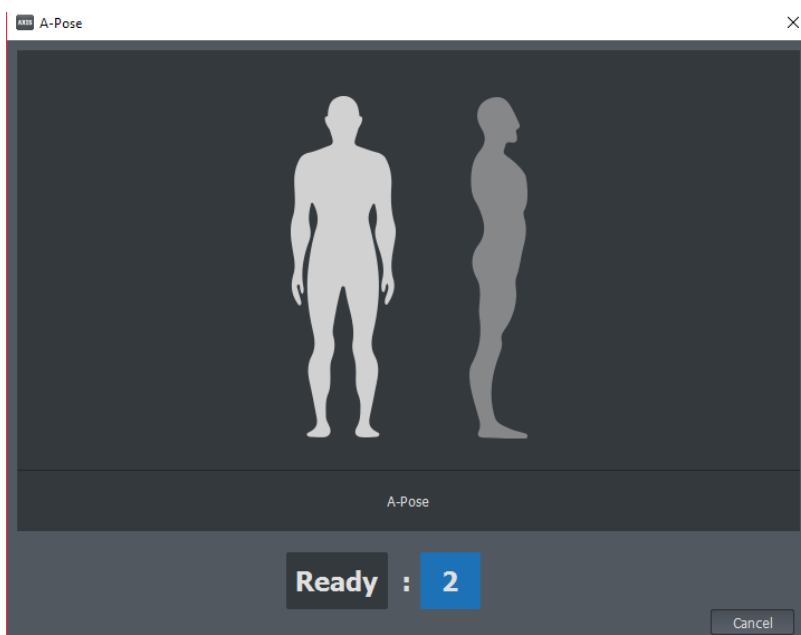
3. When performing the Steady Pose calibration the actor must remain still. We recommend having the actor remain in a sitting position.



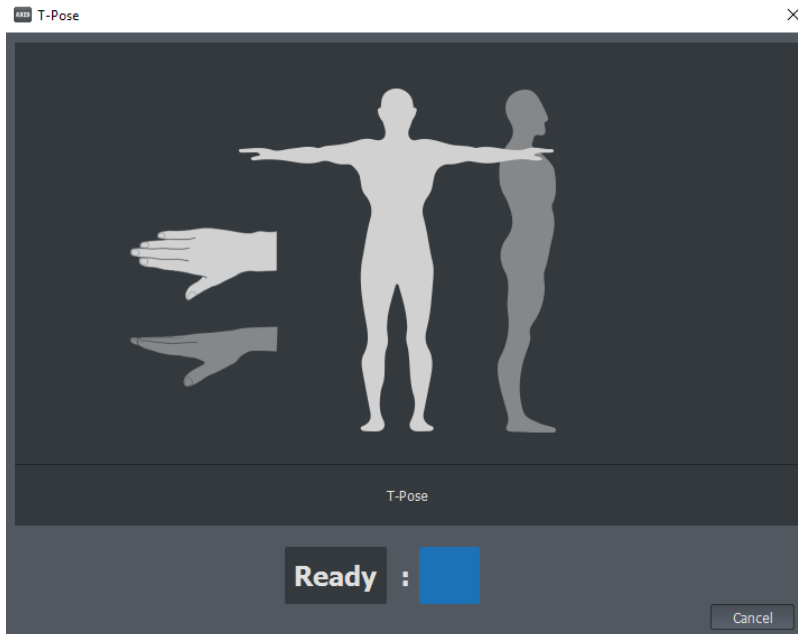
4. Once the Steady Pose is complete reopen the posture calibration window and select **A, T, S pose**. (Available pose will depend on the working mode.)



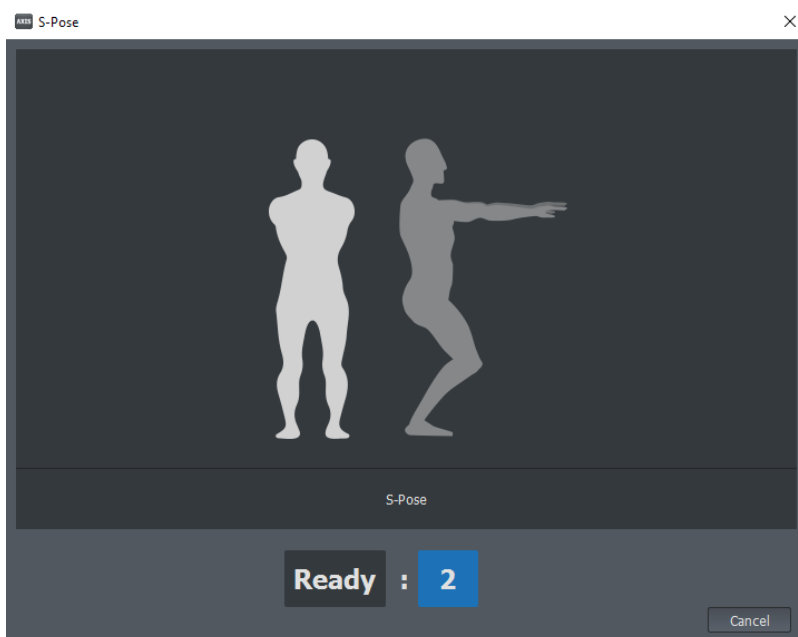
- 4.1. A Pose calibration - During the countdown, the actor will have time to position his/her body for the correct posture. Place hands on the side of the thigh and keep feet parallel. The Upper Arm Strap should be parallel to the palm sensor in a single line chain.



4.2. T Pose calibration - Arms need to be extended out parallel to the floor. The actor should not shuffle their feet between the posture calibration positions. Hands should be a little over-extended with the thumb facing 45 degrees out and 45 degrees down (see image).



4.3. S Pose calibration - Bend the knees and position your body in the letter 'S'. Maintain your back upright perpendicular to the floor. Move your arms in front of you and position them parallel to the floor.

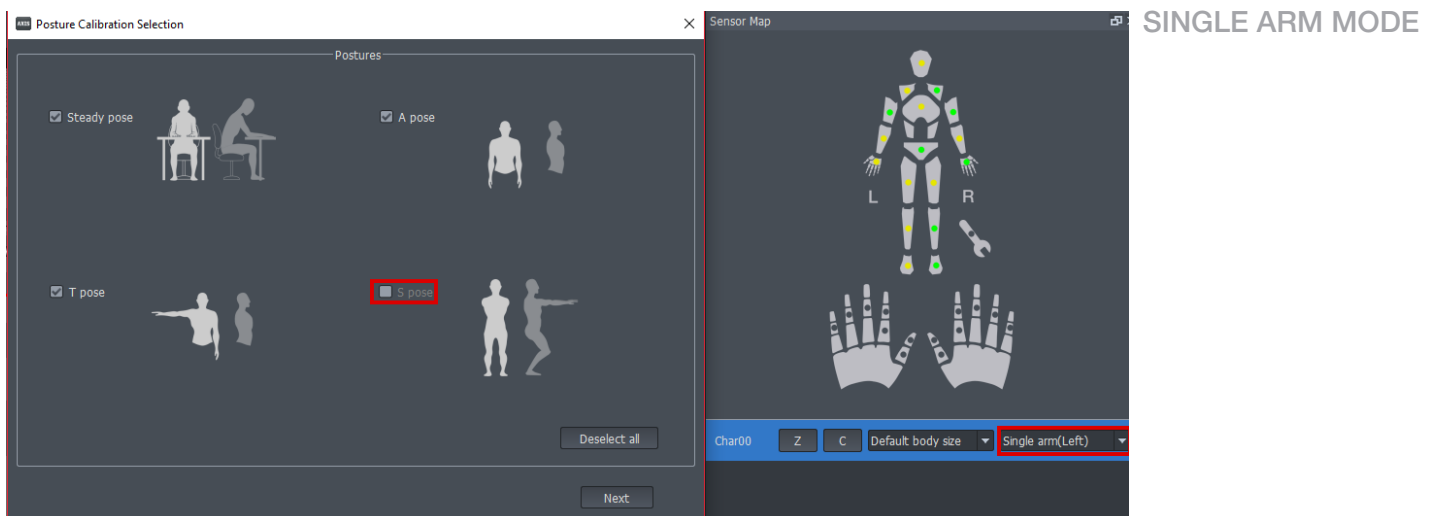


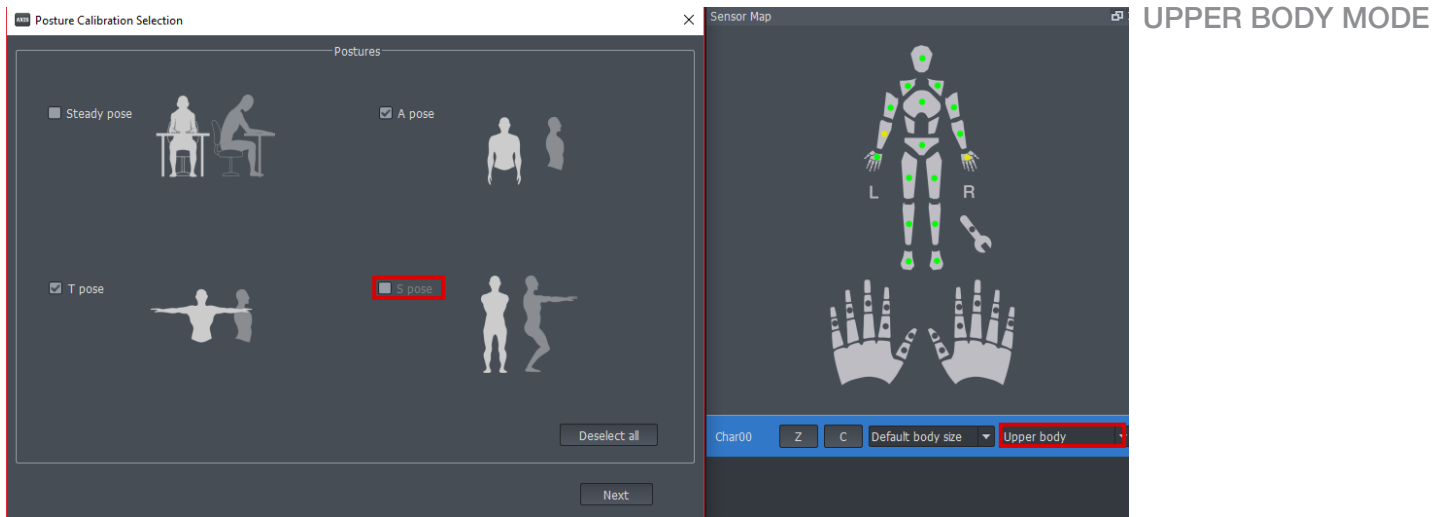
## TIPS

- Having a second person supervise your calibration poses is advised.
- Feet must remain parallel, do not shuffle your feet during all posture calibrations.
- Knees on the S-Pose are to be parallel to your feet.
- If you find the avatar is having issues with a closed fist, then we suggest to over extend the hand during the T Pose.

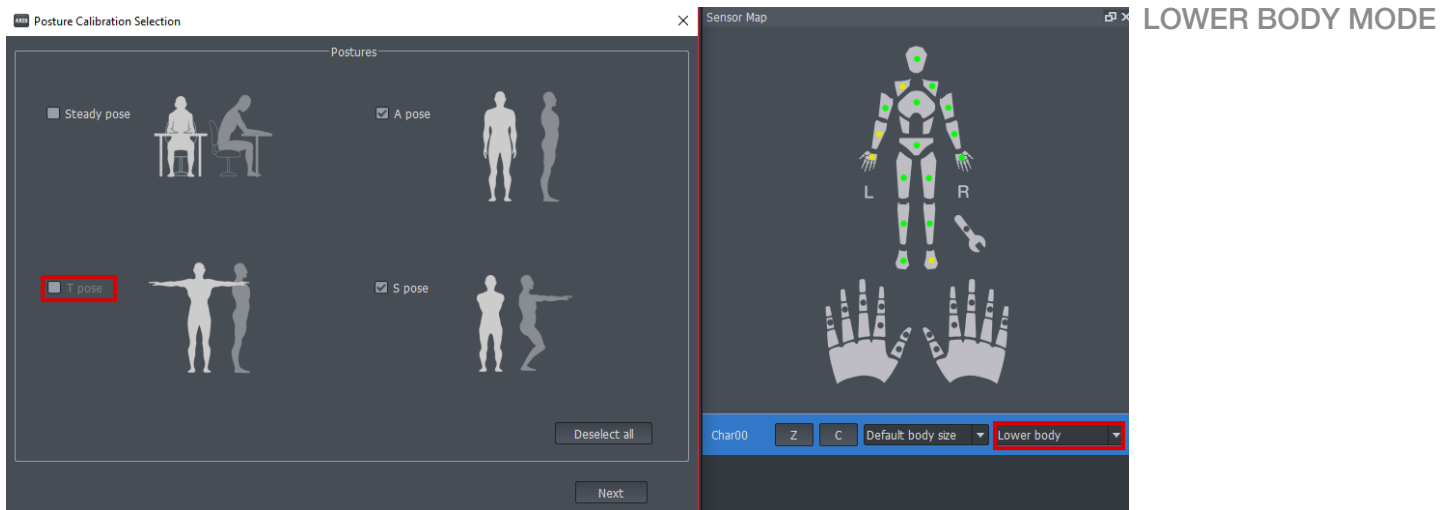
### Notes:

1. When the working mode is set to Single arm or Upper Body mode, the S-pose is not required. When the mode is set to Lower body, the T-pose calibration is not required.





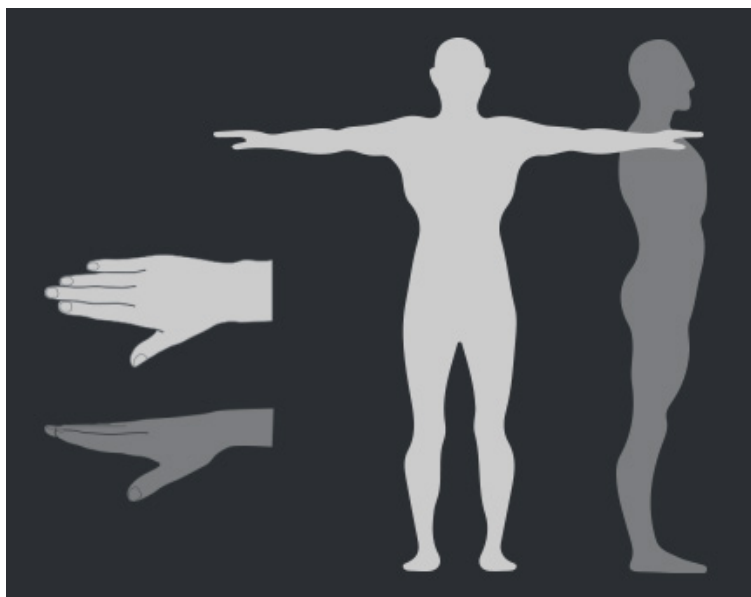
UPPER BODY MODE



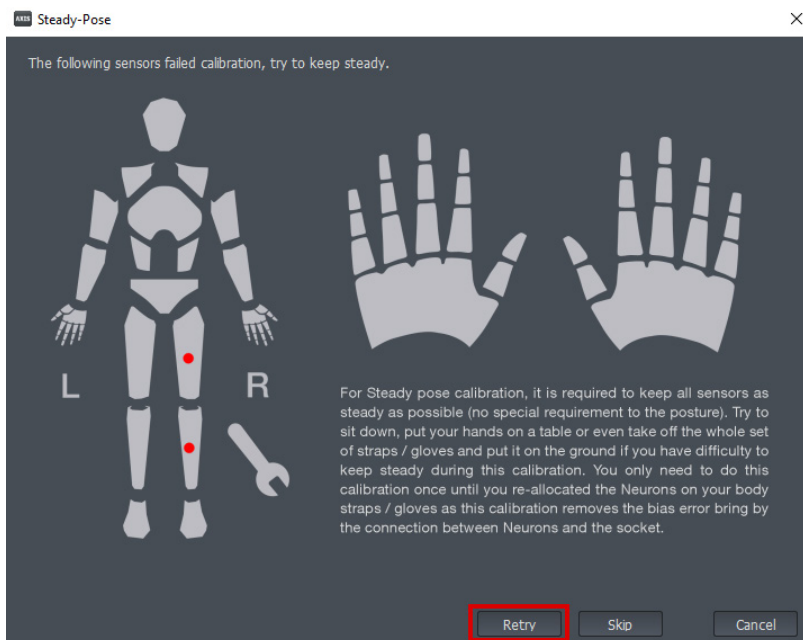
LOWER BODY MODE

2. The Posture calibration will need to be performed again if the body size has been changed for the avatar.

3. When equipped with the full finger gloves, during the T-pose calibration pay attention to the position of the thumb. The actor must position the thumb 45 degrees from the palm in the top view and left view.



4. During the steady pose, calibration it is not necessary to put the Perception Neuron suit on the actor. The Perception Neuron suit can be placed on a flat secured surface during the steady pose, improving sensor stability during this calibration step. It is important to keep the Perception Neuron sensors stable as much as possible otherwise Axis Neuron will show an error hint. If you see a red spot, this means that Perception Neuron's steady pose calibration failed. You can click Retry to recalibrate it.



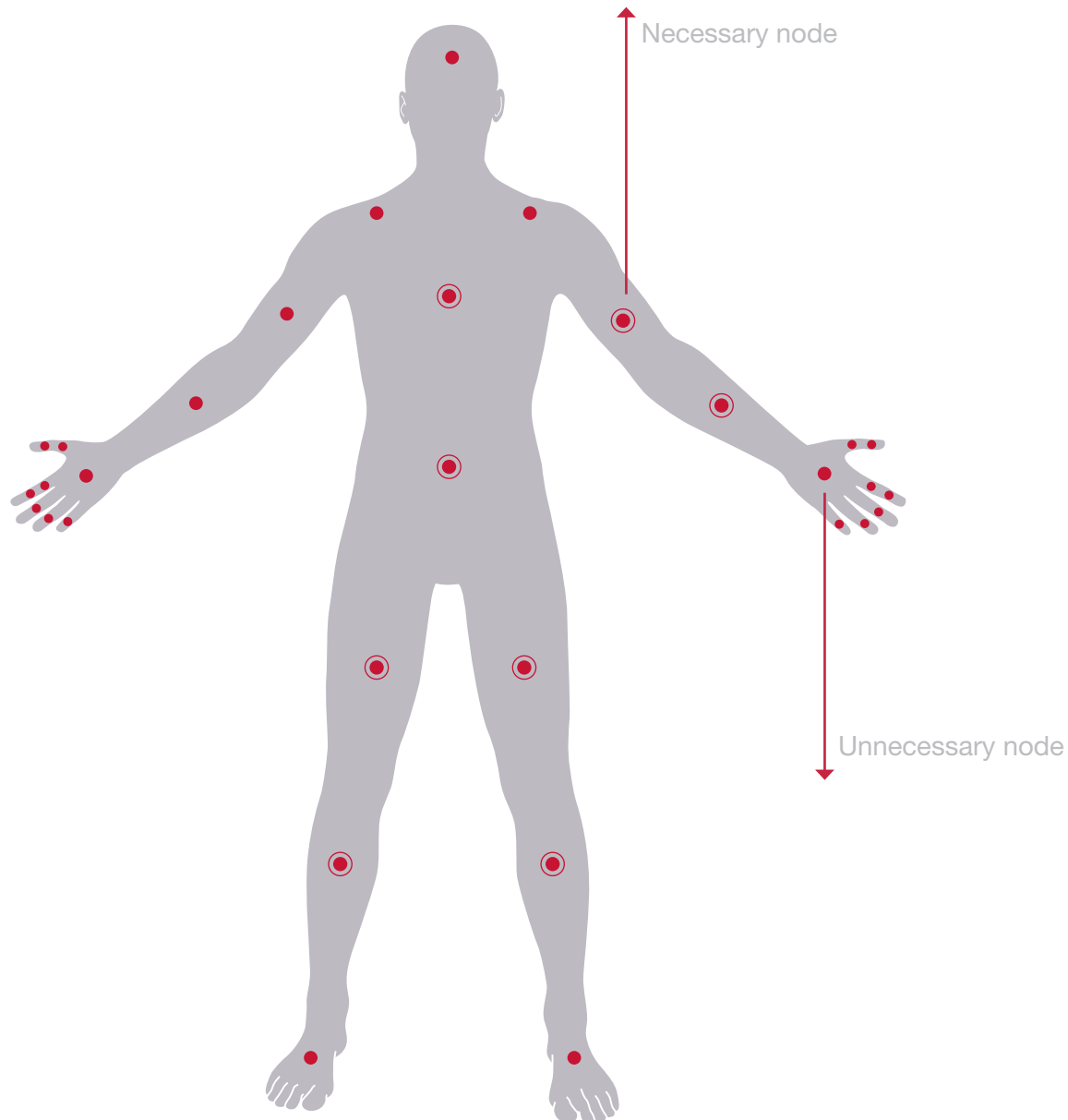
5. If the environment causes interference after the Posture Calibration has been performed, you may consider elevating the actor with the suit off the ground during the calibration to improve capture accuracy. This will eliminate feet sliding and finger curling which is caused by ground or environment interference.



# 5. Sensor Wear Combination Mode

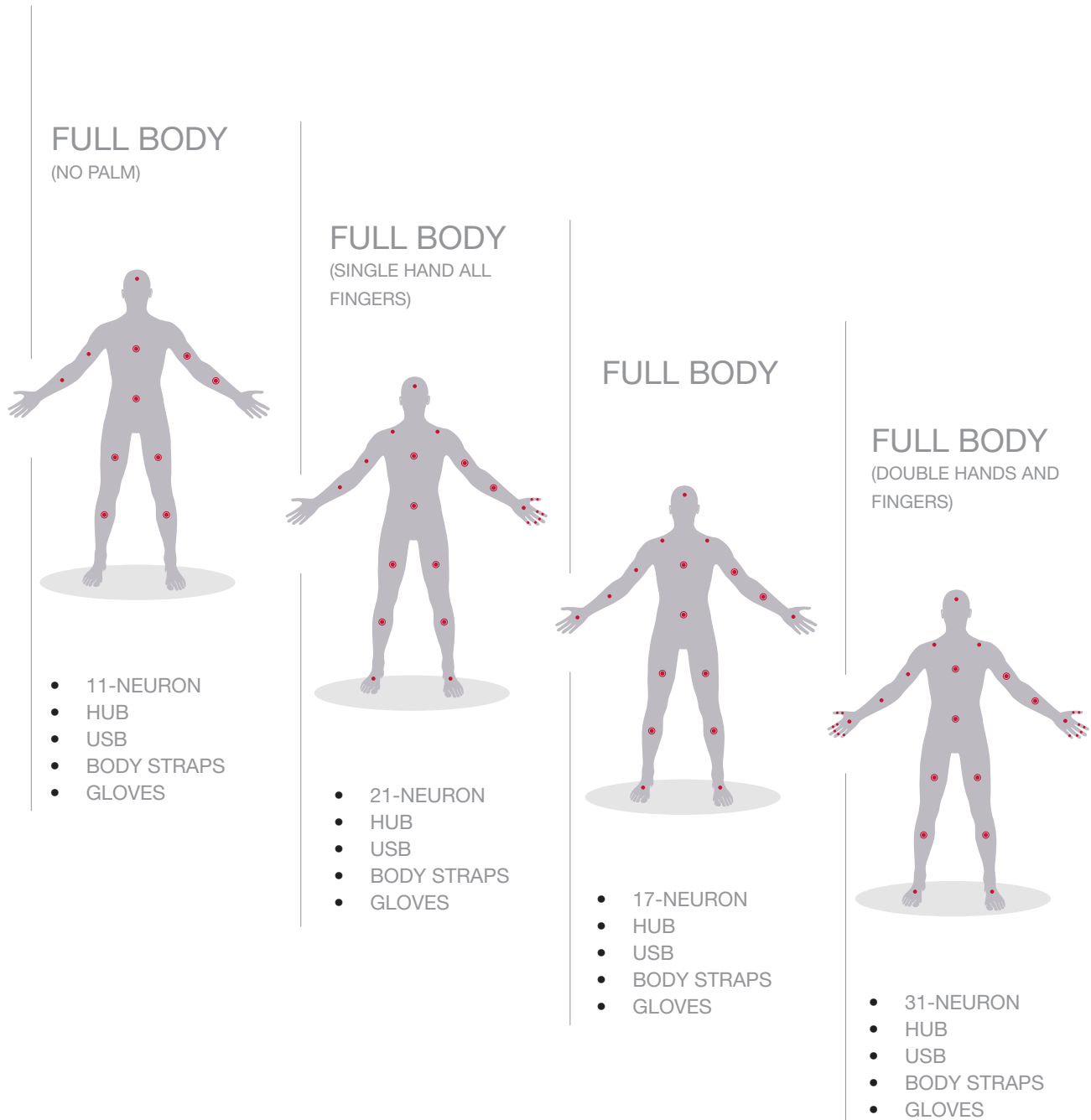
## 5.1 Working Mode Introduction

Perception Neuron allows you to change working mode based on the body segments needed. If accuracy is not essential, users have the flexibility to connect the most necessary sensors allowed. The image below shows an example of how to read the different working mode diagrams.



## 5.1.1 Full Body Mode

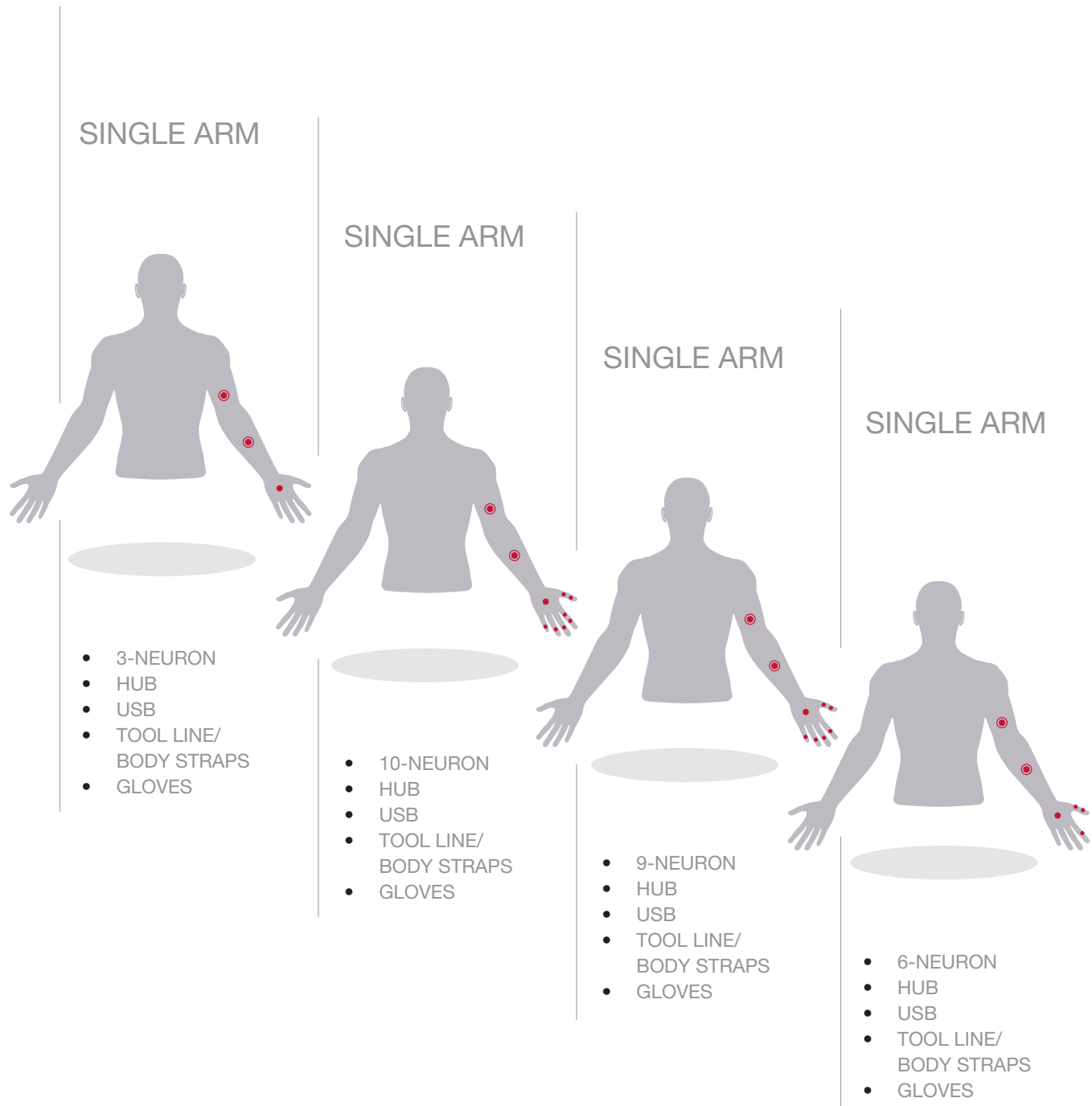
Full body (Necessary Sensors: Both L/R - Upper Arm and Lower Arm, Hip, Spine, Upper Leg and Lower Leg.)





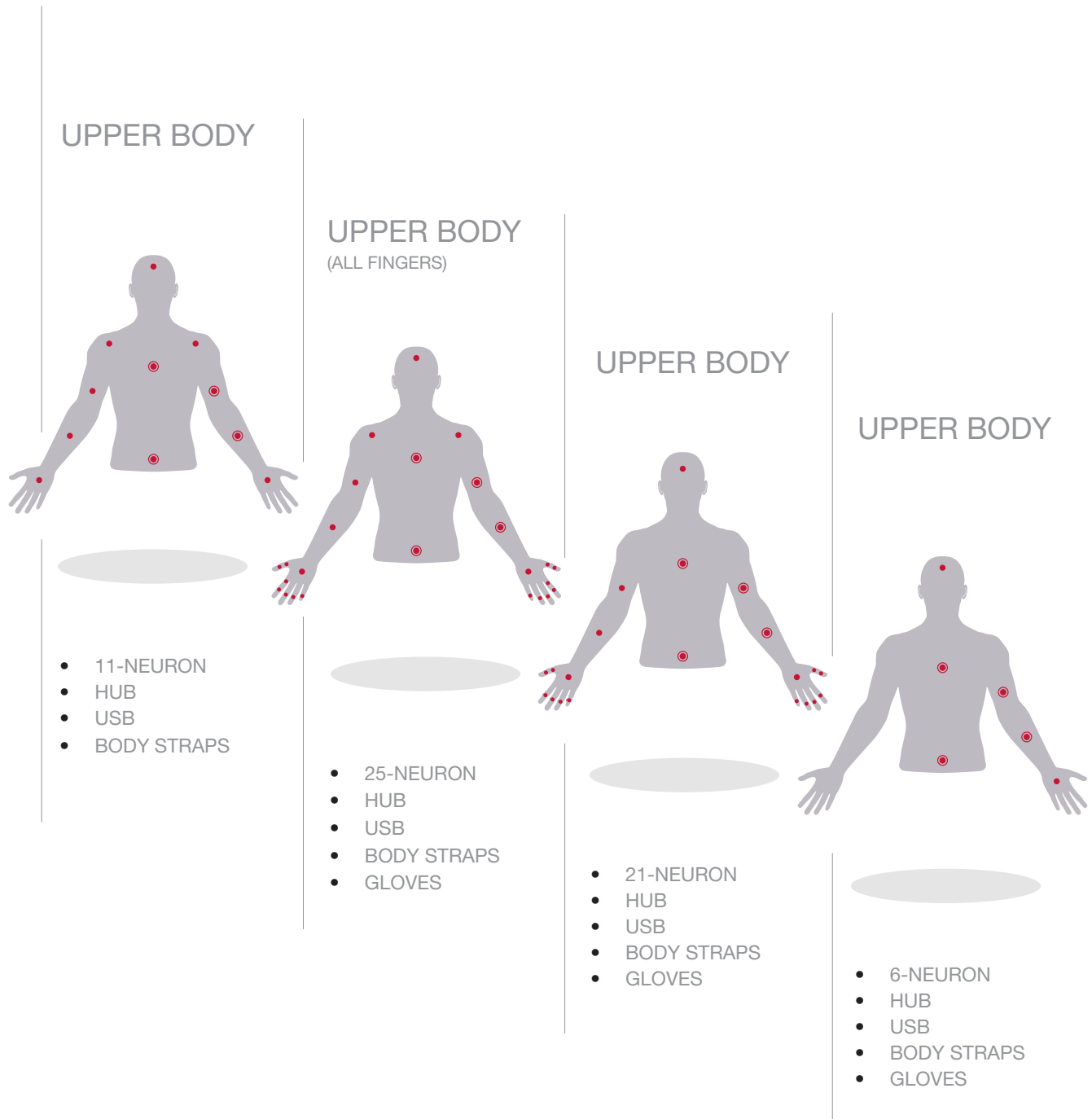
## 5.1.2 Single Arm Mode

Single Arm (Necessary mode: Both L/R - Upper Arm and Lower Arm.)



## 5.1.3 Upper Body Mode

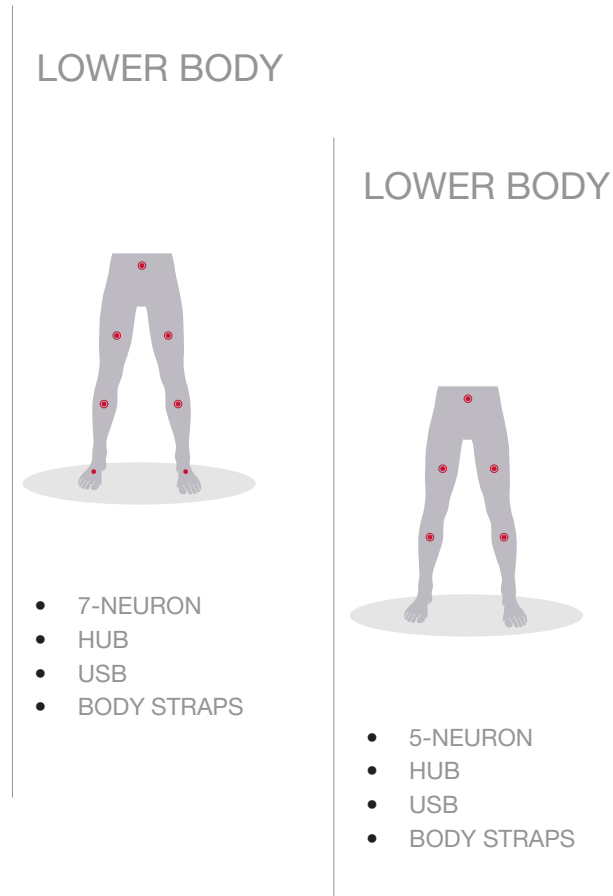
Upper Body (Necessary mode: Both L/R - Upper Arm + Lower Arm, Hip, Spine.)





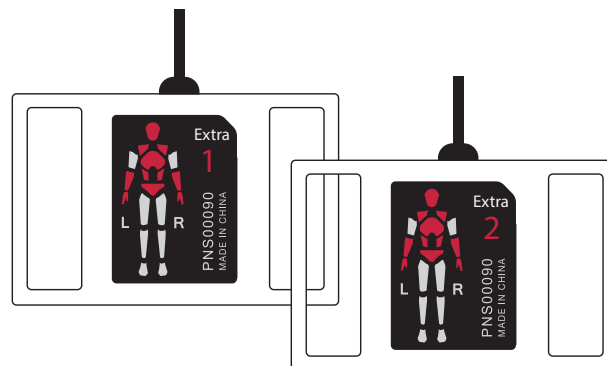
## 5.1.4 Lower Body Mode

Lower Body (Necessary mode: Hip, both L/R Upper Leg and Lower Leg.)



## 5.2 Universal Straps

The socket straps with the labels Extra 1 and Extra 2 are known as universal straps. If a body strap on the suit is found to have a connection problem you may use one of the universal straps to replace the bad strap. A universal strap cannot replace any of the UPPER BODY STRAPS, GLOVES, or the HEAD STRAP. Both Extra 1 and Extra 2 can be used simultaneously.

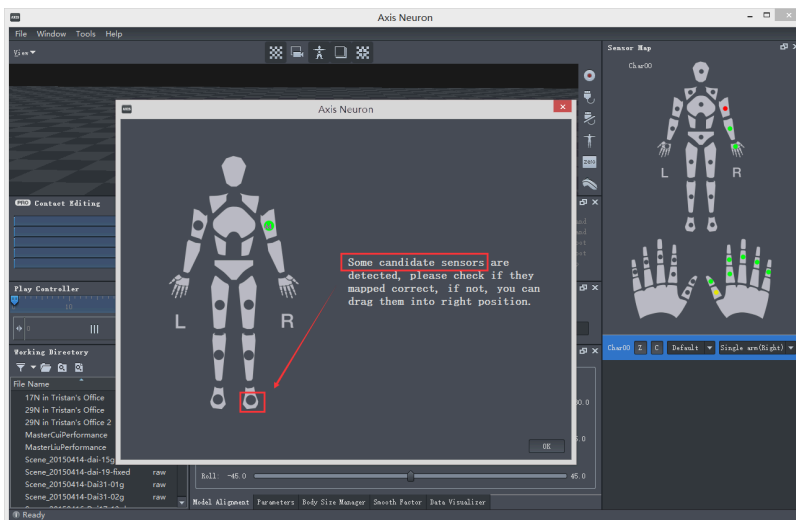
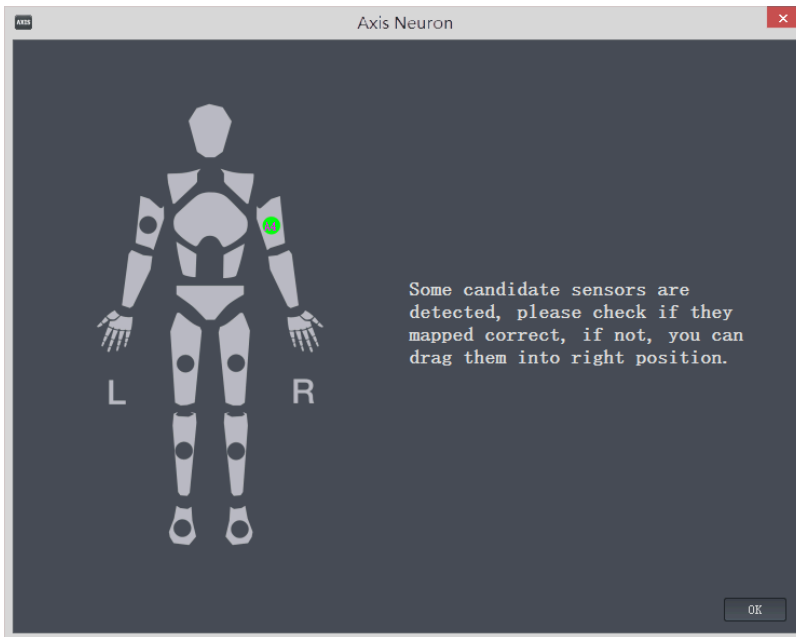




## FAQs:

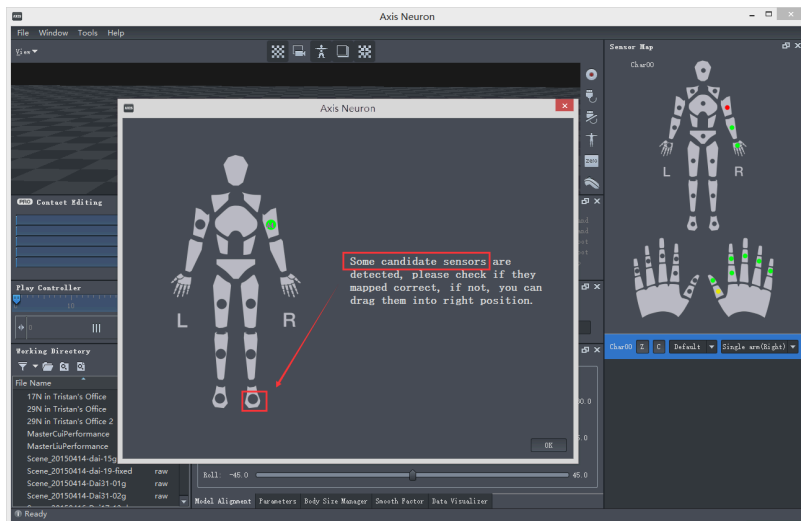
1. **Condition:** Using the extra device as right upper arm in a 3-Neuron single arm mode.

When establishing the connection with Axis Neuron, the software will check the position of the universal strap sensor and prompt you whether the placement of the device was mapped correctly. If the universal strap was mapped incorrectly by the software, then the user has the option to drag the node to the correct position by using the diagram.

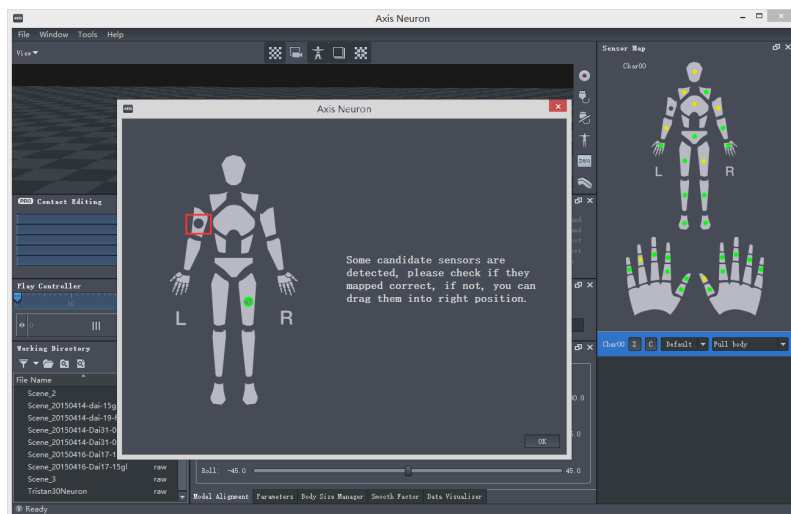


2. **Condition:** Extra 1 and Extra 2 used together in a 28-Neuron upper body mode with positions at right upper arm and left upper arm.

This scenario will generate the same prompt dialog.

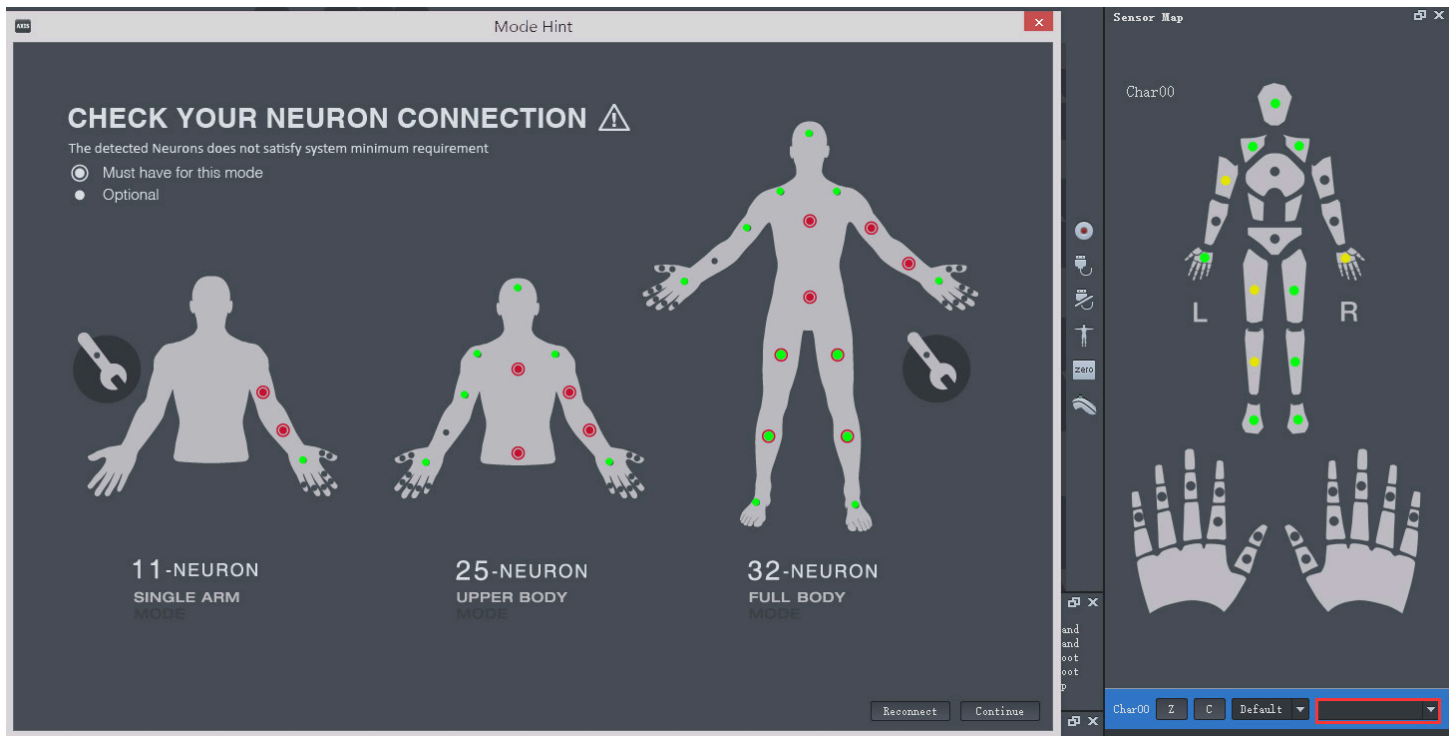


3. **Condition:** Using the extra device as the left upper arm in a 30-Neuron Single Arm/ Upper Body mode and no sensor at right upper leg. In this scenario, the software will automatically detect the extra device on the right upper leg to match Full Body Mode and you will need to drag it to the right position manually.



# 5.3 Attention

If the sensors that are detected by the system can not satisfy the necessary nodes of the corresponding working mode, the system will automatically set the working mode to any qualified working mode. If there is no matching working mode found, the system will inform you which necessary nodes are lacking sensors. The red spots show the positions that require a sensor for the necessary nodes.



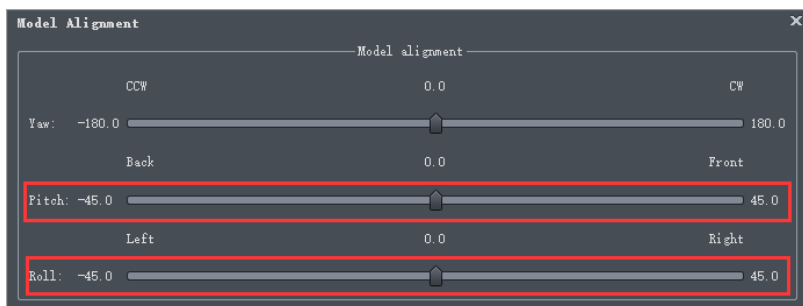
6.

# Data Editing

## 6.1 Model Alignment

You can adjust the following posture angle to accurately capture an actor's motion and optimize 3D Effect of the motion capture.

1. **Yaw:** Direction settings. This parameter is used for adjusting model direction. The default value is 0. The clockwise direction is positive and the counterclockwise direction is negative. The range is -180 degrees to +180 degrees.
2. **Pitch:** This parameter is the included angle between the sensor and the ground in vertical direction. Front is positive and back is negative. The range is -45 degrees to +45 degrees.
  - a) Application: Optimizes the contact effect. After posture calibration the contact effect may be inaccurate. So you can use Pitch to adjust the model's posture.
3. **Roll:** This parameter is the included angle between the sensor and the ground in a horizontal direction. Rightward is positive and leftward is negative. The range is -45 degrees to +45 degrees.



### TIPS

- After you've completed the 4-step posture calibration, if the model in the viewport still has directional issues or problems with the position of the angle, then you can adjust Pitch and Roll to correct the posture.

### Some Common Issues:

- If the model always has front-back incline after calibration, adjust the pitch before recording. (Human shape and posture problem).
- Carefully spend time perfecting the posture calibration before recording, this will save you time in post editing.

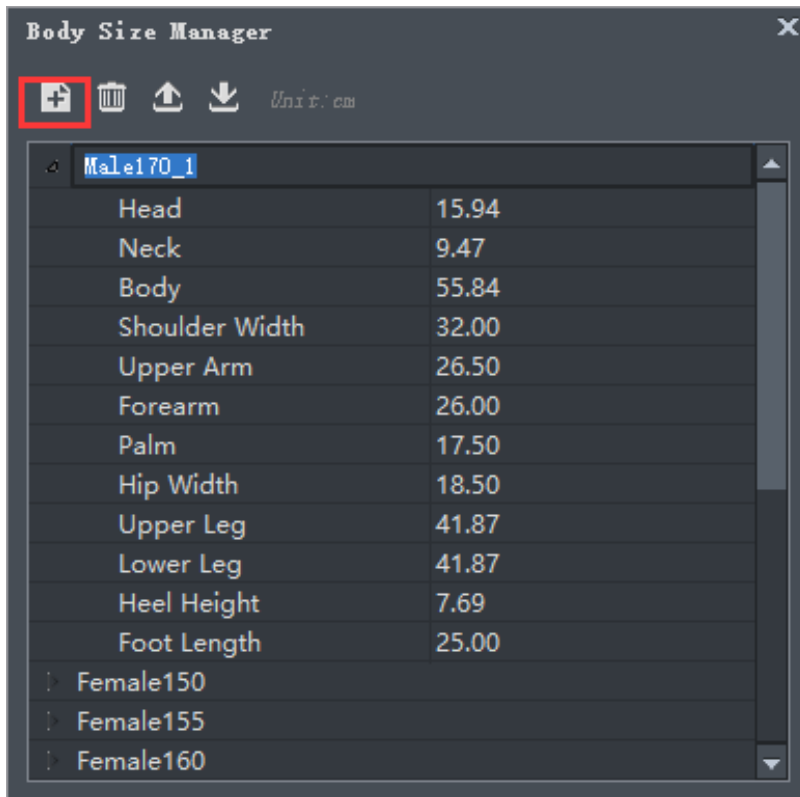
### Operation Examples:

- If the model leans back and the feet are not contacting the ground when walking forward.  
**Solution:** increase the Pitch value to make the model incline forward.
- If the model leans forward when the actor walks backwards and the feet have difficulty contacting the ground.  
**Solution:** decrease the Pitch value to make the model incline backward.
- If the model leans right and the left foot is not contacting the ground.  
**Solution:** decrease the Roll value.
- If the model leans left and the right foot is not contacting the ground.  
**Solution:** increase the Roll value.

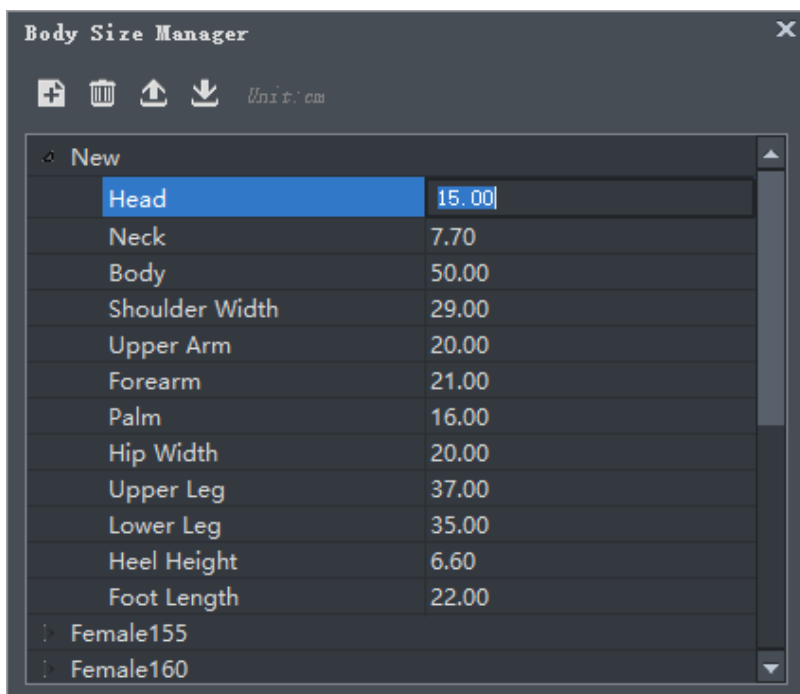
## 6.2 Body Size Manager

Adjusting the body size for you avatar inside of Axis Neuron can improve the data accuracy of the motion data. In the Body Size Manager, you can create, store, import, export or edit the body size data. There are some default body size files in Help-> Open Folder-> Body Size. Choose from one of the available presets or manually input an accurate body size measurement. For real-time capturing, you should choose a body size that matches the actor's real size before posture calibration.

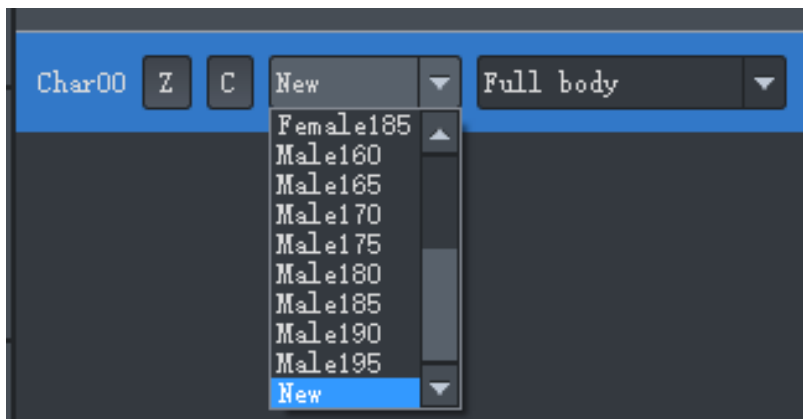
1. Measure the actor's dimensions in centimeters:  
Reference 6.7 Body Size Measure.
2. Click Add Body Size.



3. Name the new body size. Then input the bone data that you just measured.

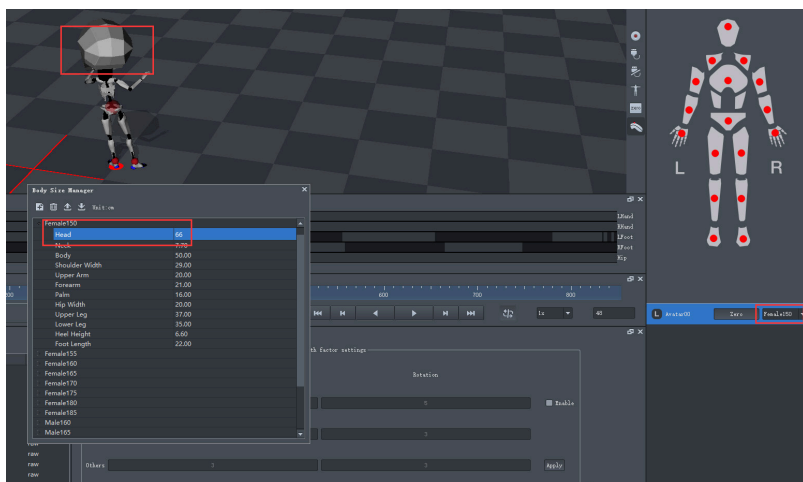




4. After establishing real-time connection, the default body size is Male 170.
5. Click Body Dimension in the Sensor Map. Then choose the body size that you just made.



#### Additional:

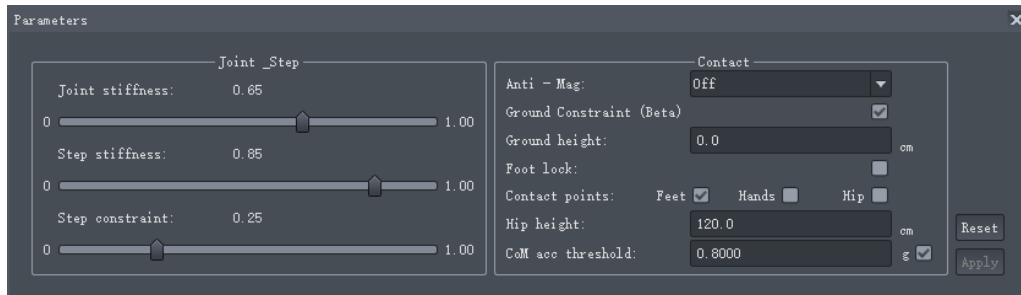
- The body size of the model can be changed during playback review of the recorded file, however, this operation is not suggested. You will get better results by establishing proper body size setting prior to performing the posture calibration.



- If you change the Body Size after your initial posture calibration then you will need to calibrate again.
- Import Body Size: Click  in Body Size Manager. You can import the existing Body Size file into Axis Neuron for use, however, the Body Size format needs to match the existing format for optimum accuracy.
- Export Body Size: Click  in Body Size Manager to export a Body Size for later use.



## 6.3 Parameters



**1. Joint stiffness:** The Default value is set to 0.65, setting a higher value will make the jointed bodies much more difficult to separate. If the Body Size is accurate, you can adjust the value much higher, however, if the Body Size is not accurate, lowering this value can add some leeway.

**2. Step stiffness:** When the model is walking, the system will use a pattern recognition algorithm to determine the contact between the feet and ground. The step stiffness value affects the speed of this status change. Larger values will plant the feet more firmly on the ground. Conversely, smaller values will allow the feet to slide easily while contacting the ground.

**3. Step constraint:** The contact sensitivity between feet and ground. The higher the value, the more likely the feet are to contact the ground. The smaller the value, the less likely the feet are to contact the floor. For example, if the actor's feet are 0.5 cm higher than the floor, when the factor is 0.2, Axis Neuron may not consider the feet to have a step on the floor, but when the factor is 0.4, Axis Neuron may already consider the actor's feet have a step on the floor.

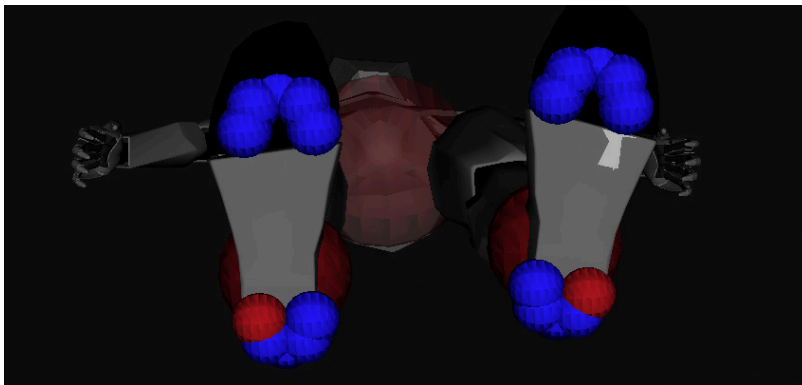
**4. Anti-Mag:** If there are high magnetic fields present, the feet may experience rotational drift. Check this box to minimize this result.

**5. Ground constraint:** Check this when parts of the actor's body are contacting the ground.

**6. Ground height:** This parameter is used to avoid the skeleton from penetrating into the ground when the actor goes upstairs or downstairs.

**7. Foot lock:** Enable this option if you are not satisfied with the Step stiffness effect. When the algorithm determines that the feet are contacting the ground, the displacement of the Z direction will be locked which can facilitate the feet becoming stuck on the ground.

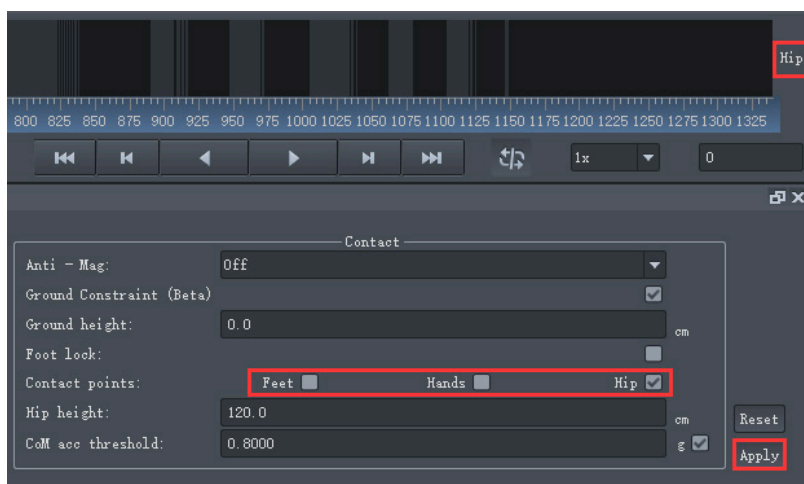
**8. Contact points:** Can be applied to the feet, hands, or hips.



- **Feet contact:** Ten contact points: 5 at Ball of the foot and 5 at the back of the foot.
- **Hands contact:** Contact points are at palm.
- **Hip contact:** Contact points are at the caudal vertebrae.

## TIPS

When the motion requires the feet to leave the ground, you need to uncheck the Feet contact points, then apply the Hip contact points. Set an appropriate fixed height for the Hip. Only posture is captured in this kind of condition, no displacement (translation of the skeleton). If you need a result that has both Feet and Hip contact posture, you can check **Hip Contact** and then uncheck **Feet Contact**. Then choose the interval for the hip contact and click **Recalculate Selected Frame**.



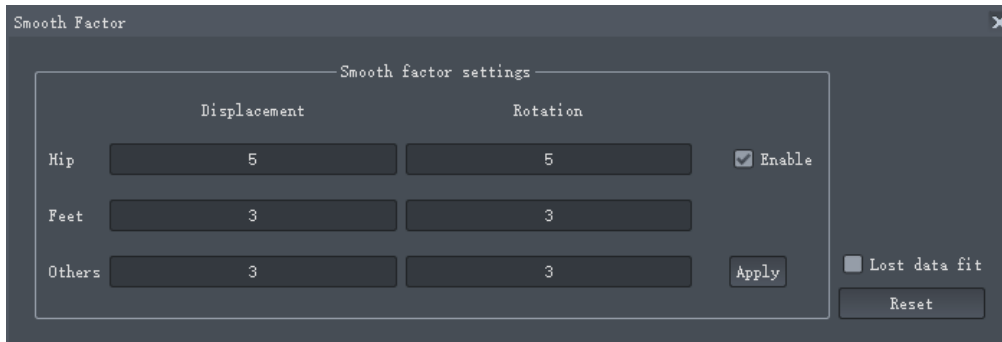
- **Hip height:** The height from the hip to the ground.
- **CoM acc threshold:** The default value is 0.8g. This is a threshold value. This value judges whether the body is contacting the ground based on the body's center of gravity.

## 6.4 Smooth Factor

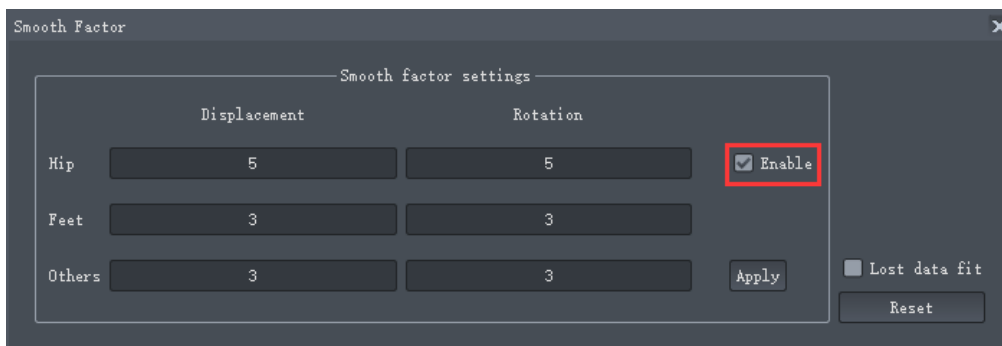
Usually, there are factors that influence the accelerated speed and acceleration of gravity when an actor wears the equipment sensors:

- Body shaking (yourself or some external factor).
- Sensor measurement error.
- Straps slack (straps and body have relative displacement).

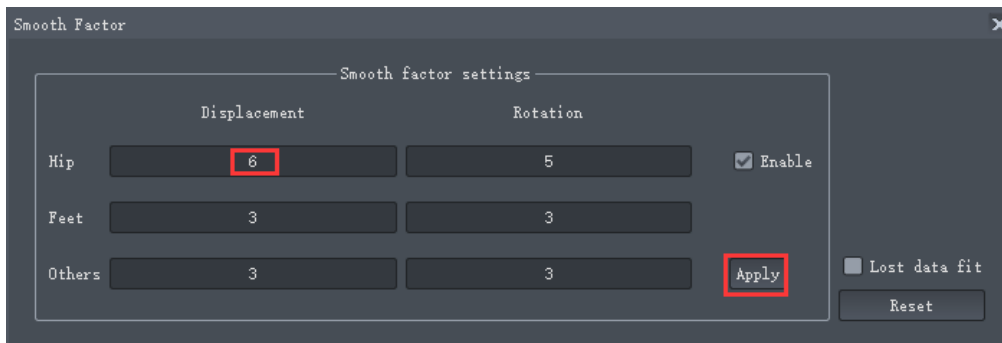
Those effects can be countered by the Smooth Factor function.



1. Open .raw file.
2. Check Enable in **Smooth Factor**.



3. After you change the value in Smooth Factor settings, click **Apply** button.

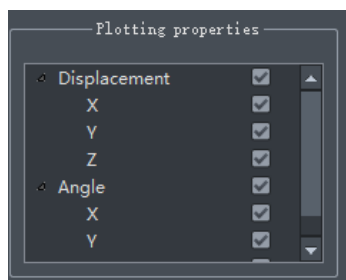
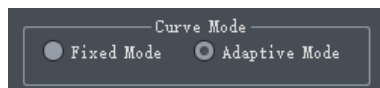
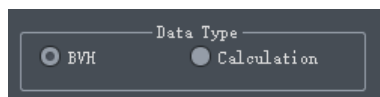
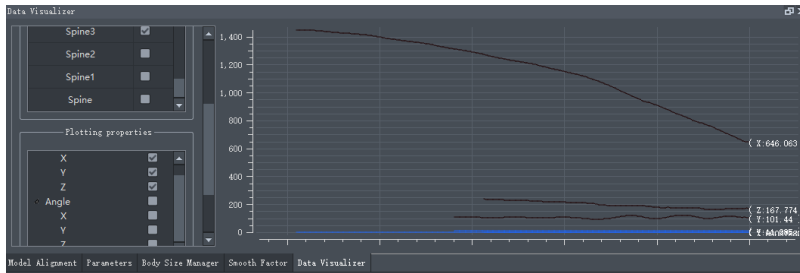


(Calculate the average hip displacement value of adjacent 5 frames).

4. Export the data.

## 6.5 Data Visualizer

Visualize real-time-changing displacement and angle data for the body in the Data Visualizer panel.



### Operations:

1. Choose the data type.
2. Set the Curve mode.
3. Choose the joints you want to visualize.
4. Choose the displacement or angle in plotting properties.
5. Play the raw file, you can check the real-time data's change.

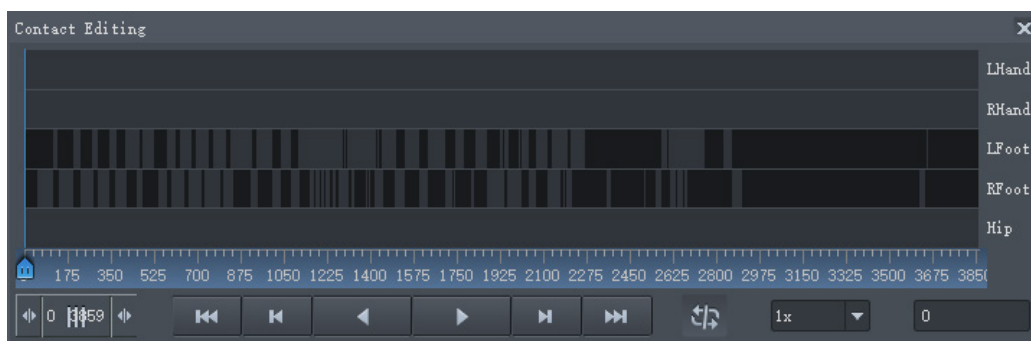
## 6.6 Contact Editing

The Perception Neuron system has an abundance of optimized algorithms. You can use them to achieve an ideal contact result. You can adjust the effect by single frames or by interval frame values.

### Caution:

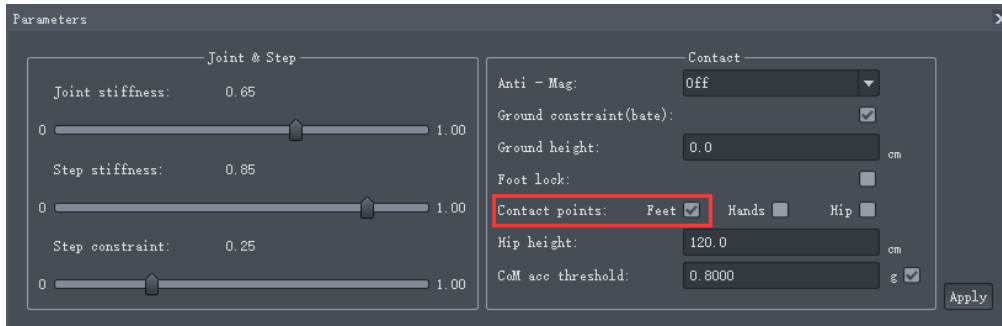
- Once you start contact editing, do not adjust the following parameters, otherwise the previous contact editing operations will be invalid.
    - a) Model Alignment: Yaw, Pitch, Roll.
    - b) Parameters: Joint stiffness, Step stiffness, Step constraint, Contact points.
  - When you are editing the Nth frame, it will influence all frames after N. But it won't influence the frames before N. Avoid editing frames that come before any edited frame.
1. System auto optimization - There are 10 levels of optimization, the default value is 2. When you turn it to 0, the system will cancel optimization.
    - a) If you didn't change the status of optimization, the status will default to a value of 2. (The auto optimization will take effect before you open the raw file.) If you change the value after you open a raw file, you need to recalculate all frames. (Right-click Contact Editing module, then click **Recalculate all frames.**)

### 2. Contact Editing Window



- Black means the body is touching the ground, if the frame is grey it means the body is not touching.
- L Hand: Left hand contact editing area.
- R Hand: Right hand contact editing area.
- L Foot: Left foot contact editing area.
- R Foot: Right foot contact editing area.
- Hip: Hip contact editing area.

- When the red ball on the ankles display, this indicates the foot is touching the ground. When you are editing contact status, you need to check **Feet Contact point**.

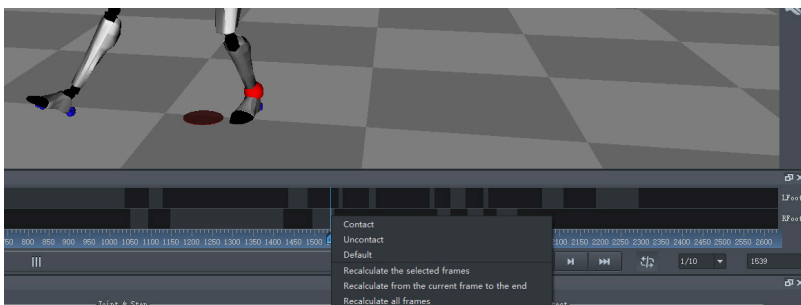
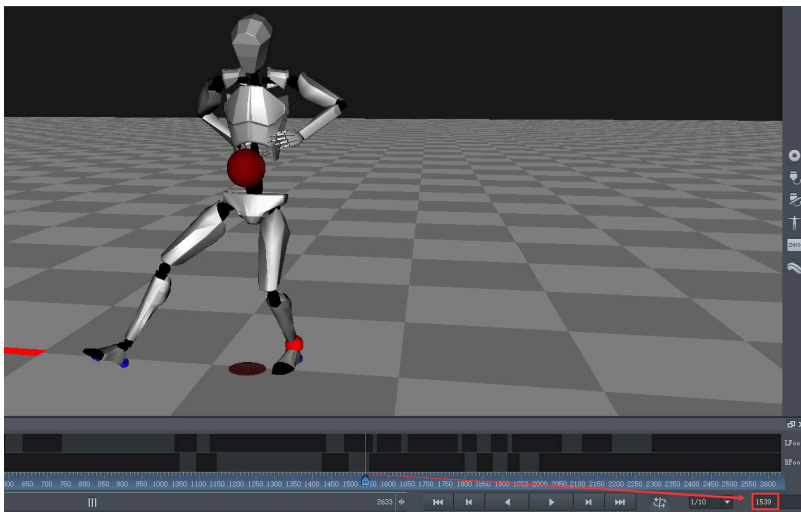


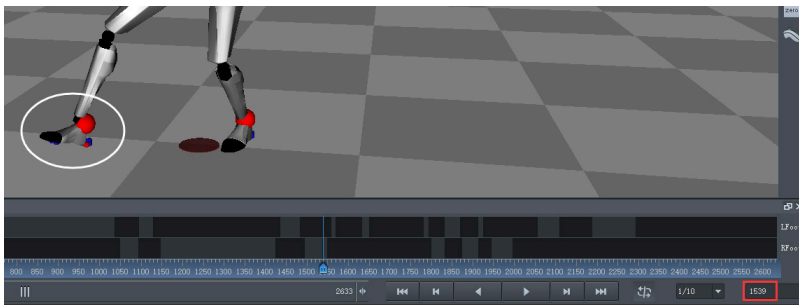
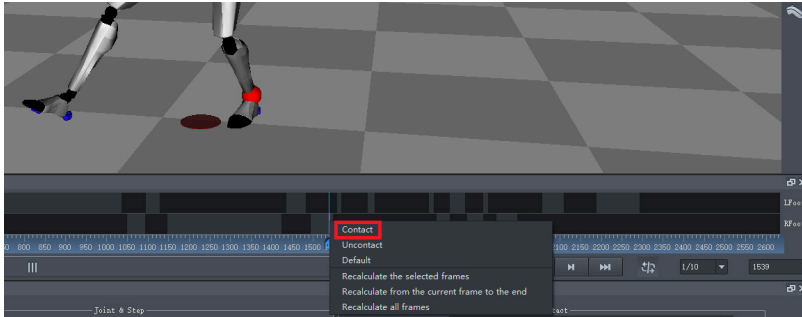
### 3. Single frame editing

Eg: Make the 1539 frame right foot status from uncontacting to contacting.

Method 1: Right click 1539 frame and choose Contact.

Method 2: Use shortcut key. Move the pointer to 1539 frame and click W.





## TIPS

- When you are contact editing, you can widen the contact editing panel to alleviate errors. When you locate a frame you want to edit, you need to make sure that the pointer is still located at the frame you want to edit after you right-click.

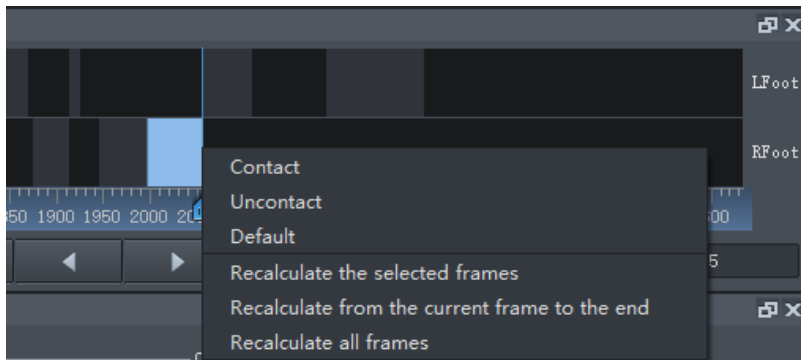
### 4. Interval frame editing

- E.g. Change the interval frame's right foot status from uncontacting to contacting.
- Right-mouse drag the frames area you want to modify, then click **Contact**.

### Caution:

This operation has no shortcut keys.





5. Combine Step stiffness to optimize feet contacting.  
Precondition: Contact Optimization Level is default value: 2.

### Steps:

- Open .raw file.
- Adjust step stiffness. Keep in mind that this step must be completed ahead of manually adjusting contact status. Reference in 6.3 Parameters.
- Recalculate all frames in the contact editing panel.
- Then you can adjust contact status of any frame and you don't need to recalculate.



## 6.7 Body Size Measure

The closer the Body Size data is to the actor's body size in Axis Neuron, the more accurate the motion capture data will be. You can add a new body size in the Body Size Manager. Then input the values you measure.

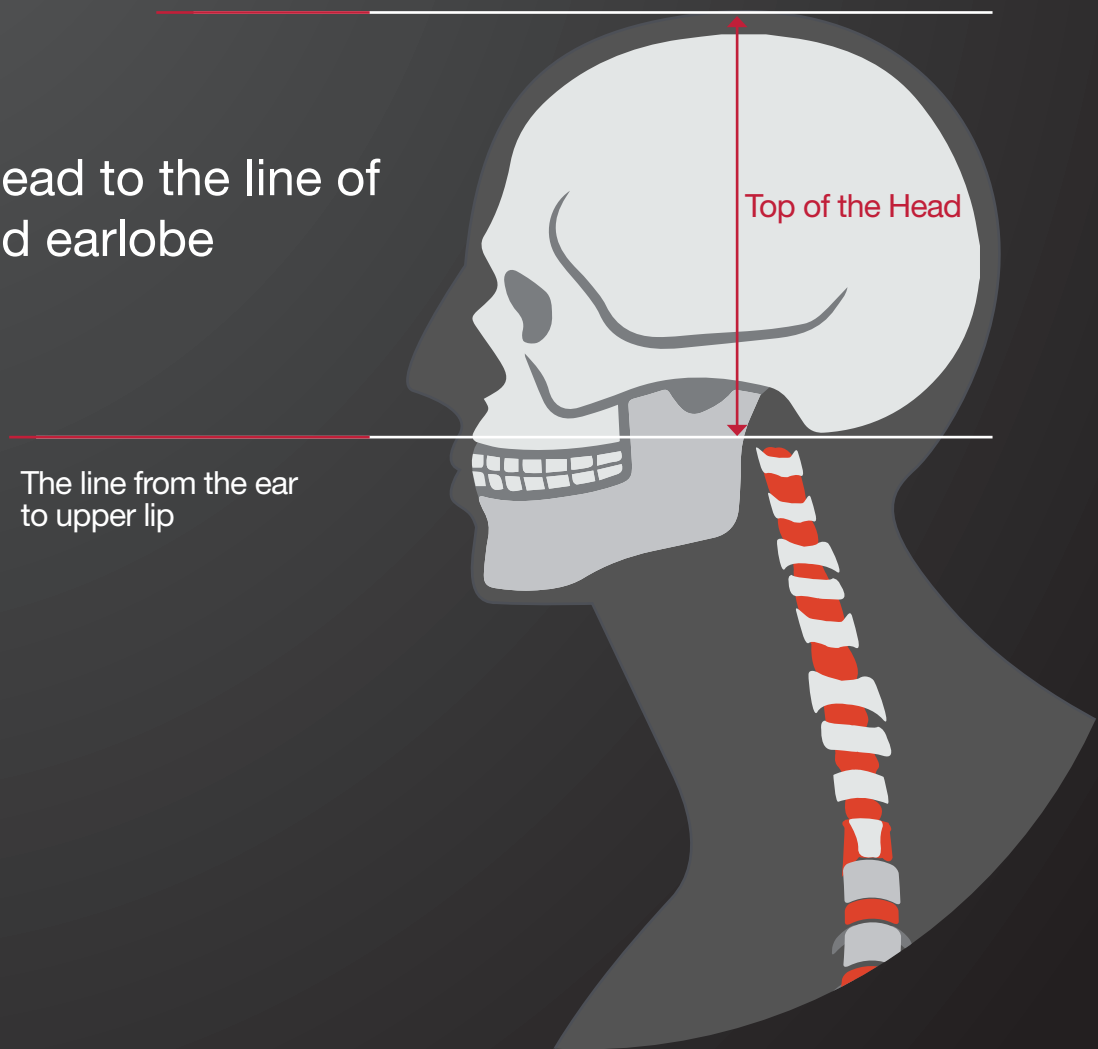
**Tips:** the unit of measurement is in centimeters.

### 1. Head

Top of head to the line of upper lip and earlobe.

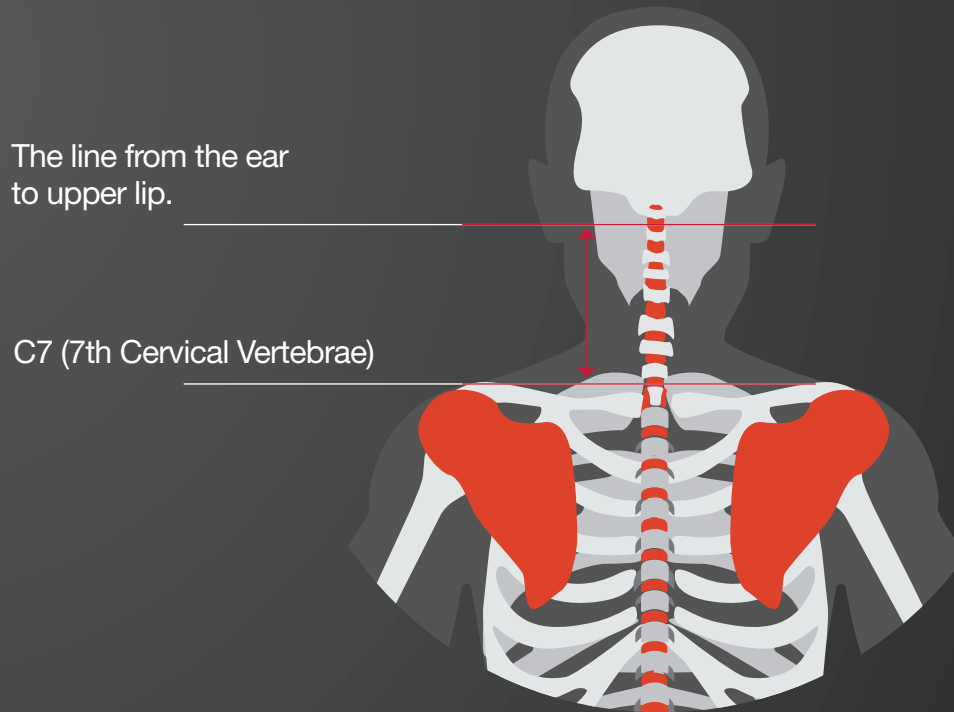
Top of the head to the line of upper lip and earlobe

The line from the ear to upper lip



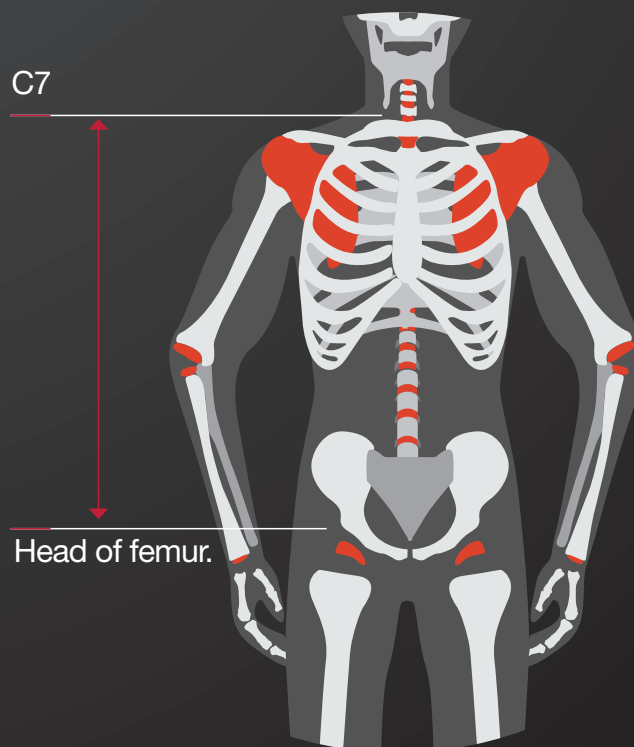
## 2. Neck

Line of upper lip and earlobe to C7 (the 7th bone of the spine).



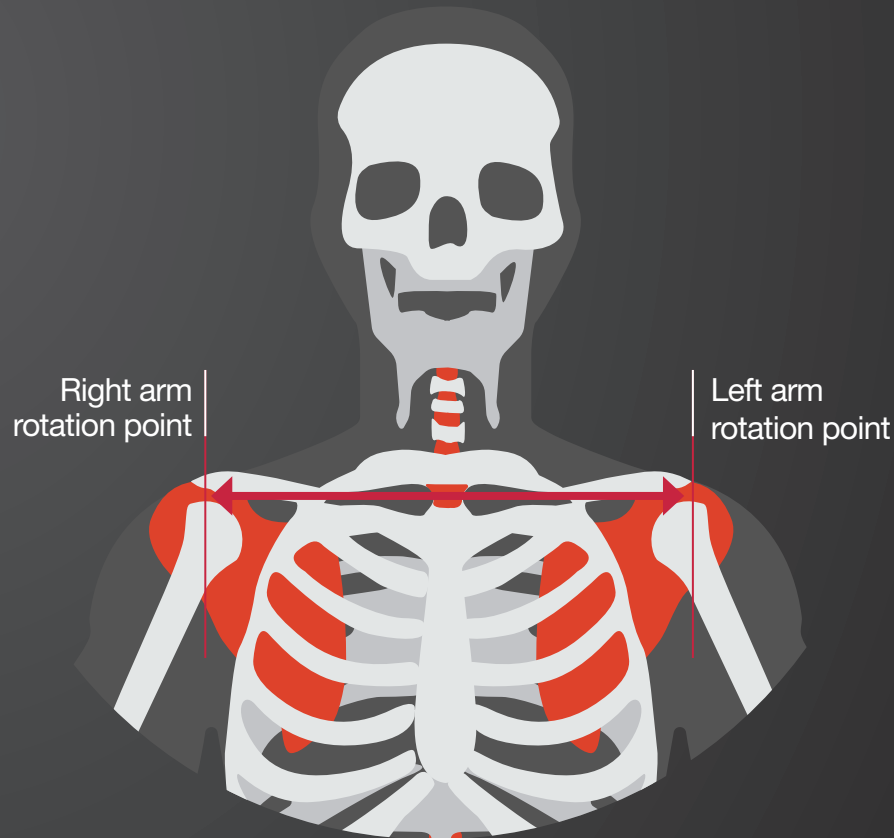
## 3. Body

C7 to head of femur.



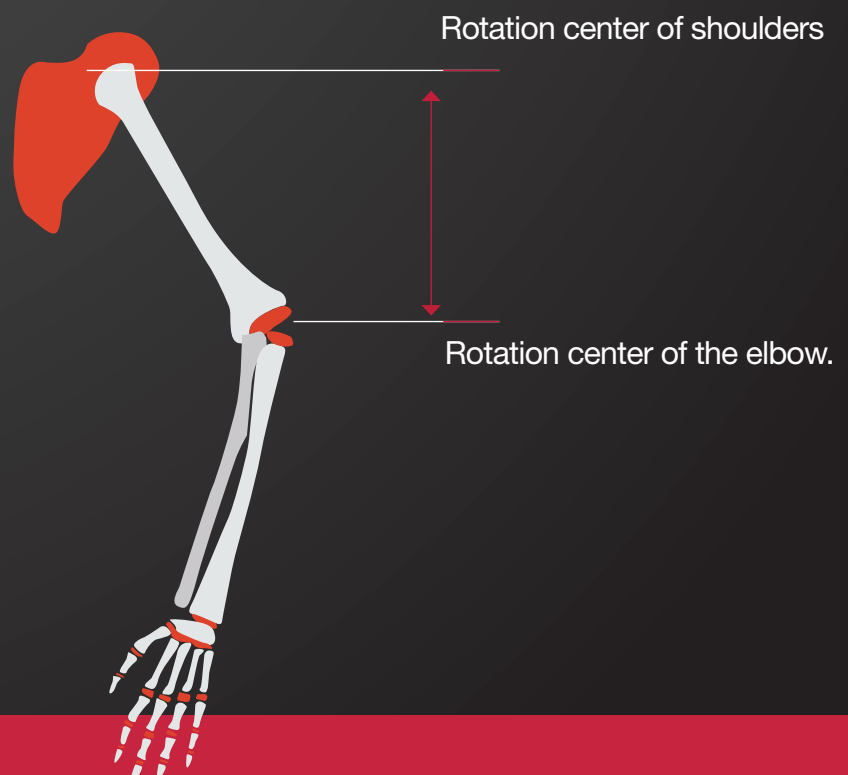
## 4. Shoulder Width

Left rotation center of shoulder to right rotation center of shoulder.



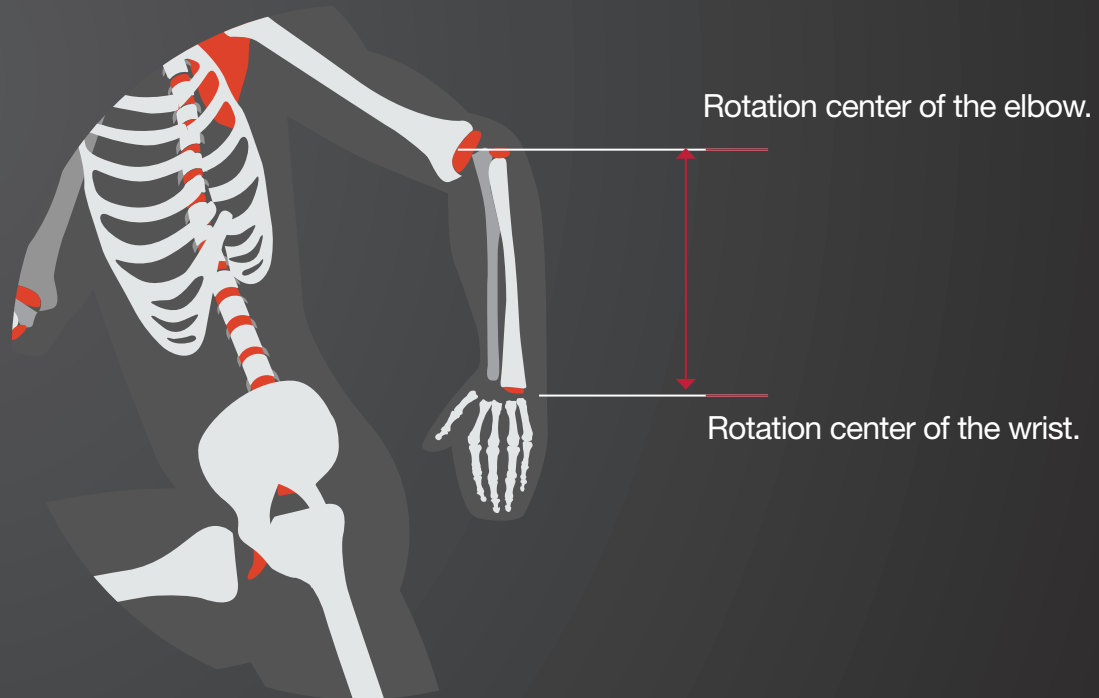
## 5. Upper Arm

Rotation center of shoulders to rotation center of elbow.



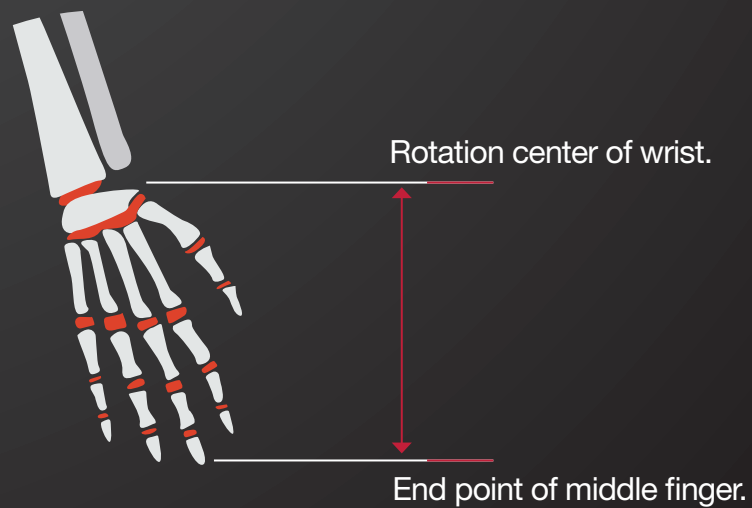
## 6. Forearm

Rotation center of elbow to rotation center of wrist.



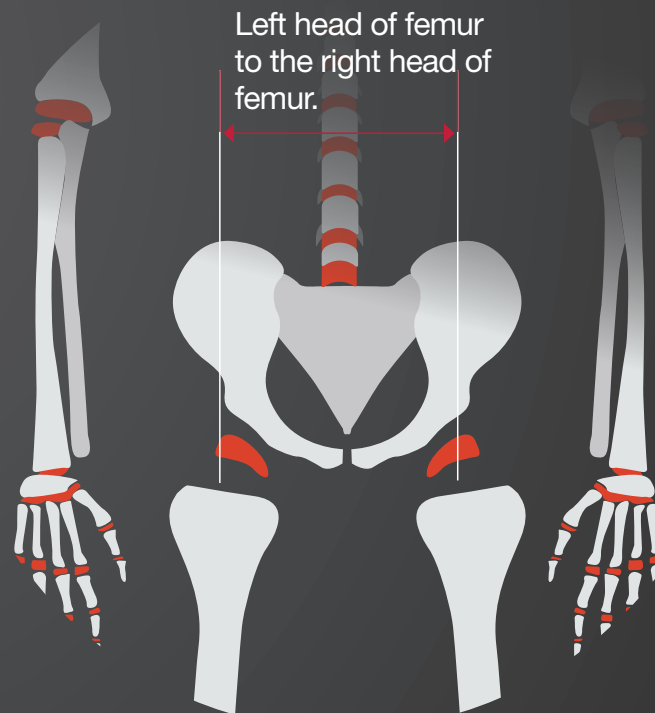
## 7. Palm

Rotation center of wrist to the top of middle finger.



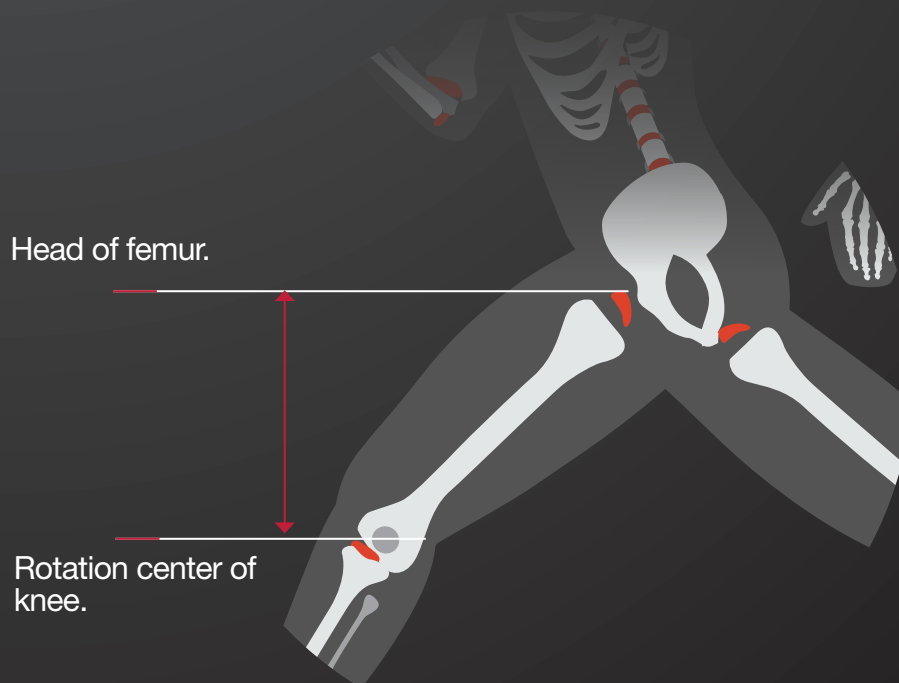
## 8. Hip Width

Left head of femur to right head of femur.



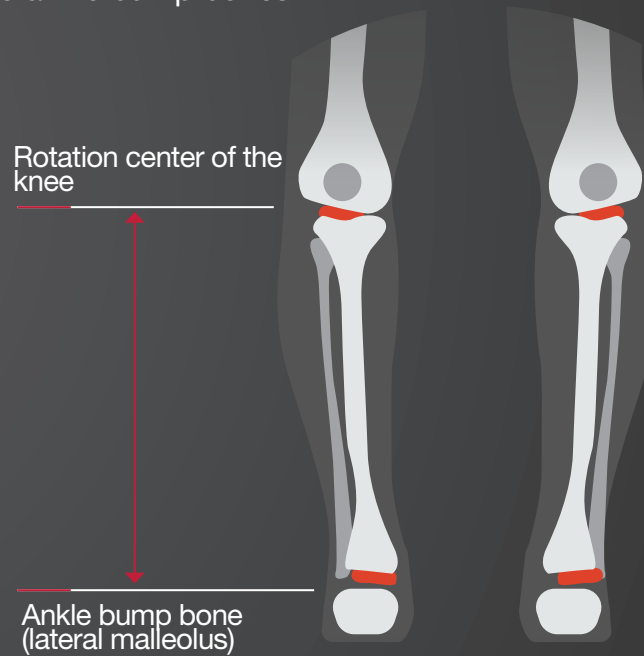
## 9. Upper Leg

Head of femur to rotation center of knee.



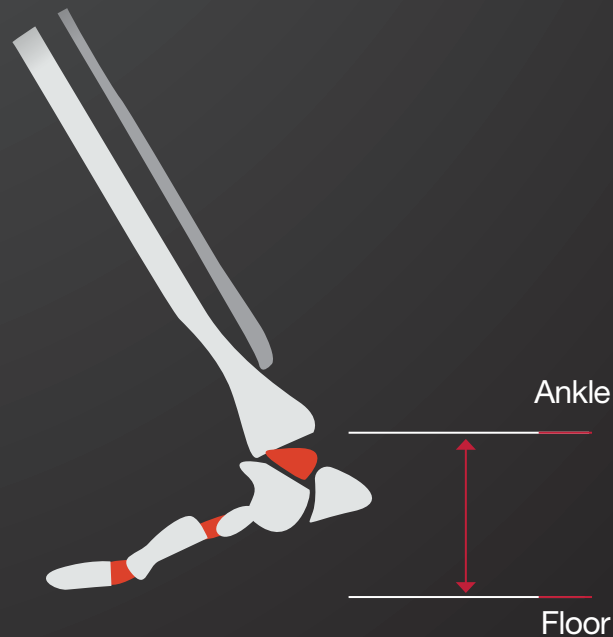
## 10. Lower Leg

Rotation center of knee to ankle bump bones.



## 11. Heel Height

Ankle to the ground. (If wearing shoes, this measurement is to the bottom of the shoes.)



# 7. Offline Recording and Prop Function

Perception Neuron supports a new way to record eliminating the need for a router, computer and the AXIS NEURON software application. The offline data can be imported to AXIS NEURON from an SD card connected directly to the Perception Neuron Hub.

## 7.1 Offline Recording

A portable USB power bank and a micro SD card will be needed for offline recording. The power bank will power the Hub and the micro SD can be used to store the motion data locally.



### 7.1.1 Status Definition

1. Connecting a power bank to the power port of the Hub will enable offline mode.
2. When offline mode is activated, the Hub will sound off two buzz alert tones. (One single tone indicates normal mode.)
3. The HUB LED will stay on when the file system of the SD card is not FAT32.
4. The HUB LED will stay on when the SD card is full.
5. The HUB LED will stay on if the SD card is removed in offline mode, until the SD and Power Bank are reconnected.

### 7.1.2 Activate Offline Mode

Press and hold the red button on the Hub and connect the Power Bank to activate Offline Mode. Release the red button immediately after the Hub powers up. The Hub will then sound off two alert tones indicating the device is now in offline mode.



## 7.1.3 Calibrate and Record

### 1. Calibration

Once offline mode has been activated, press and hold the red button once more, release the red button after the alert tone stops.

(3 slow beeps means to prepare for posture calibration, 10 beeps means calibrating.)

The posture calibration has four stages that follow consecutively.

-STEADY POSE

-A POSE

-T POSE

-S POSE

**STEADY POSE:** body keeps still until the rushing sound finishes.

**A, T, S POSE:** Three slow “beeps” means to prepare for calibration. (Please take the corresponding actions.) When the beeping sound is rapid, please keep the posture still. The Perception Neuron LED will remain flashing at 1Hz.

### 2. Record

After the posture calibration has been completed, the Perception Neuron suit will begin to record immediately. All motion data during this time will be recorded locally onto the micro SD card.

## 7.1.4 Stop Recording

There are two ways to Stop Recording:

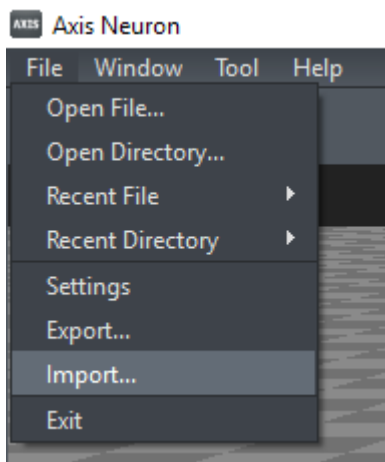
1. Unplug the Power Bank.
2. Press and hold the black button.

## 7.2 Offline Data Import

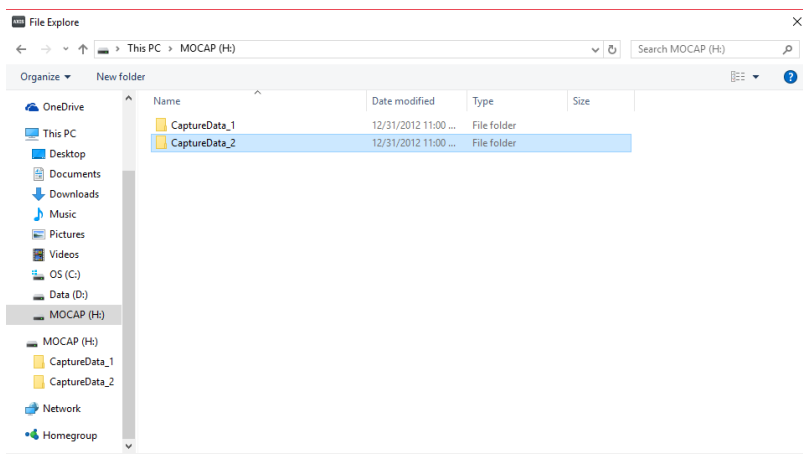
All offline data will be stored in the micro SD card as a .bin file format. Axis Neuron will allow you to convert the .bin files to a .raw file format for playback and review.

### Steps:

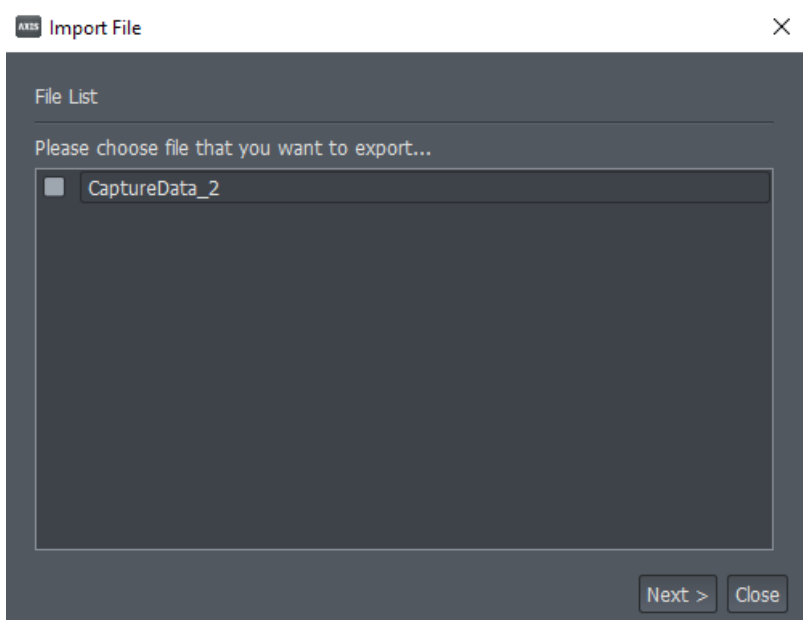
1. Open Axis Neuron and insert the micro SD card into the card reader on the Hub. Connect the Hub directly to a computer via USB.
2. Inside Axis Neuron, click File > Import.



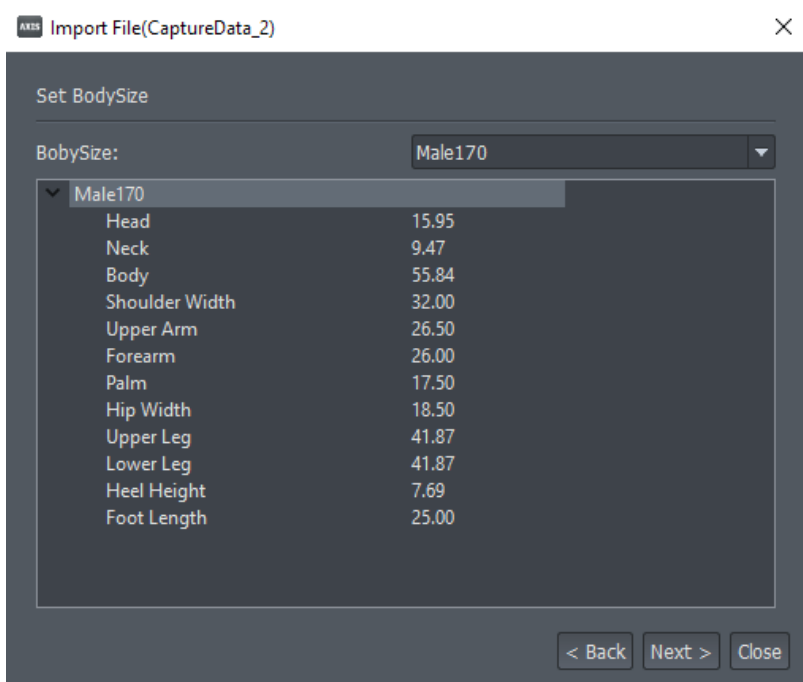
3. Choose the directory.



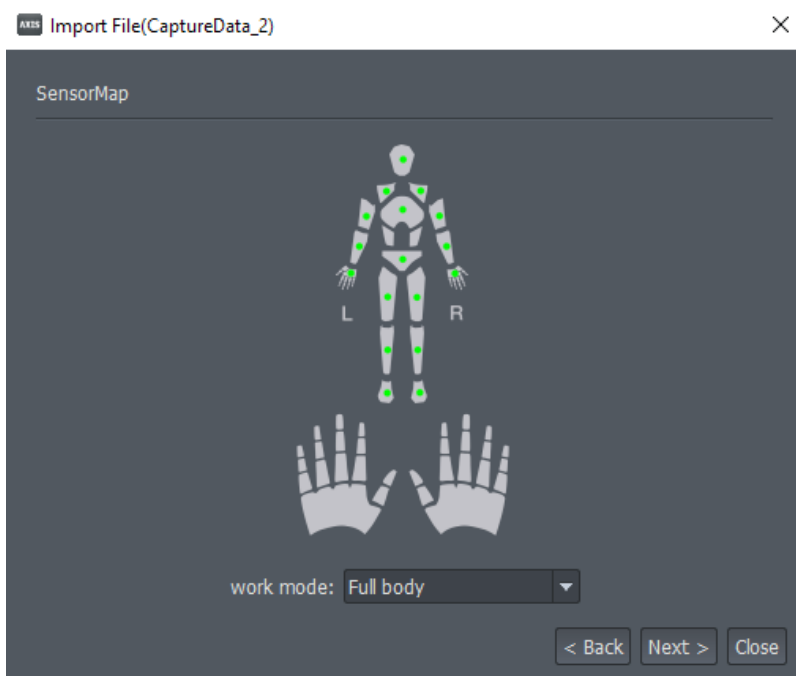
4. Click Next after you choose the file you wish to import.



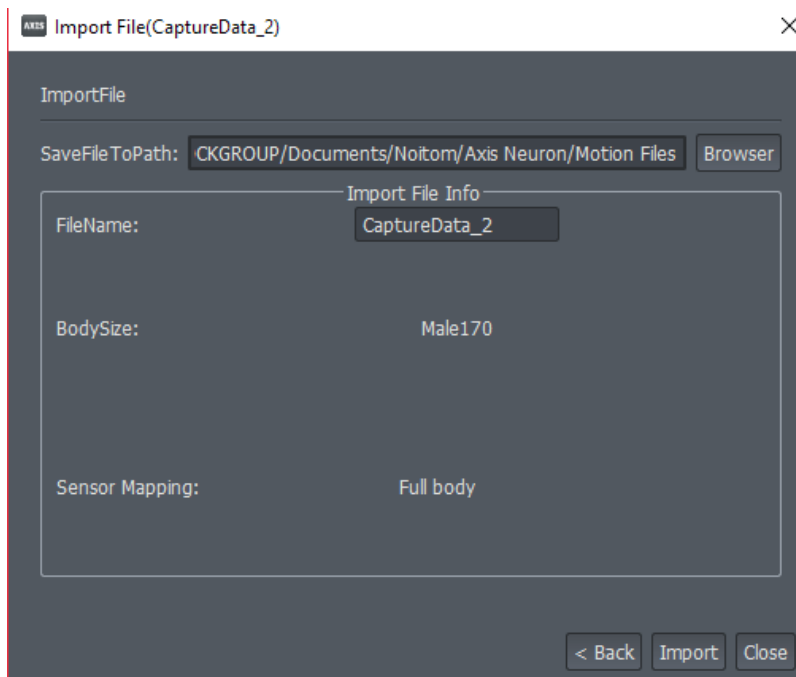
5. Set the body size.



6. Set the working mode.



7. Choose the directory to save the .raw file.



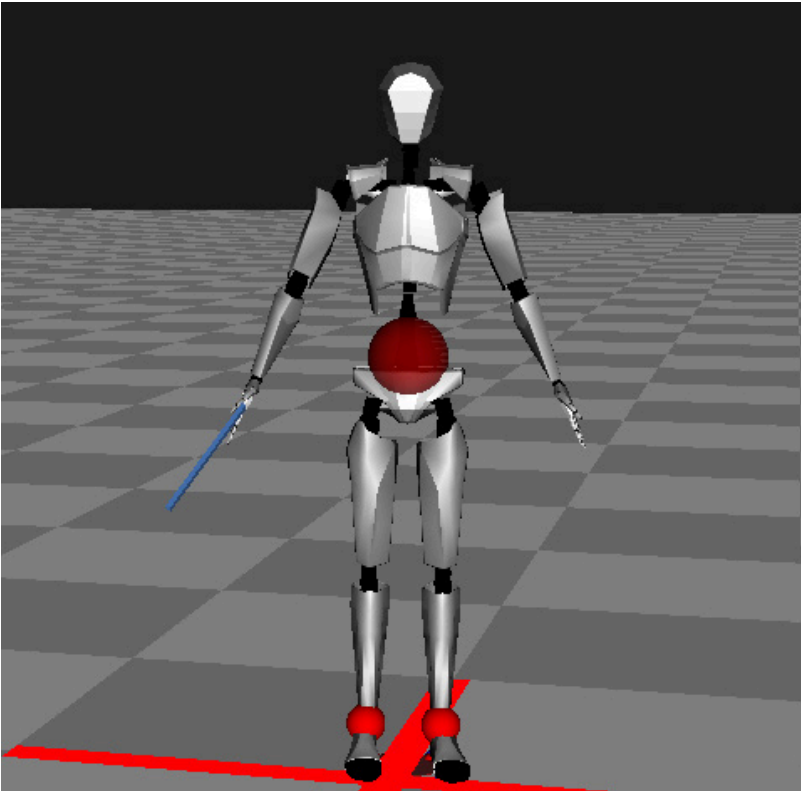
8. Click import.

9. Open the newly created .raw file located in the directory that it was saved to. You may now playback your capture and edit the file as you wish.

**Caution:** Prop Function is not supported in offline mode.

## 7.3 Prop Funtion

The Prop Function is designed to help users capture and create added elements into the motion capture data. While recording, the user is able to hold the prop sensor or bind the sensor onto an object (e.g. a stick to simulate a sword, knife, etc.)

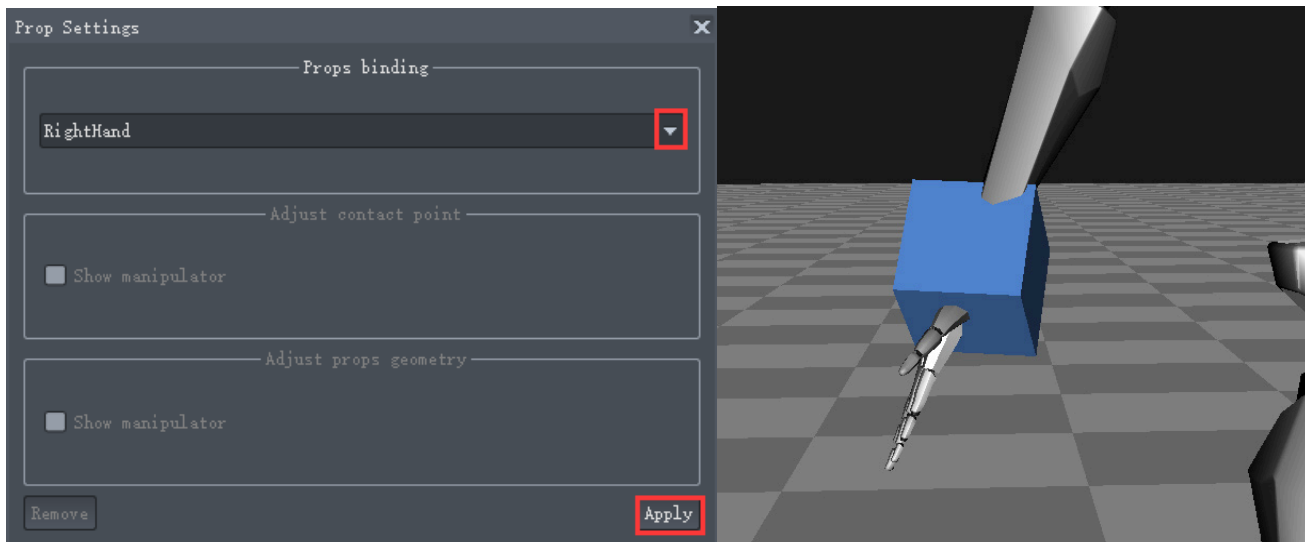


Contact point: This is defined as the center rotation of the prop. The prop sensor may rotate around the contact point.

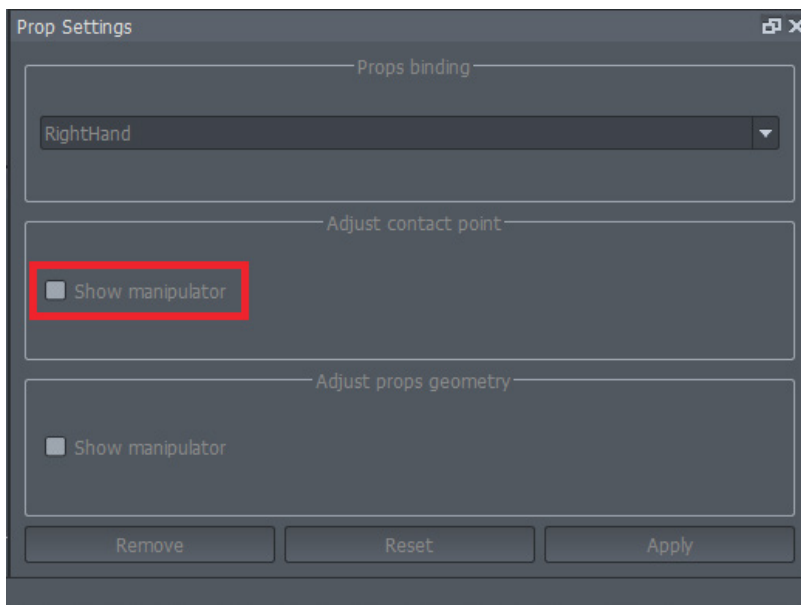
### Operations:

a. Connect the prop tool cable with a Perception Neuron sensor to a spare socket on the body strap, this sensor will now become a prop sensor. Prop sensor function will only work in full body mode. When the prop sensor has been connected and detected by Axis Neuron, the Prop Settings panel will be enabled.

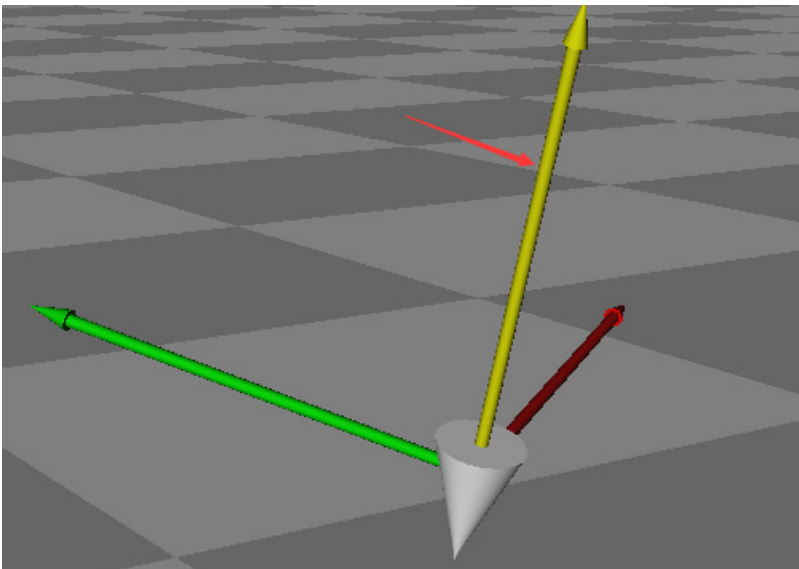
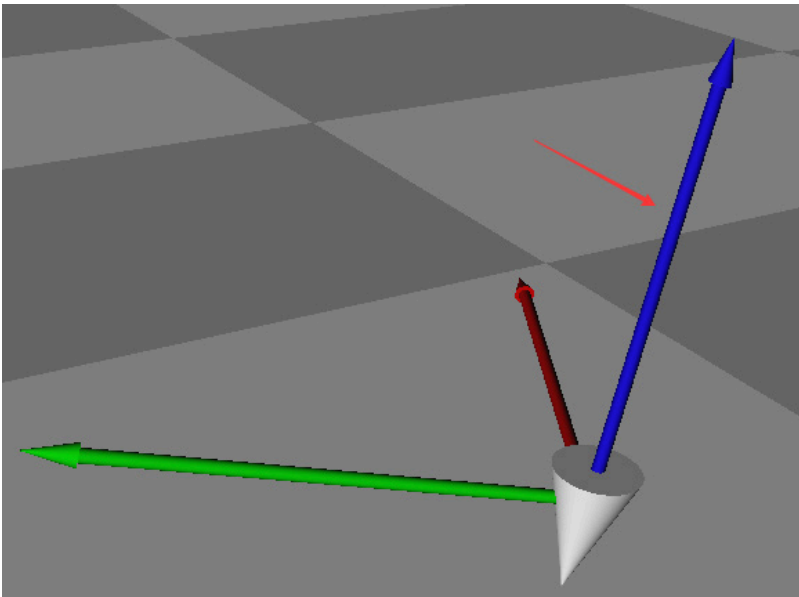
b. Select the parent location of prop from the drop-down list of Props binding. By default, the prop tool will bind to the RightHand bone, you may click apply. In the Viewport, a 3D cube will now display on the parented bone that was selected, representing the prop.



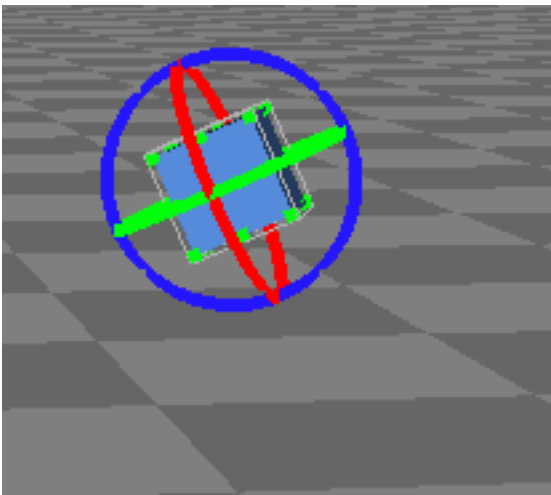
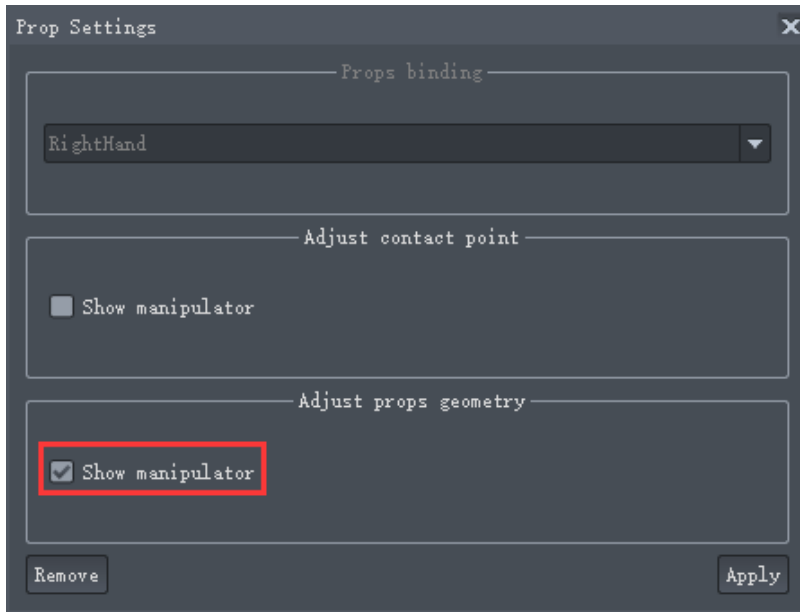
c. In the Adjust contact point section, the Show manipulation checkbox will display the Manipulator of the contact point controller if selected. The contact point is located at the center of cone's bottom surface. The prop's position should be on the blue ray that is perpendicular to the bottom surface of the cone.



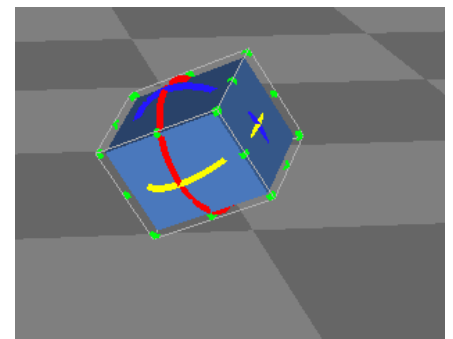
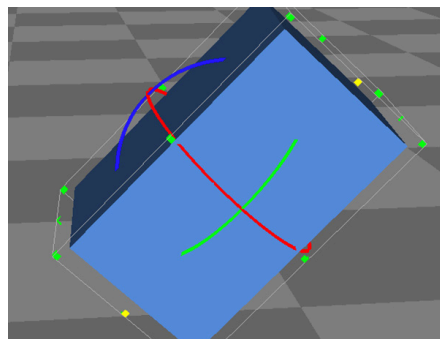
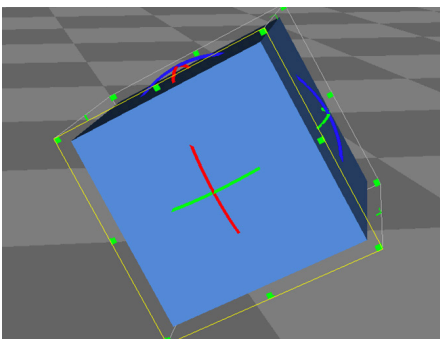
Then you can adjust the spatial position of the contact point by left/right dragging an axis of the manipulator (axis selected will turn yellow).



d. In the Adjust props geometry section, activate the Show manipulator checkbox to show the manipulator of the Prop controller inside of the viewport.

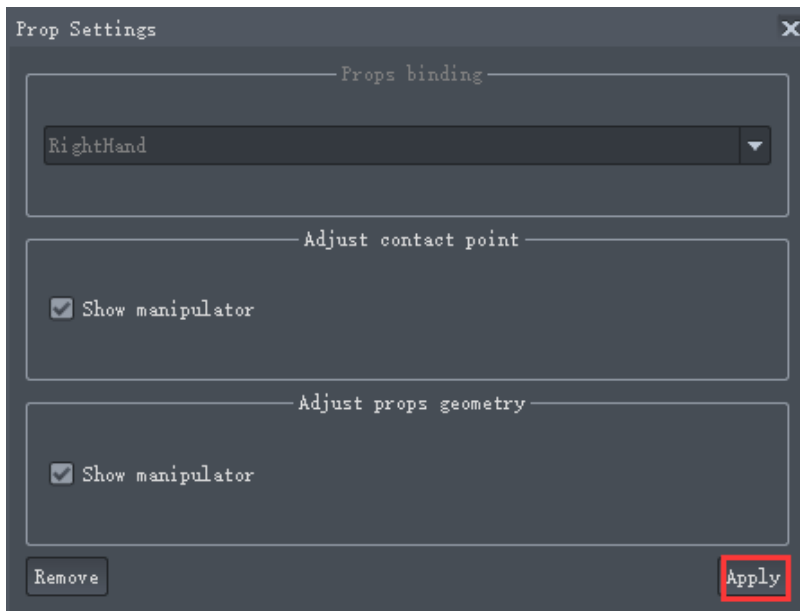


e. Select one surface of the Prop manipulator, then press and hold the left mouse button to move the spatial position of the prop, If the green corner of the Prop manipulator is selected, the user can scale the prop and select the axis that can rotate the prop (when the border line/green corner/ring is selected, it will turn yellow).

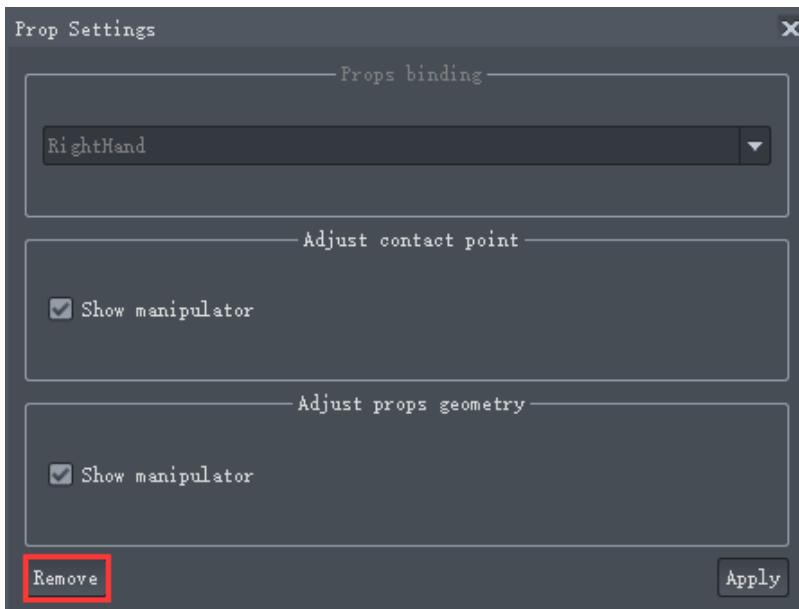




f. Select Apply in order to save all the changes that have been made.



g. Click remove if you would like to remove the prop tool all together.



8.

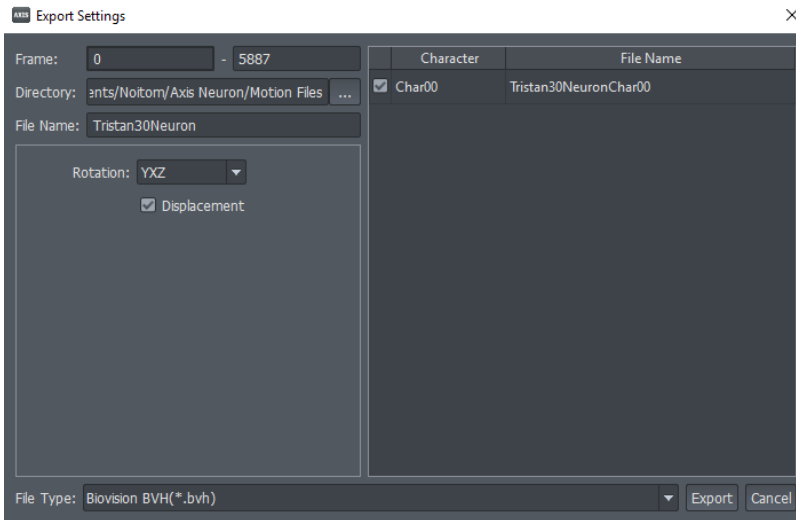
# File Export & Data Transmission

## 8.1 File Export

Axis Neuron can export in BVH and FBX file format. Any software applications capable of reading these file formats can utilize motion capture data recorded through Axis Neuron.

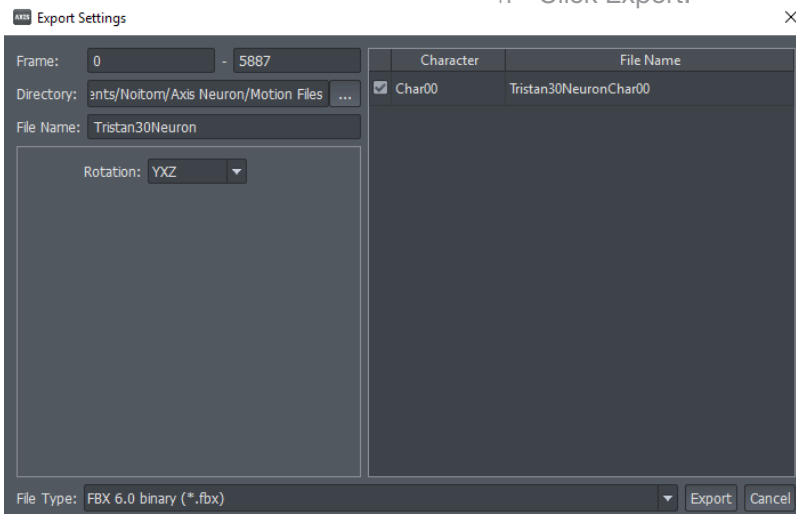
### 8.1.1 BVH File Export

1. Open a .raw file.
2. Click Export in the File menu.
3. On the File Type option, select BVH format inside of the Export Settings dialogue.
4. Click Export.



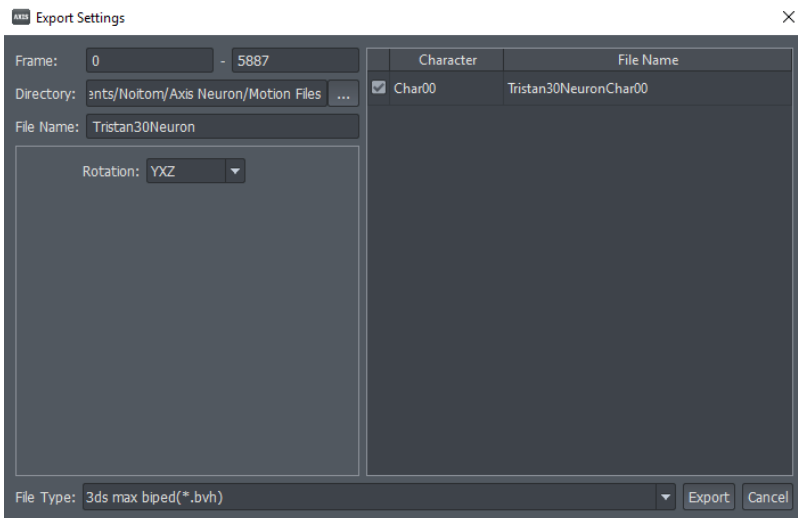
### 8.1.2 FBX File Export

1. Open a .raw file.
2. Click Export in File menu.
3. On the File Type option, select FBX format inside of the Export Settings dialogue.
4. Click Export.



## 8.1.3 3ds Max Biped File Export

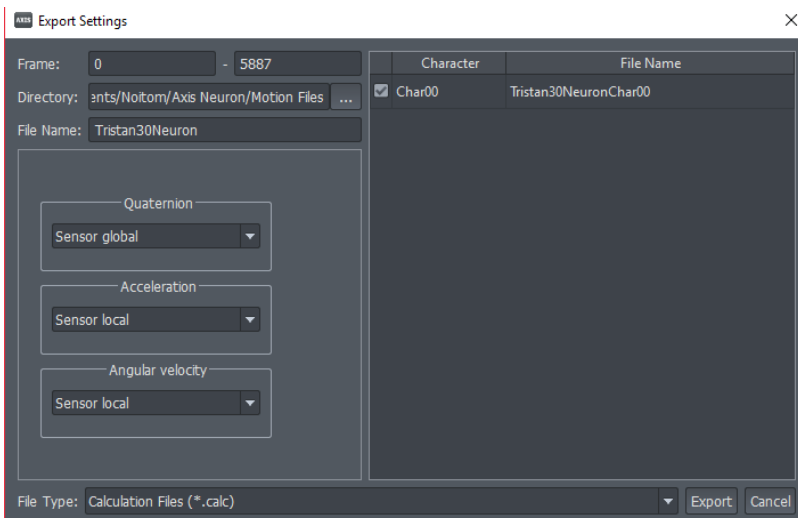
1. Open .raw file.
2. Click Export in File menu.
3. On the File Type option, select 3ds max Biped.
4. Click Export.



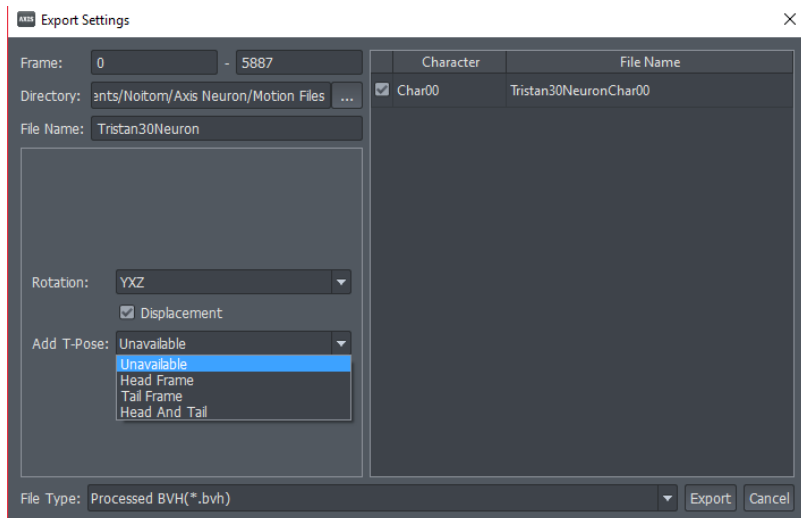
## 8.1.4 Calculation File Export

Axis Neuron can export calculation file data. This data type includes bone posture quaternion in bone coordinate; displacement, speed in ground coordinate; original acceleration, and gyro data in module coordinate.

1. Open .raw file.
2. Click Export in the File menu.
3. On the File Type option, select Calculation.
4. Click Export.



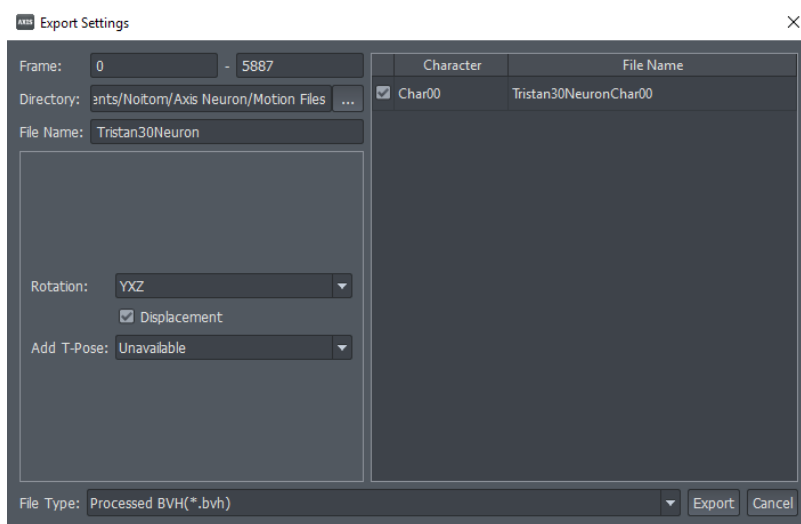
## 8.1.5 Processed BVH File Export



### TIPS

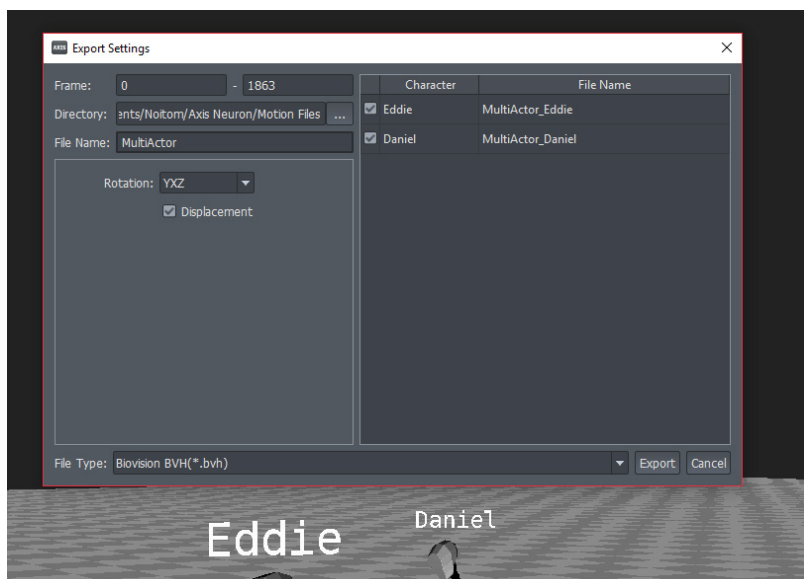
- Unavailable: No T-pose at the first frame and tail frame.
- Head Frame: A T-Pose before the first frame.
- Tail Frame: A T-Pose after the tail frame.
- Head and Tail: Both T-Pose at the first frame and tail frame.

1. Open .raw file.
2. Click Export in File menu.
3. On the File Type option, select Processed BVH.
4. If you need a T-pose at the first frame or tail frame, you can choose this in the Add T-Pose option.
5. Click Export.



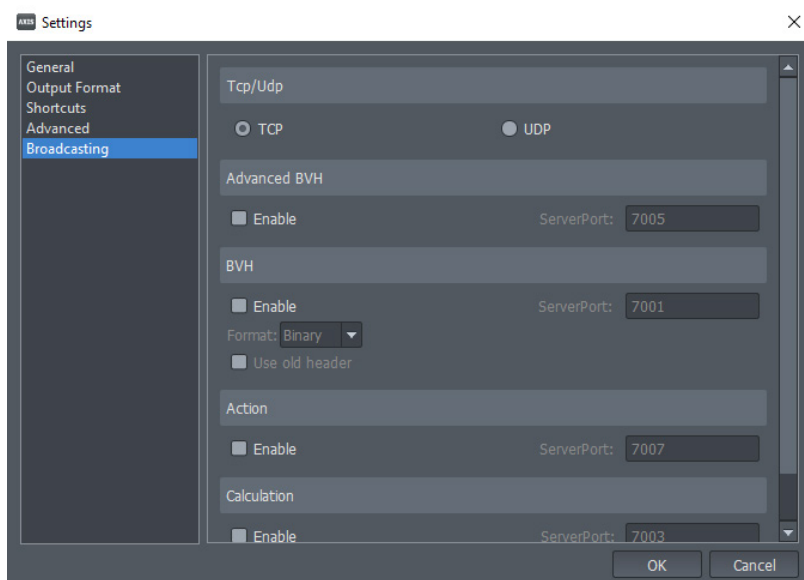
## 8.1.6 Multi-Character File Export

1. Open .raw file.
2. Click Export in File menu.
3. Select the file type you want to export in Export Settings.
4. Choose which character you wish to export or all by selecting the checkbox.
5. Click Export.



## 8.2 Data Transmission

Choose the content you want to transfer in File → Settings → Broadcasting. Axis Neuron supports BVH, Action, and Calculation data formats.



We will introduce these three data formats and the internet protocol.

## 8.2.1 BVH

### 1. Advanced BVH

The basic BVH data channel only supports simplex communication. There are found issues with original BVH format which include restrictions of information and no backward compatibility. Therefore we defined a new format based on Google's Protobuf protocol, Advanced BVH. This new format supports two-way communication and backward compatibility.

We recommend you use this format. The definition of Protobuf protocol part is as follows:

```

syntax="proto2";
option optimize_for = SPEED;
option cc_enable_arenas=false;
package AxisPlugs;
message BVH_VECTOR{
  required float X=1;
  required float Y=2;
  required float Z=3;
}
message BVH_JOIN{
  enum Channel {
    Xposition=0;
    Yposition=1;
    Zposition=2;
    Xrotation=3;
    Yrotation=4;
    Zrotation=5;
  }
  required string  joinName=1;
  repeated Channel  Channels=2;
  required BVH_VECTOR  Offset=3;
  optional BVH_VECTOR  EndSite=4;
  repeated BVH_JOIN  ChildJoin=5;
}
message BVH_FRAME{
  repeated float  MotionData=1;
  optional uint32  ActorTag=2;
  optional string  ActorName=3;
}

message BVH_HEADER{
  required BVH_JOIN  RootJoin =1;
  optional uint32  ActorTag =2;
  optional string  ActorName =3;
}

message TAG_MAP_STRING{
  map<uint32,string>  Map  = 1;
}

```

```

message ERROR_MESSAGE{
  required uint32 ErrorCode=1;
  required string ErrorMsg=2;
}
message COMMAND{
  enum CommandType{
    Notify_Characterised    =1;
    Notify_Uncharacterised  =2;
    Notify_ActorsList      =3;
    Notify_Error            =5;
    Command_Query_BVH_Header =6;
    Command_Query_ActorList =7;
    Command_ZeroOutActor   =8;
  }
  required CommandType CmdType =1;
  oneof Content{
    uint32 ActorTag =2;
    TAG_MAP_STRING ActorsList =3;
    ERROR_MESSAGE ErrorMsg =4;
  }
}
message AXIS_PLUGIN_MESSAGE{
  enum MessageType{
    COMMAND =0;
    HEADER_DATA=1;
    FRAME_DATA=2;
  }
  required MessageType Message = 1;
  oneof Content{
    BVH_HEADER Header=2;
    BVH_FRAME Frame=3;
    COMMAND Command=4;
  }
}

```

Every frame data format::

```

{
  uint32 ----->start mark, 0x41414141 is source data, 0x43434343 is zipped
data
  uint32 ----->the data length
  data
}

```

If data is packed, we need to extract data and then analyze it with Protobuf. If the data is source data, you can analyze it directly. The packed data is in zip format. When another client connects with this channel, the Axis Neuron client will send a command of Notify\_ActorList to inform of the actor's number and other details. When another client connects with this channel, the Axis client will send BVH\_FRAME uninterruptedly, BVH\_HEADER needs requirement to send.



## 2. BVH

There are two formats: string or binary.

String is mainly used for backward compatibility. It is inefficient and the quantity of information is limited. We don't suggest you use this format.

- The string format:

```
0 Avatar00 -17.80 99.86 -2.70 ... ||
```

0 represent character's index.

**Avatar00** represents the character's name. The rest is this frame's data.

|| means the tail of one frame.

Every frame's data format is obtained from BVH headers. The easiest way to get the BVH headers is to export a BVH file according to current settings. Then get every frame from the BVH headers.

- The binary format:

This will send binary streams directly. Every frame will have headers and body data. So far, there are 2 versions of the header: 1.0.0.3 and 1.1.0.0. You can check **use old header** to switch between different headers. Here are the header formats of two versions.

```
// DataVersion: 1.0.0.3
struct _tagBVH_PIPE_DATA_FRAME
{
    NUINT16 BvhHeaderToken1; // Package start token: 0xDDFF
    DATA_VER DataVersion; // Version of community data format. e.g.: 1.0.0.2
    NUINT32 DataCount; // Values count, 180 for without disp data
    NINT32 WithDisp; // With/out dispement
    NINT32 WithReference; // With/out reference bone data at first
    NUINT32 AvatarIndex; // Avatar index
    NUINT8 AvatarName [32]; // Avatar name
    NUINT32 Reserved1; // Reserved, only enable this package has 64bytes
length
    NUINT32 Reserved2; // Reserved, only enable this package has 64bytes
length
    NUINT16 BvhHeaderToken2; // Package end token: 0xEEFF
    NFLOAT vMotionData [0];
};
```

```

// DataVersion: 1.1.0.0
struct _tagBVH_PIPE_DATA_FRAME_EX
{
    NUINT16 BvhHeaderToken1; // Package start token: 0xDDFF
    DATA_VER DataVersion; // Version of community data format. e.g.: 1.0.0.2
    NUINT16 DataCount; // Values count, 180 for without disp data
    NINT8 WithDisp; // With/out dispement
    NINT8 WithReference; // With/out reference bone data at first
    NUINT32 AvatarIndex; // Avatar index
    NUINT8 AvatarName [32]; // Avatar name
    NUINT32 FrameIndex;
    NUINT32 Reserved;
    NUINT32 Reserved1; // Reserved, only enable this package has 64bytes length
    NUINT32 Reserved2; // Reserved, only enable this package has 64bytes length
    NUINT16 BvhHeaderToken2; // Package end token: 0xEEFF

    NFLOAT vMotionData [0];
};

union DATA_VER
{
    NUINT32 _VersionMask;
    struct
    {
        NUINT8 BuildNumb; // Build number
        NUINT8 Revision; // Revision number
        NUINT8 Minor; // Subversion number
        NUINT8 Major; // Major version number
    };
};
};

```

## 8.2.2 Action

This is a motion identification channel. This channel will have data only when motion patterns are triggered.

The definition of this format :

```
// Action Recognition data
typedef struct _ActionRecognitionData
{
    ActionRecognitionDataTypes DataType; // Type of action
    int          DataLength; // Data length
    int          TotalLength; // Total length
    void*        DataPtr; // Address of data, always be the next address
of 'DataPtr'
}ActionRecognitionData;

// Recognized action data types
typedef enum _ActionRecognitionDataTypes
{
    Action_SingleTapping, // Hand single tapping
    Action_DoubleTapping, // Hand double tapping
    Action_Fire, // Fire
    Action_InwardFlipping, // Hand in-ward flipping
    Action_OutwardFlipping, // Hand out-ward flipping
    Action_MassVector, // Vector data of center of gravity
    Action_SwingVector, // Vector data of body swing
    Action_Unknown, // Unknown type
}ActionRecognitionDataTypes;
```

## 8.2.3 Calculation

This channel's data is obtained from calculations. It has string and binary formats.

- String format: bone ID-data type-data subtype

```
01-X-x 01-X-y 01-X-z 01-V-x 01-V-y 01-V-z 01-Q-s 01-Q-x 01-Q-y 01-Q-z 01-A-x 01-A-y 01-A-z 01-W-x
01-W-y 01-W-z 02-X-x 02-X-y 02-X-z 02-V-x 02-V-y 02-V-z 02-Q-s 02-Q-x 02-Q-y 02-Q-z 02-A-x 02-A-y
02-A-z 02-W-x 02-W-y 02-W-z 03-X-x 03-X-y 03-X-z 03-V-x 03-V-y 03-V-z 03-Q-s 03-Q-x 03-Q-y 03-Q-z
03-A-x 03-A-y 03-A-z 03-W-x 03-W-y 03-W-z 04-X-x 04-X-y 04-X-z 04-V-x 04-V-y 04-V-z 04-Q-s 04-Q-x
04-Q-y 04-Q-z 04-A-x 04-A-y 04-A-z 04-W-x 04-W-y 04-W-z 05-X-x 05-X-y 05-X-z 05-V-x 05-V-y 05-V-z
05-Q-s 05-Q-x 05-Q-y 05-Q-z 05-A-x 05-A-y 05-A-z 05-W-x 05-W-y 05-W-z 06-X-x 06-X-y 06-X-z 06-V-x
06-V-y 06-V-z 06-Q-s 06-Q-x 06-Q-y 06-Q-z 06-A-x 06-A-y 06-A-z 06-W-x 06-W-y 06-W-z 07-X-x 07-X-y
07-X-z 07-V-x 07-V-y 07-V-z 07-Q-s 07-Q-x 07-Q-y 07-Q-z 07-A-x 07-A-y 07-A-z 07-W-x 07-W-y 07-W-z
08-X-x 08-X-y 08-X-z 08-V-x 08-V-y 08-V-z 08-Q-s 08-Q-x 08-Q-y 08-Q-z 08-A-x 08-A-y 08-A-z 08-W-x
08-W-y 08-W-z 09-X-x 09-X-y 09-X-z 09-V-x 09-V-y 09-V-z 09-Q-s 09-Q-x 09-Q-y 09-Q-z 09-A-x 09-A-y
09-A-z 09-W-x 09-W-y 09-W-z 0A-X-x 0A-X-y 0A-X-z 0A-V-x 0A-V-y 0A-V-z 0A-Q-s 0A-Q-x 0A-Q-y 0A-Q-z
0A-A-x 0A-A-y 0A-A-z 0A-W-x 0A-W-y 0A-W-z 0B-X-x 0B-X-y 0B-X-z 0B-V-x 0B-V-y 0B-V-z 0B-Q-s 0B-Q-x
0B-Q-y 0B-Q-z 0B-A-x 0B-A-y 0B-A-z 0B-W-x 0B-W-y 0B-W-z 0C-X-x 0C-X-y 0C-X-z 0C-V-x 0C-V-y 0C-V-z
0C-Q-s 0C-Q-x 0C-Q-y 0C-Q-z 0C-A-x 0C-A-y 0C-A-z 0C-W-x 0C-W-y 0C-W-z 0D-X-x 0D-X-y 0D-X-z 0D-V-x
0D-V-y 0D-V-z 0D-Q-s 0D-Q-x 0D-Q-y 0D-Q-z 0D-A-x 0D-A-y 0D-A-z 0D-W-x 0D-W-y 0D-W-z 0E-X-x 0E-X-y
0E-X-z 0E-V-x 0E-V-y 0E-V-z 0E-Q-s 0E-Q-x 0E-Q-y 0E-Q-z 0E-A-x 0E-A-y 0E-A-z 0E-W-x 0E-W-y 0E-W-z
0F-X-x 0F-X-y 0F-X-z 0F-V-x 0F-V-y 0F-V-z 0F-Q-s 0F-Q-x 0F-Q-y 0F-Q-z 0F-A-x 0F-A-y 0F-A-z 0F-W-x
0F-W-y 0F-W-z 10-X-x 10-X-y 10-X-z 10-V-x 10-V-y 10-V-z 10-Q-s 10-Q-x 10-Q-y 10-Q-z 10-A-x 10-A-y
10-A-z 10-W-x 10-W-y 10-W-z 11-X-x 11-X-y 11-X-z 11-V-x 11-V-y 11-V-z 11-Q-s 11-Q-x 11-Q-y 11-Q-z
11-A-x 11-A-y 11-A-z 11-W-x 11-W-y 11-W-z 12-X-x 12-X-y 12-X-z 12-V-x 12-V-y 12-V-z 12-Q-s 12-Q-x
12-Q-y 12-Q-z 12-A-x 12-A-y 12-A-z 12-W-x 12-W-y 12-W-z 13-X-x 13-X-y 13-X-z 13-V-x 13-V-y 13-V-z
13-Q-s 13-Q-x 13-Q-y 13-Q-z 13-A-x 13-A-y 13-A-z 13-W-x 13-W-y 13-W-z 14-X-x 14-X-y 14-X-z 14-V-x
14-V-y 14-V-z 14-Q-s 14-Q-x 14-Q-y 14-Q-z 14-A-x 14-A-y 14-A-z 14-W-x 14-W-y 14-W-z 15-X-x 15-X-y
15-X-z 15-V-x 15-V-y 15-V-z 15-Q-s 15-Q-x 15-Q-y 15-Q-z 15-A-x 15-A-y 15-A-z 15-W-x 15-W-y 15-W-z
contactL contactR
```

Eg: Body ID is 01 and body's displacement(X)'s three channel(x,y, and z) description:

```
01-X-x 01-X-y 01-X-z
```

All the data types:

World coordinate displacement: X (X, Y, Z), unit is meter

World coordinate displacement: V (X, Y, Z), unit is meter per second.

World coordinate module's posture data: Q (W, X, Y, Z).

Module coordinate accelerated speed: A (X, Y, Z), unit is g.

Module coordinate accelerated speed: M (X, Y, Z), unit is radian per second.

World coordinate displacement: X (X, Y, Z), unit is meter

Bone mappings as follows:

```

01 Hips
02 RightUpLeg
03 RightLeg
04 RightFoot
05 LeftUpLeg
06 LeftLeg
07 LeftFoot
08 RightShoulder
09 RightArm
0A RightForeArm
0B RightHand
0C LeftShoulder
0D LeftArm
0E LeftForeArm
0F LeftHand
10 Head
11 Neck
12 Spine3
13 Spine2
14 Spine1
15 Spine

```

Binary format:

```

struct _tagQVX_PIPE_DATA_FRAME
{
    NUINT16 HeaderToken1; // Package start token: 0xDDFF
    DATA_VER DataVersion; // Version of community data format. e.g.: 1.0.0.2
    NUINT32 DataCount; // Values count
    NUINT32 AvatarIndex; // Avatar index
    NUINT8 AvatarName[32]; // Avatar name
    NUINT32 Reserved1; // Reserved, only enable this package has 64bytes length
    NUINT32 Reserved2; // Reserved, only enable this package has 64bytes length
    NUINT32 Reserved3; // Reserved, only enable this package has 64bytes length
    NUINT32 Reserved4; // Reserved, only enable this package has 64bytes length
    NUINT16 HeaderToken2; // Package end token: 0xEEFF
    _tagQVX_MOTION_SEGMENT vMotionData [0];
};
struct _tagQVX_MOTION_SEGMENT
{
    NFLOAT displacement [3];
    NFLOAT velocity [3];
    NFLOAT quaternion [4];
    NFLOAT acceleration [3];
    NFLOAT gyroscope [3];
};

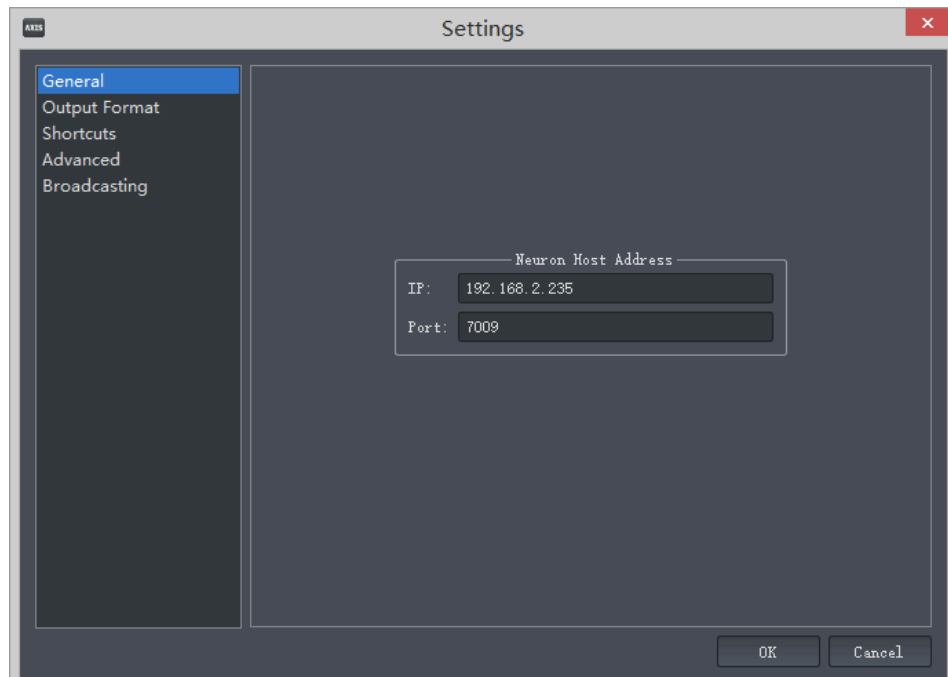
```

## 8.2.4 IP selected

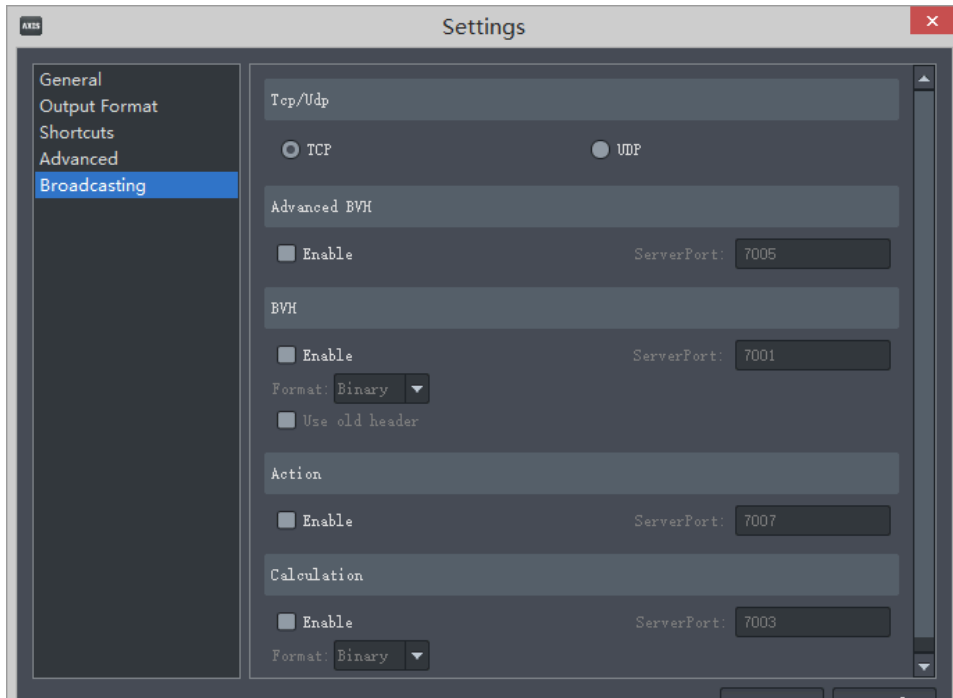
Axis Neuron client uses TCP/UDP to send body motion data. It can be read on a local computer or any other computer via the internet.

### 1. TCP

a) Select TCP in File -> Settings -> Broadcasting. Axis Neuron's Host IP will now become the Host address.



b) Select transmission type, like BVH binary, and set the port.



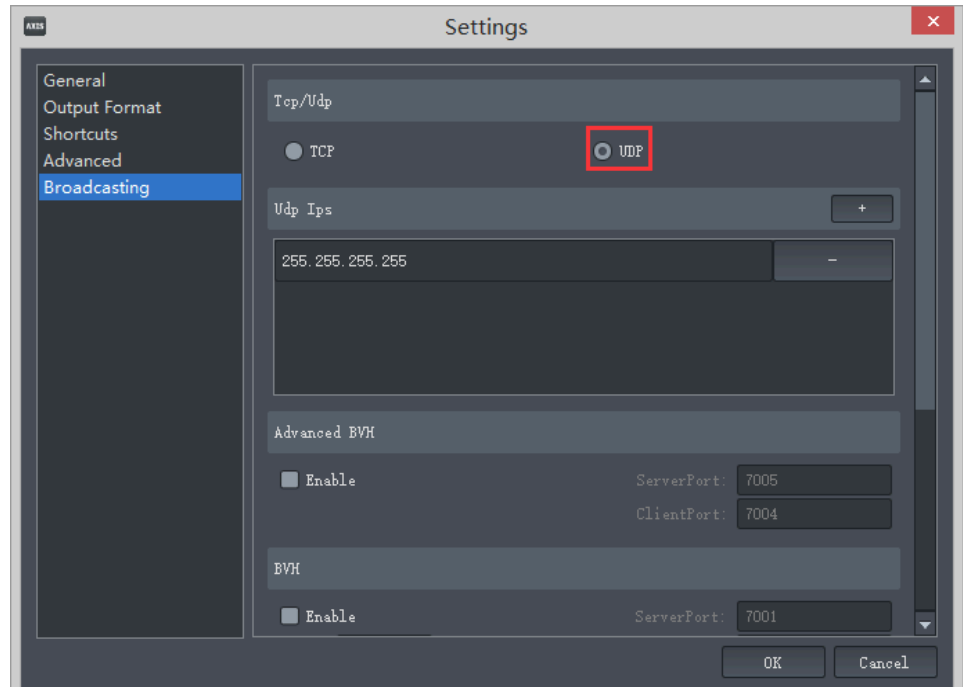
c) Click **OK**.

d) Open the third-party client, then input Axis Neuron's Host IP in Server IP, then input the port number, then click Connect.

e) After the connection has been established, open a .raw file in Axis Neuron. Any machine linked to this Host IP can now receive data from AXIS NEURON.

## 2. UDP

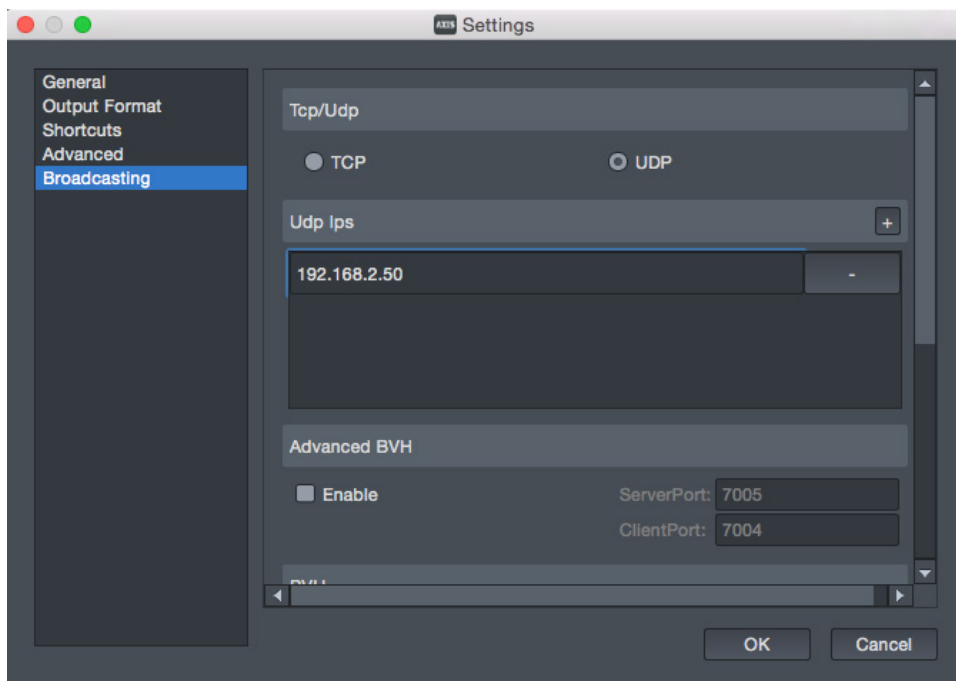
### a) Local computer transmission.



b) Select UDP in File → Settings → Broadcasting. Choose 127.0.0.1 in Host Address.

c) Select data type, like BVH binary, set the port. Then click Add button, input 127.0.0.1:8888 or 255.255.255.255:8888. Local computer must add Client IP address and inform a different port number with data channel.





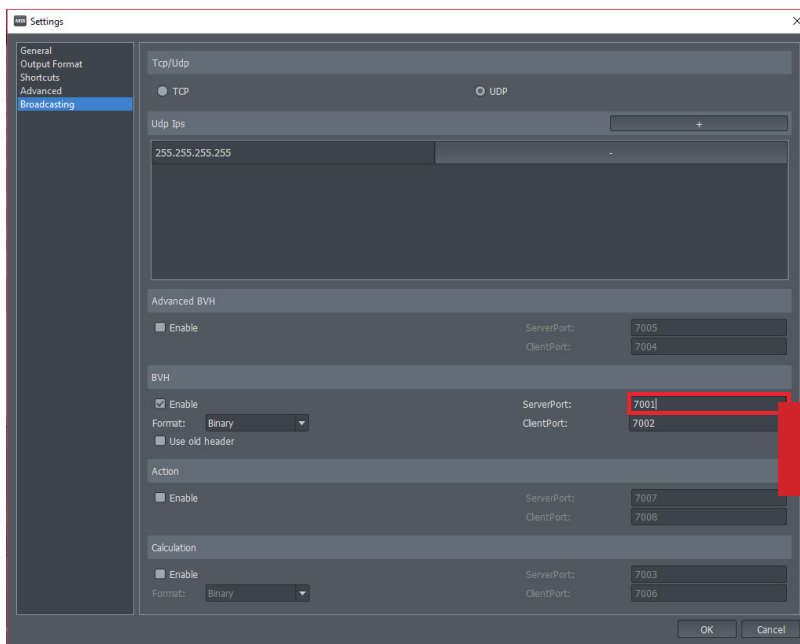
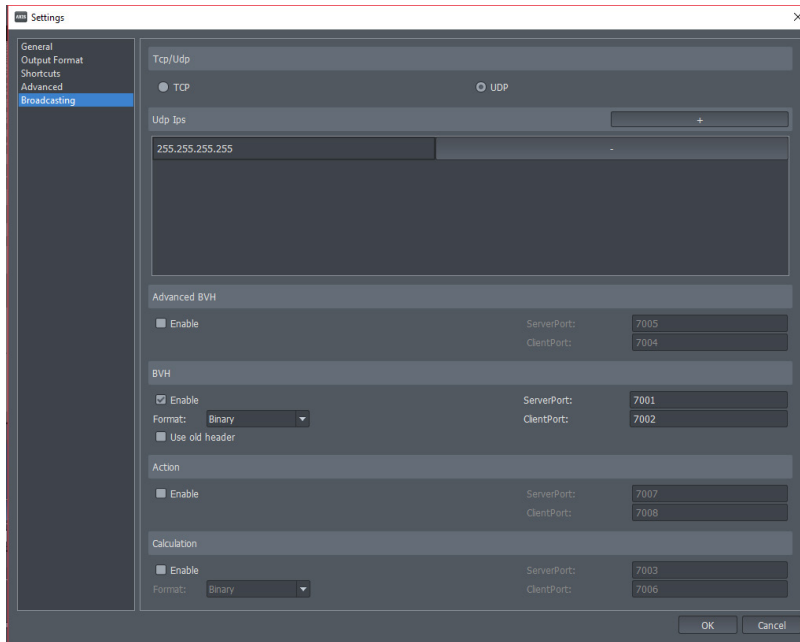
## TIPS

- If Host Address is 192.168.2.50 the client address must also be 192.168.2.50

- d) Click OK button.
- e) Open another client, set the port to 8888.
- f) Open raw file in Axis Neuron or build a real time connection with equipment.

3. Transfer to another computer:
  - a) Select UDP in File → Settings → Broadcasting, choose Axis Neuron's host IP but can't be 127.0.0.1.
  - b) Choose the data type, like BVH binary, and set the port.
  - c) Click Add button, add another client's address or input 255.255.255.255.

If the third-party's client is not on the same computer with Axis Neuron, you can define the port number. Input the port number you defined in the address panel; if not, input behind the data type port number.



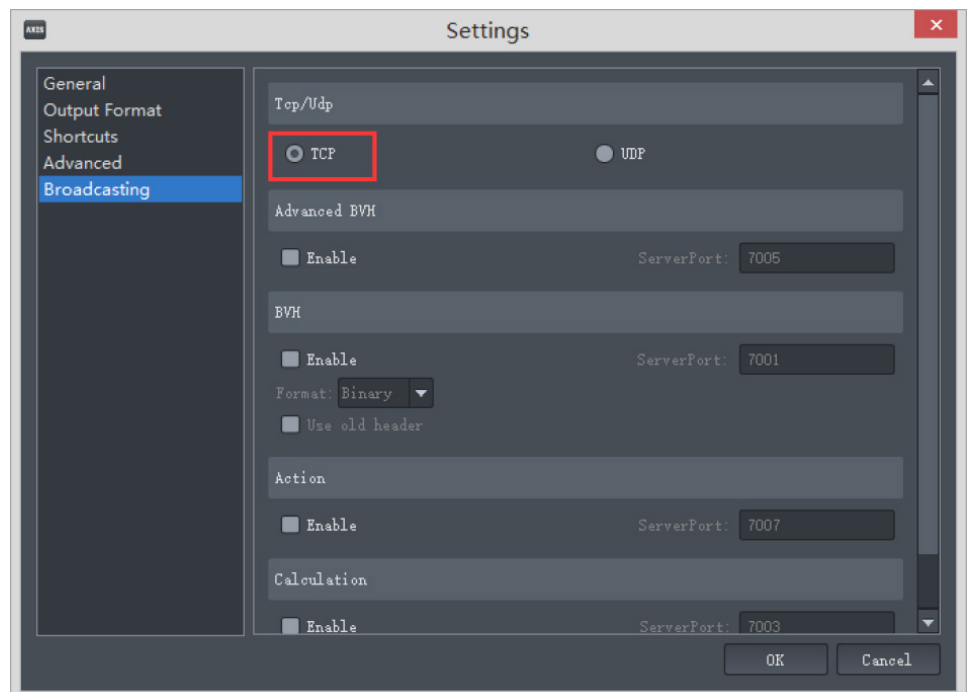
- Click OK.
- Start another client, set the port in Axis Neuron.
- Build real time connection.

9.

# Third-Party Software Support

Perception Neuron supports current creation softwares like Motionbuilder, Maya, and 3ds Max. Character models can be driven in real time through most of these applications. This chapter explains how to use these functions and the plugin installation process.

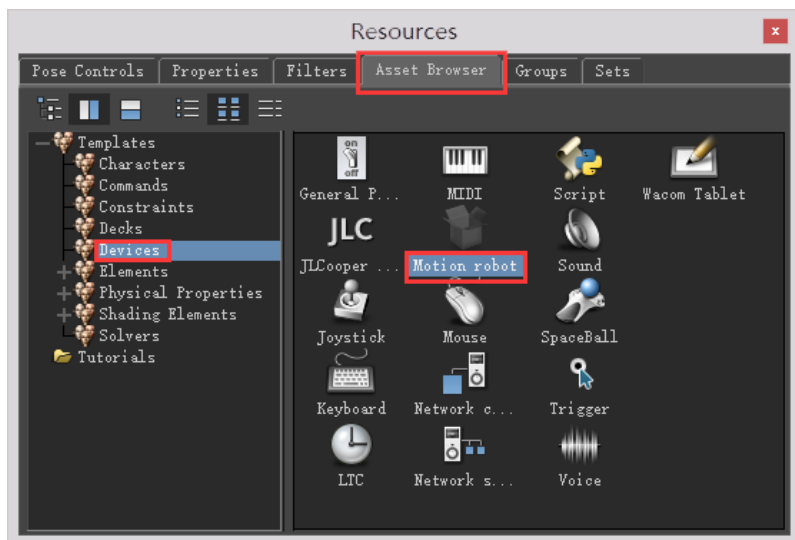
1. Plugin install -Run MBPluginInstaller.exe.
2. Axis Neuron Settings:
  - a) Launch Axis Neuron, build real time connection with equipment or open a valid .raw file.
  - b) In File -> Settings -> Broadcasting, check TCP and Advanced BVH format, than input the valid port.



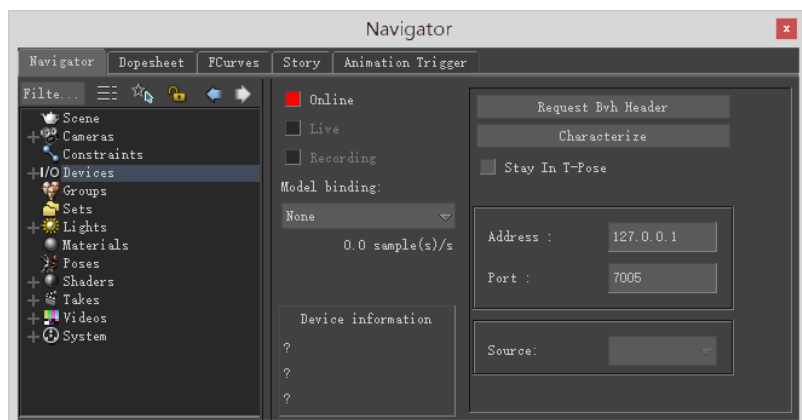
- c) Set displacement and Reference in Output Format.
- d) Click OK.

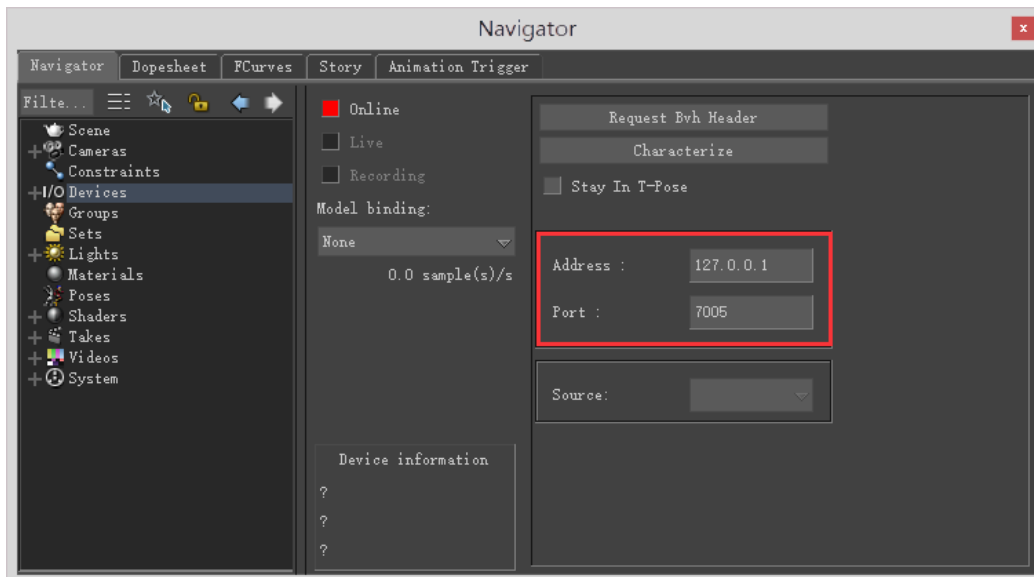
## 9.1 Autodesk Motion Builder

1. Run Motion Builder. Click the Resources panel in the Asset Browser -> Devices, then drag Motion robot into the 3D scene.

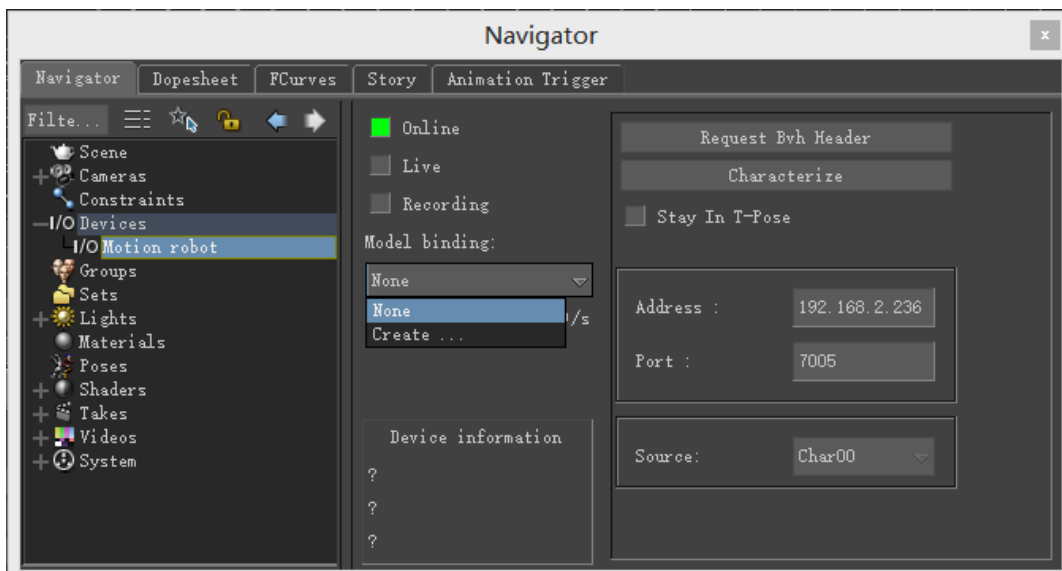


2. Input Axis Neuron host IP address and Advanced BVH using Port in Navigator parameters panel, then click Online. If the button changes to green, that means the connection has established successfully. The character's name will show in the Source.

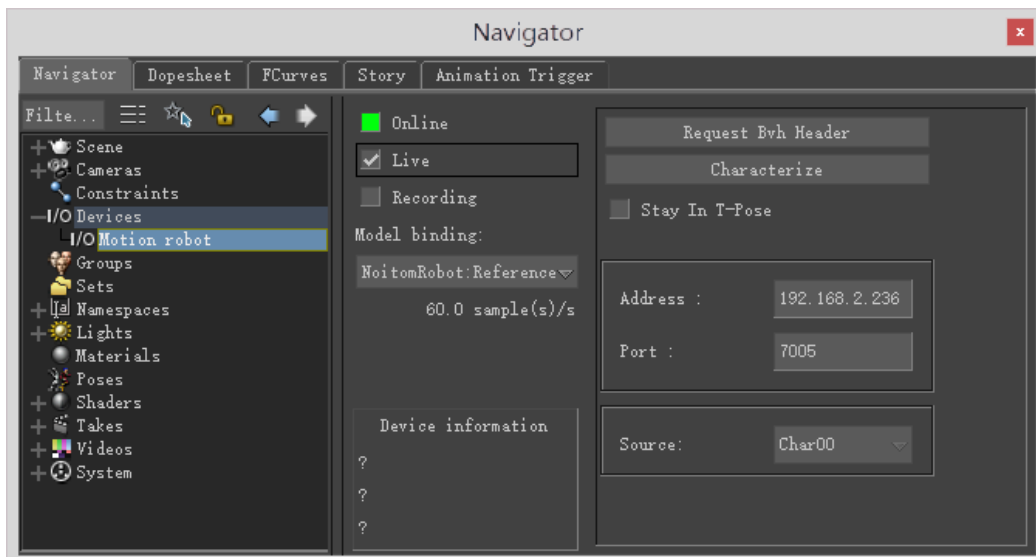




3. Choose a character in Source Combo box.
4. Create a bone model in Model binding.

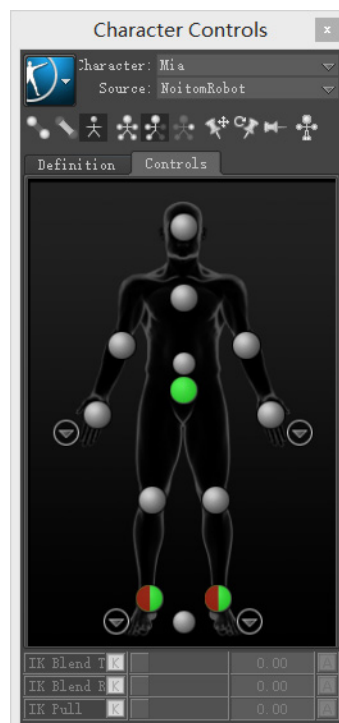
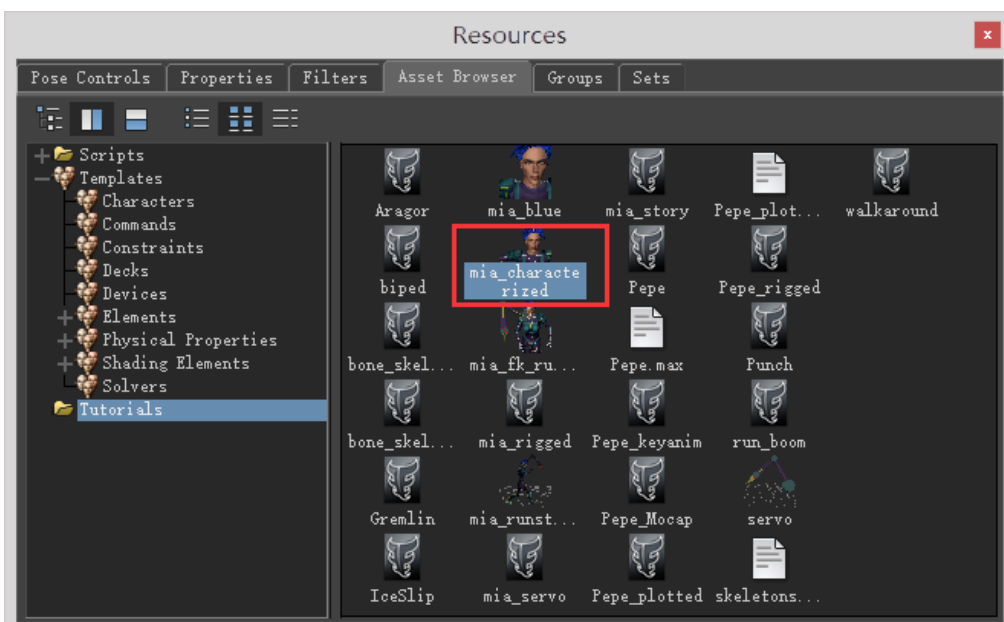


5. Check Live. This time the actor in Motionbuilder's 3D scene will be driven by the Axis Neuron actor.



6. Click the Characterize button.

7. Drag the Mia character from the Motionbuilder Tutorials into the 3D scene, then choose Mia and NoitomRobot as the Source in the control panel. The bones will drive the 3D Mia model.



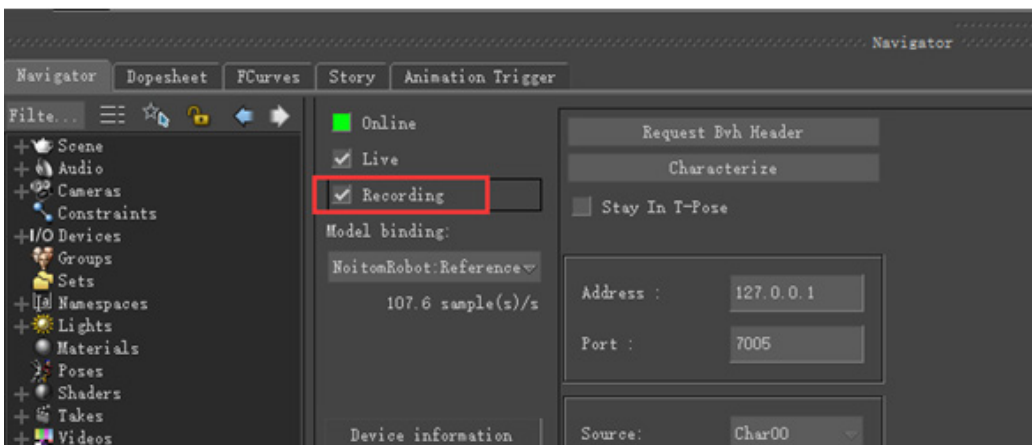
8. If you reset the Actor's parameters in Axis Neuron, you need to click **Request BVH Header** button to recreate the bones.

Using the Motionbuilder Plugin record function:

## TIPS

- When you use the Motionbuilder plugin record function, the model in Axis Neuron must be in real-time mode and the Broadcasting settings should remain the same as before.

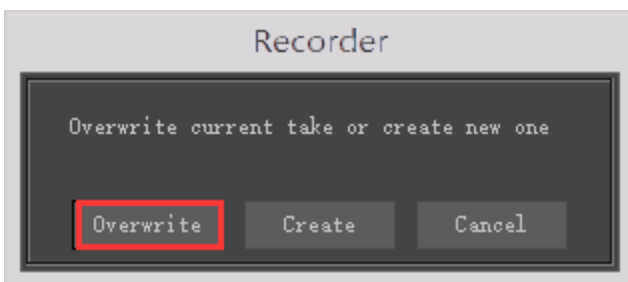
1. Check Recording in plugin panel.



2. Click Recorder.



3. Click Overwrite.

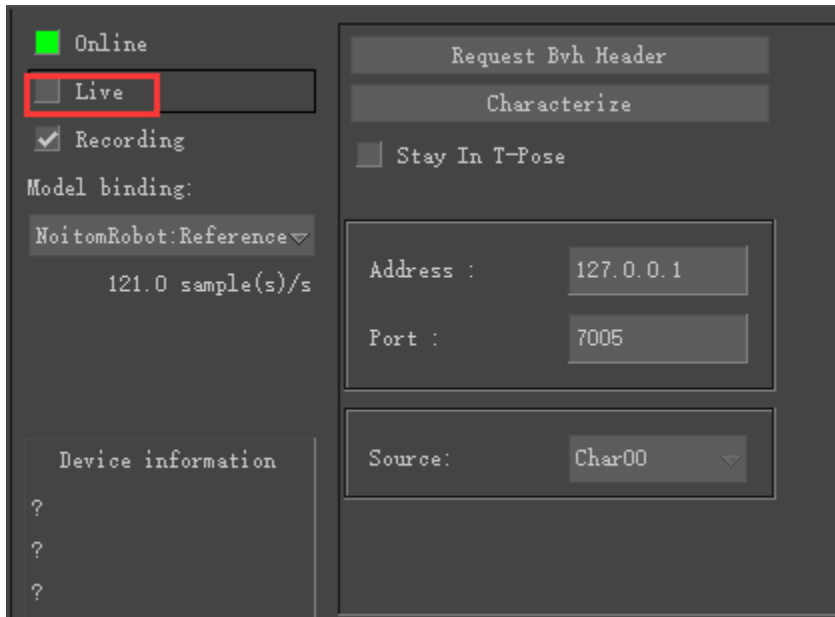




- Click play button to start recording.



- After recording, click the stop button, then uncheck the live checkbox.



- Click on the play button to playback your recorded animation.

The Motionbuilder versions currently supported by Perception Neuron and Axis Neuron:

- Autodesk Motion Builder 2012
- Autodesk Motion Builder 2013
- Autodesk Motion Builder 2014
- Autodesk Motion Builder 2015
- Autodesk Motion Builder 2016

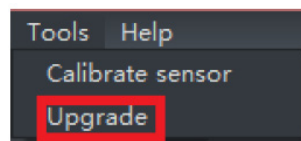
# 10. Equipment Maintenance

## 10.1 Device Firmware Upgrade

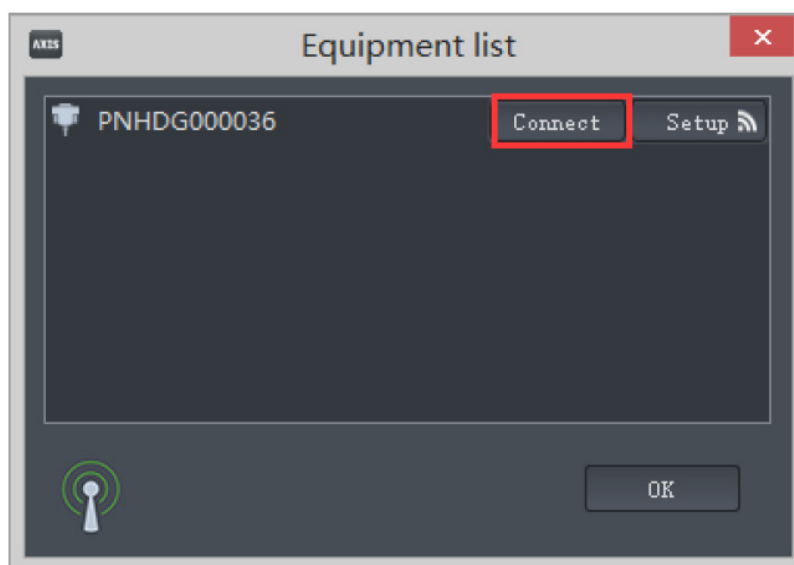
Both the Hub and the Perception Neurons sensors firmware can be updated together using Axis Neuron. When the Hub and Neuron are upgraded together, the Hub will be upgraded first and then the Perception Neuron sensors will follow. There is also support for upgrading the Hub or Perception Neuron sensors independently. When the Hub does not connect to the Neuron client, a dialogue will display, just click **Only HUB upgrade**.

When either the Hub or Perception Neuron sensors need an upgrade, a red light indicator inside of the sensor map will display. A green light indicator on the sensor map indicates the firmware is up-to-date.

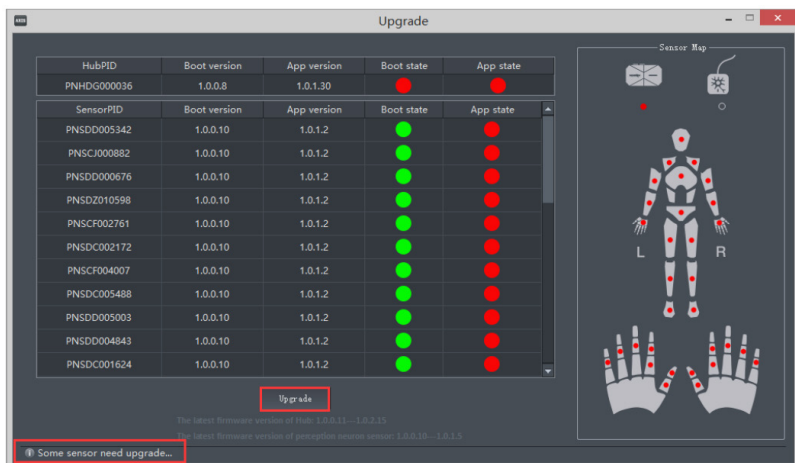
1. Upgrading the Hub and Perception Neuron sensors together:
  - Connect the Perception Neuron suit to the computer via USB.
  - You must have the Hub connected to the computer through the Data port.
  - Launch Axis Neuron, choose Upgrade in the tools menu.



- Click Connect in the Equipment list.

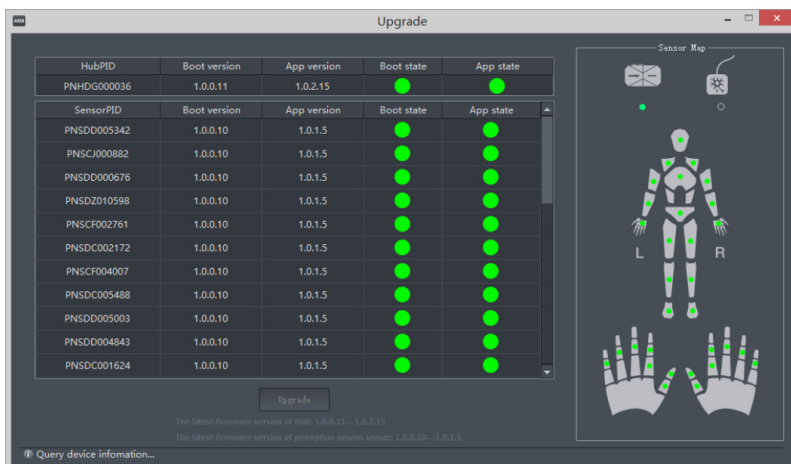


- Click the **Upgrade** button.

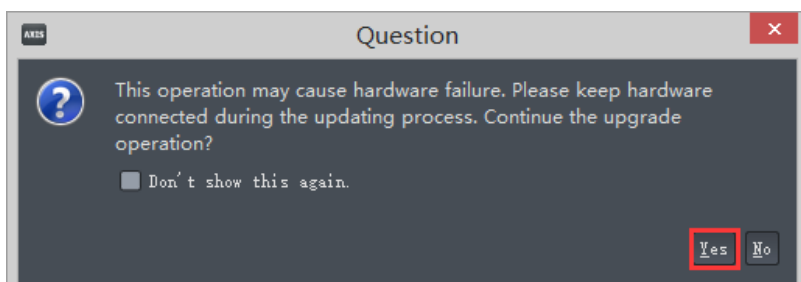


## TIPS

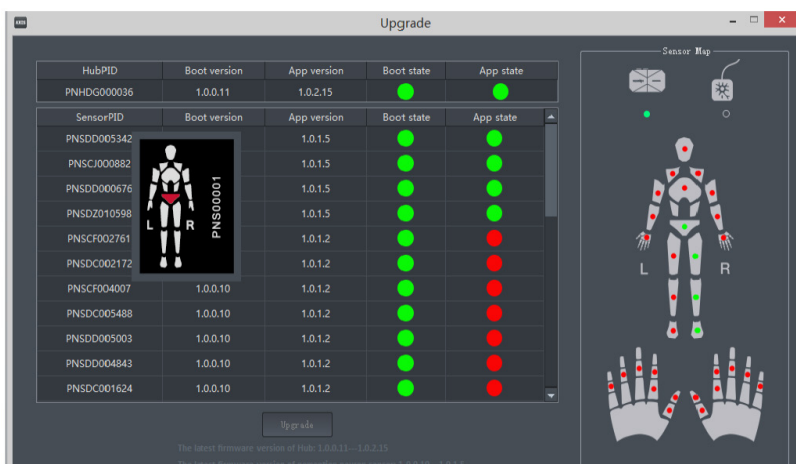
- If all the light indicators are green, this indicates that the firmware on the equipment does not need to be upgraded, you may close the window.



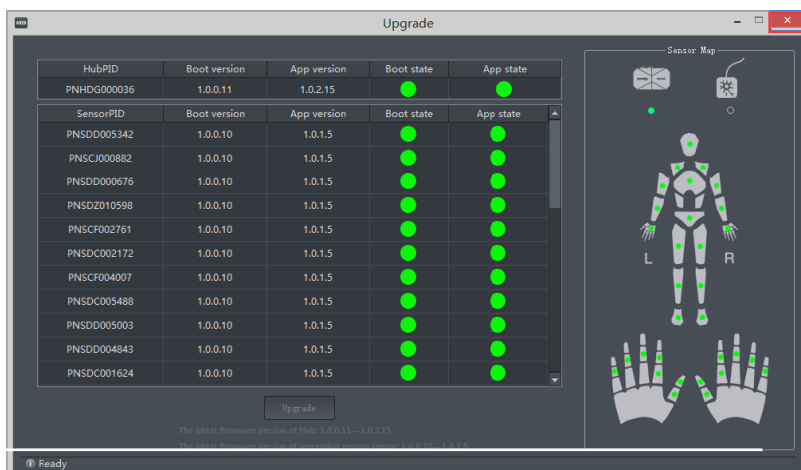
- Click Yes.



- Axis Neuron will upgrade the Hub first, then it will upgrade the Perception Neuron devices. There will be a second beep after the Hub has upgraded successfully. Then the Perception Neuron sensors that have the outdated firmware will begin to upgrade. There will be a tone indicator after each sensor has upgraded successfully, the corresponding light will then change to a green light indicator.

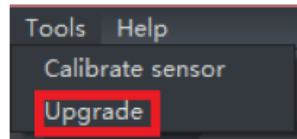


- Click Finish button.

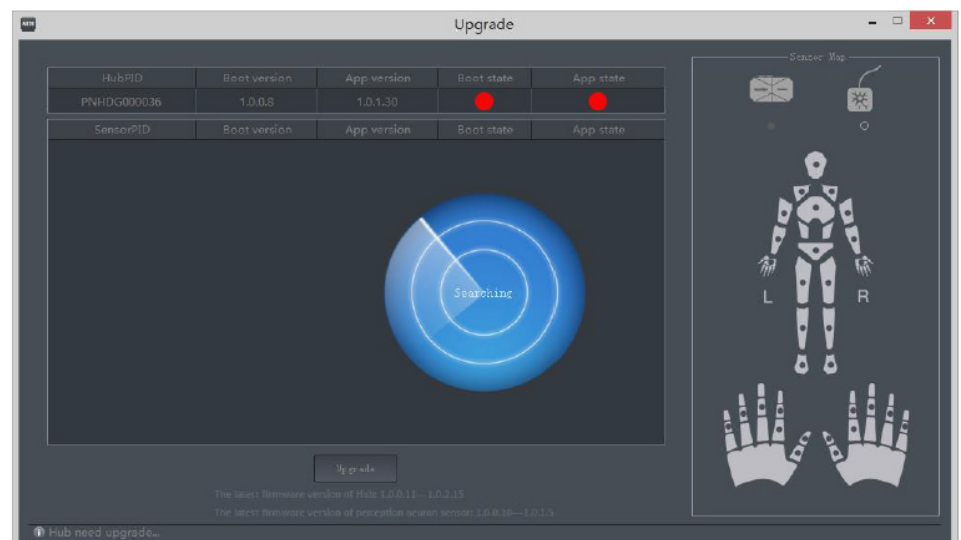
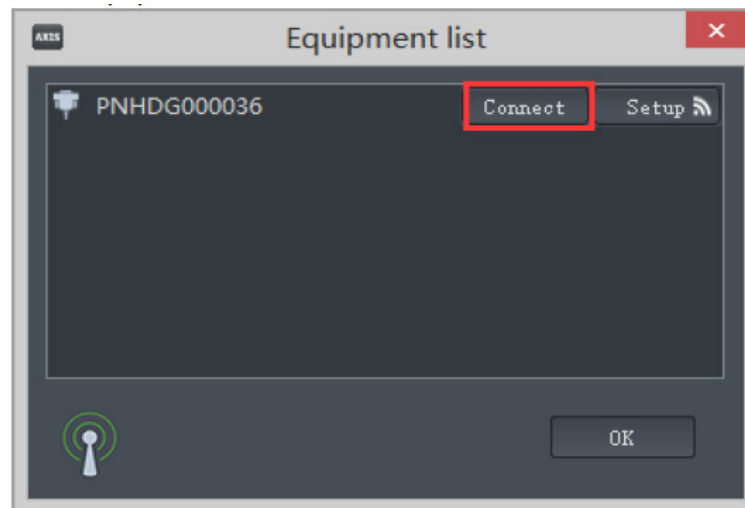


## 2. Hub upgrade only:

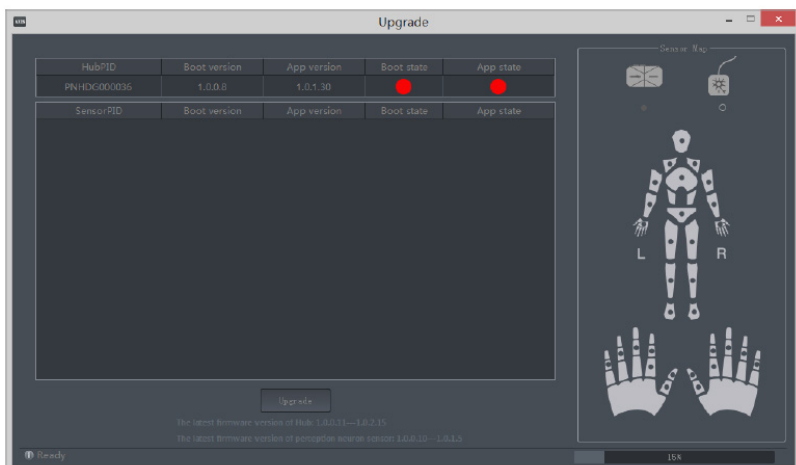
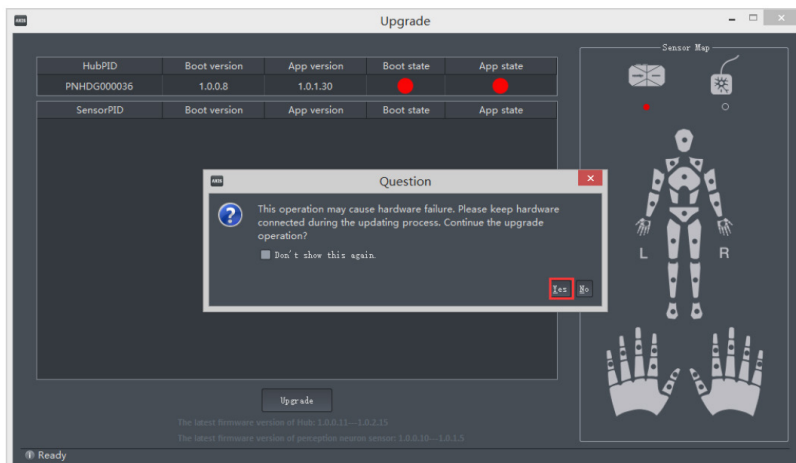
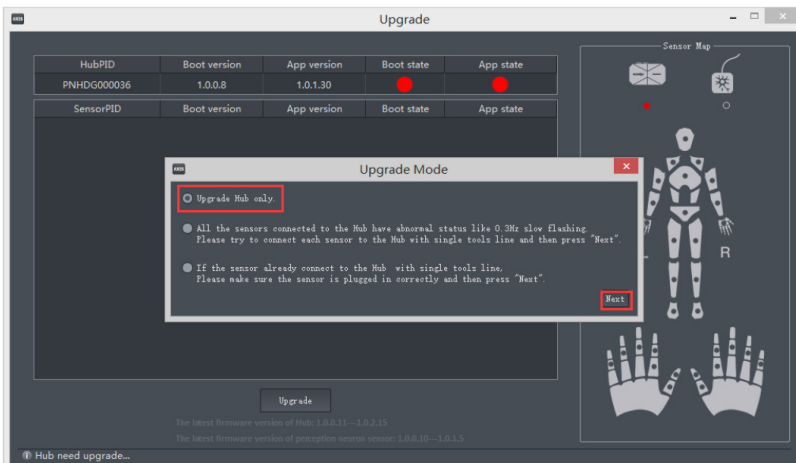
- Connect Hub and computer with a USB. The USB cable must be connected to the Hub's data port.
- Launch Axis Neuron, choose **Upgrade** in Tools menu.



- Click **Connect** button in Equipment list.



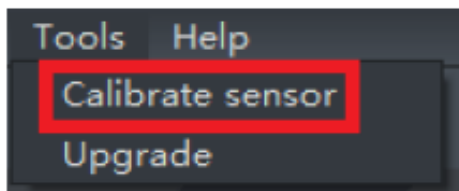
- Click Upgrade HUB Only button.



## 10.2 Neuron Calibration

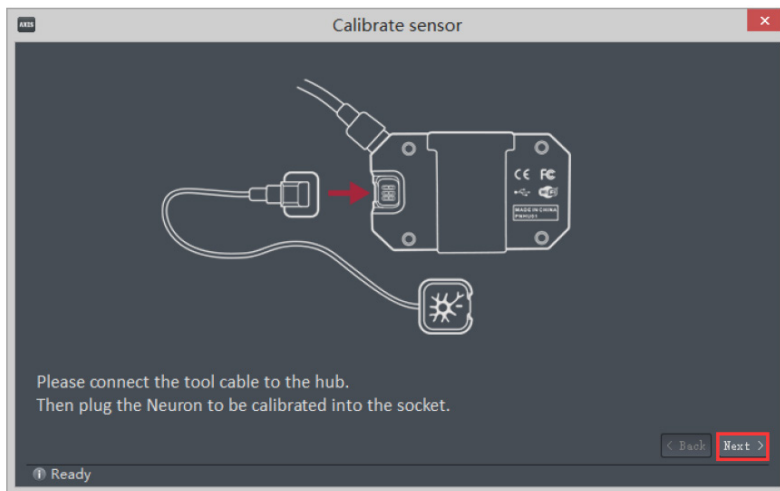
After longterm use, the sensors might accumulate some calculation errors. This will cause posture problems such as drifting. To correct this, you can install the Perception Neuron Sensor into the Prop Cable, then go to Axis Neuron to calibrate.

1. Calibrate sensor directly with the Prop Cable.
  - Launch Axis Neuron.
  - Click **Calibrate sensor** in Tools menu.

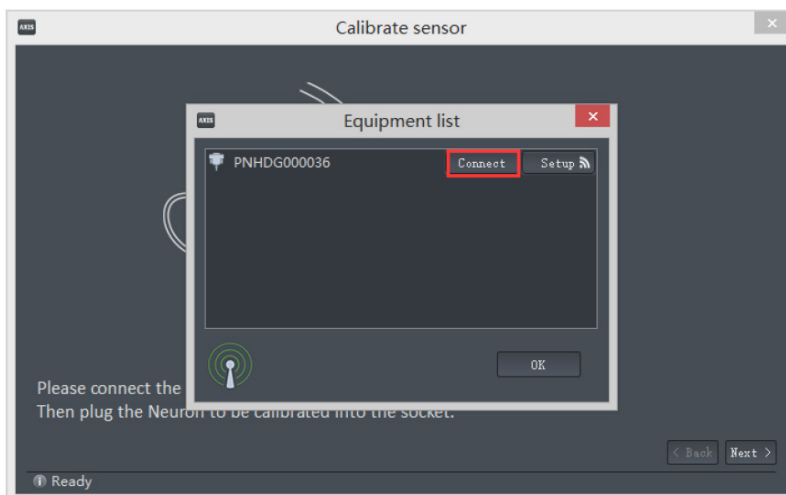


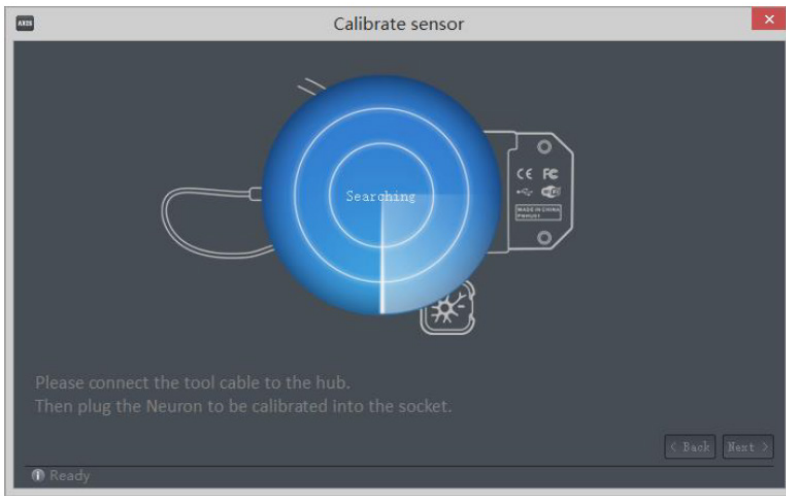


- Place the sensor into the Prop tool socket and connect the pogo pin connector to the Hub. Then Click **Next**.

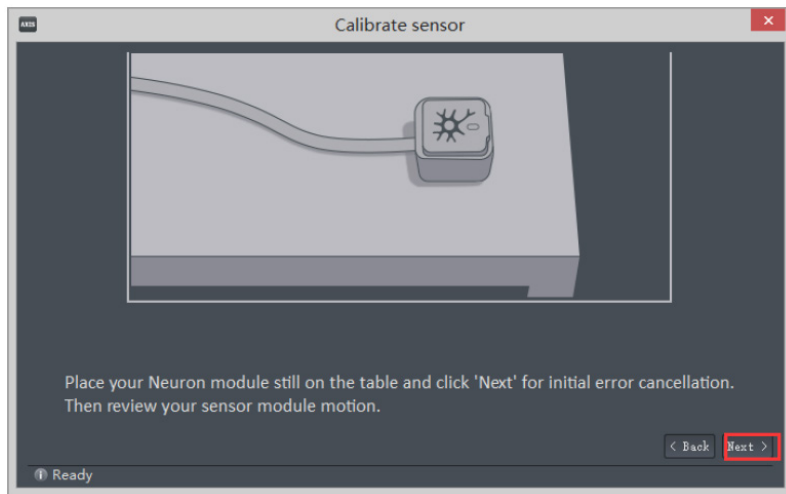


- Click **Connect** in Equipment list.

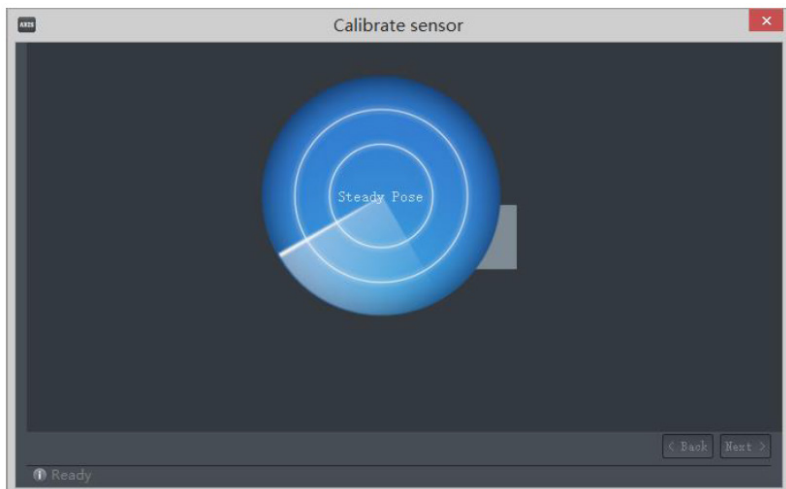




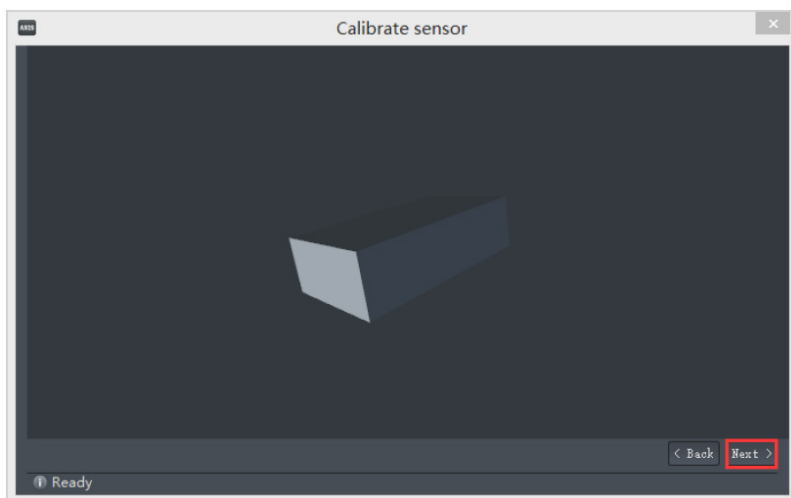
- Click Next.



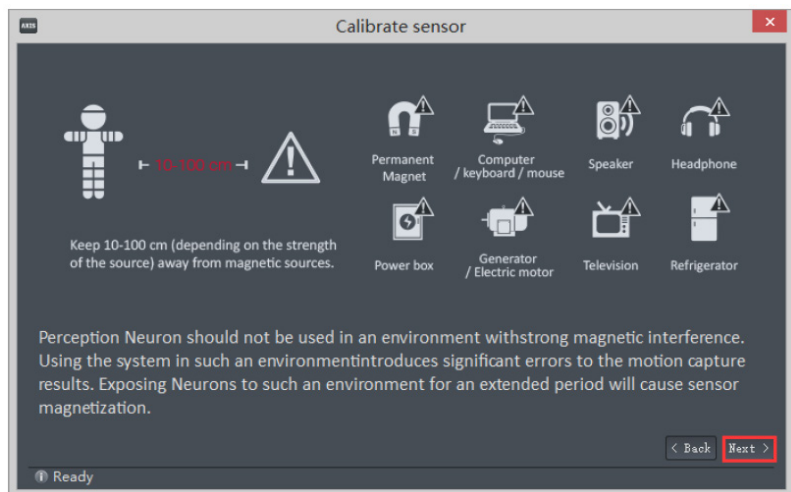
- Steady Pose status.



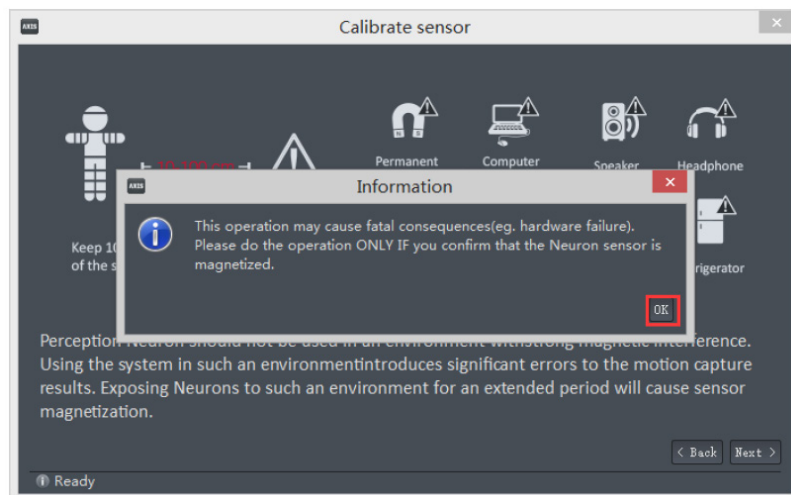
- After Steady pose, move the sensor. The model in the window will show the sensor's posture. If the posture is drifting, this indicates that the sensor is magnetized and you need to calibrate the sensor. Click **Next**.



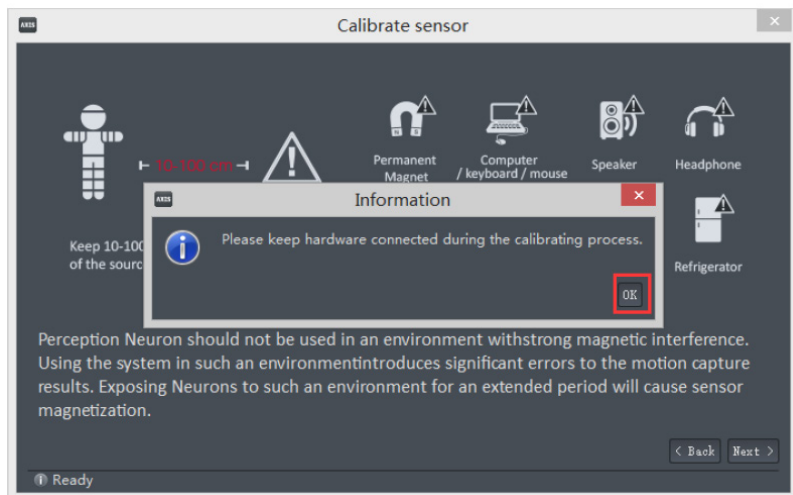
- Click Next.



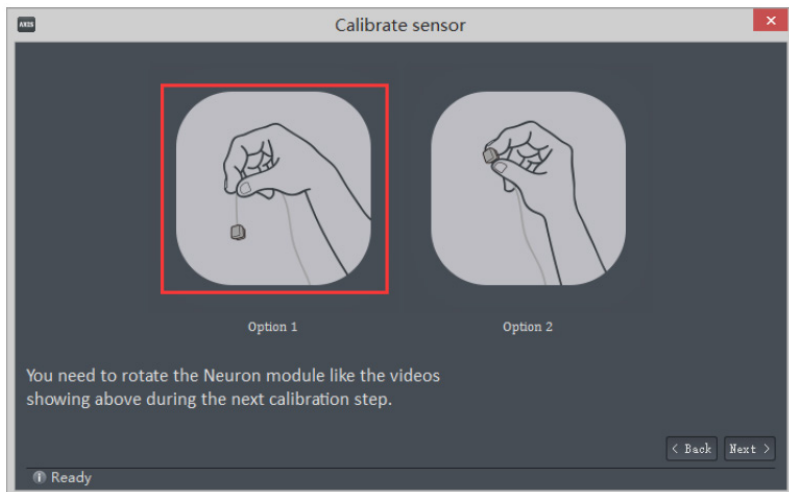
- Click OK.



- Click **OK**

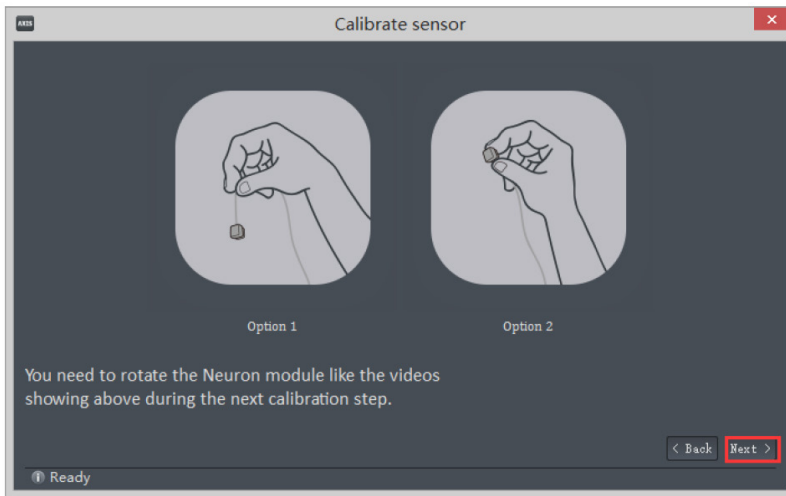


- There are two different kinds of techniques to choose from to calibrate the Perception Neuron sensor. Click on either image for a visual reference on the calibrating techniques.

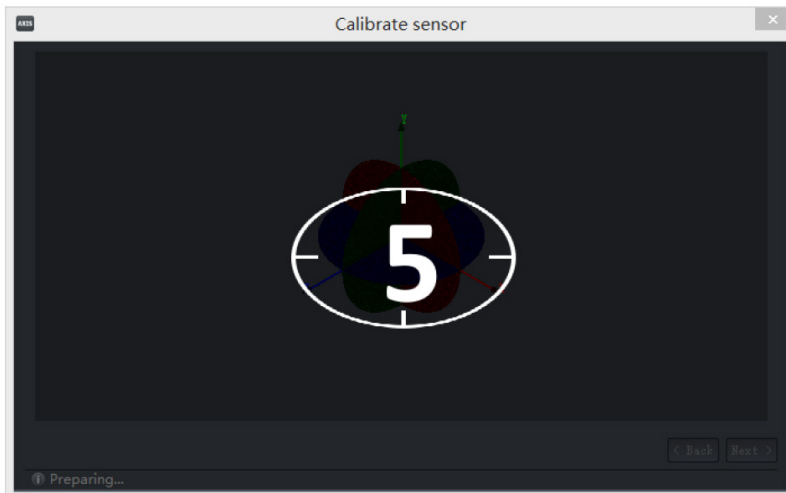


e.g. Holding the Prop Tool cable with your hand and rotating the socket along all axes (x,y,z). Alternatively, you can hold the Prop Tool socket on the tip of your fingers and rotate the socket in  $-x,y,z$ .

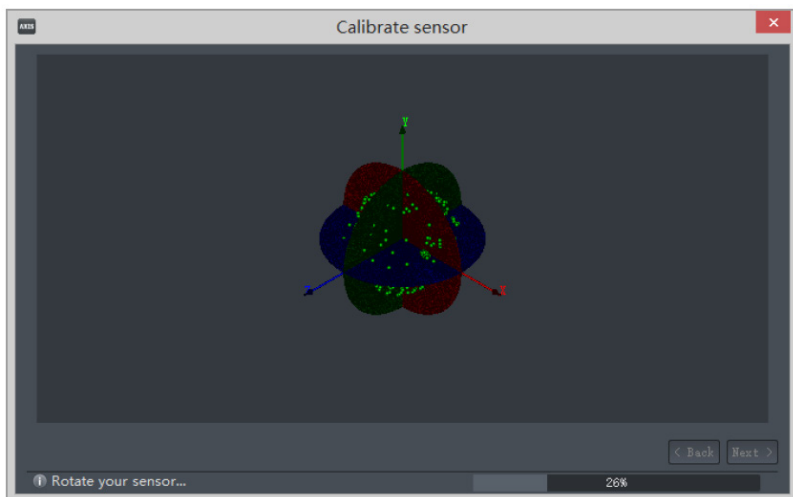
- Click **Next** when the video is done.



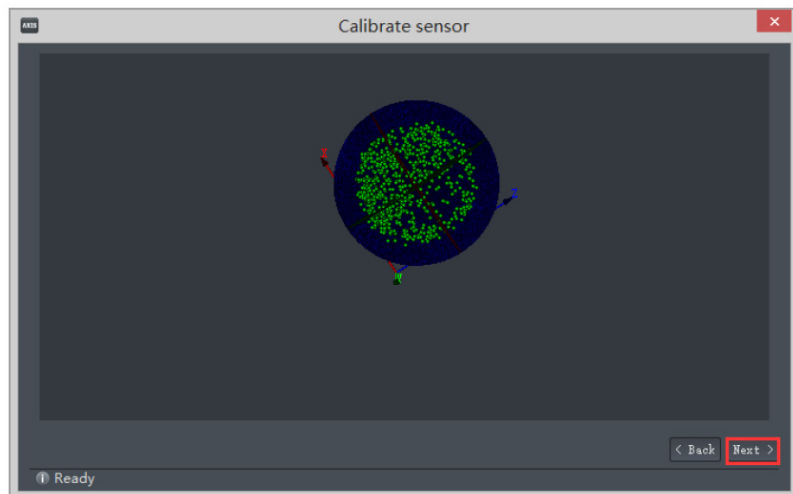
- 5 second countdown will begin.



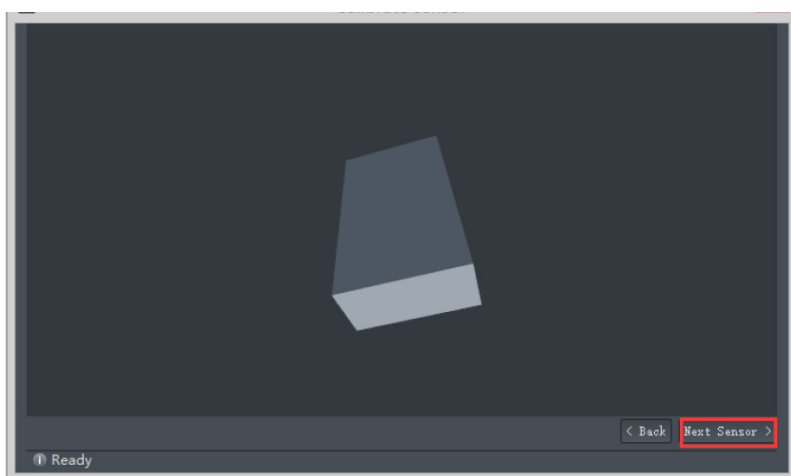
- Begin rotating the sensor as demonstrated in the videos. A green point cloud will appear showing the collected data.



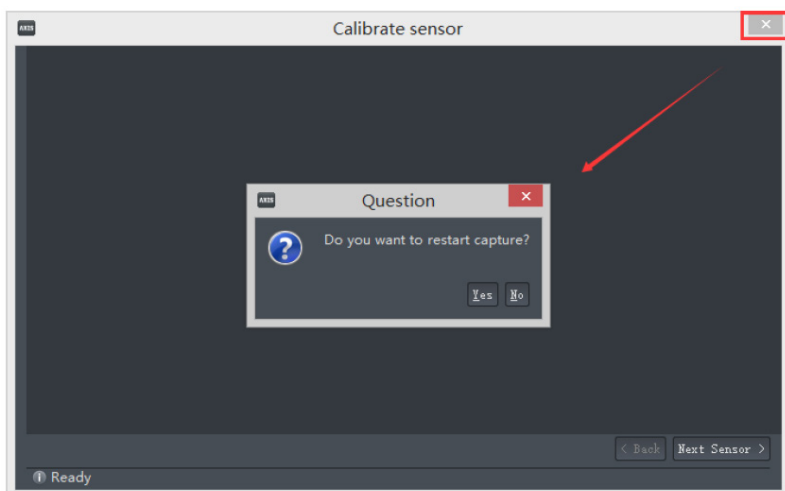
- When this process reaches 100 percent, the Hub will start buzzing. Click **Next** to end the calibration.



- After calibration, you can check the posture of the sensor, otherwise you can perform the calibration again if you are not satisfied with the sensor's posture. Click **Next Sensor** to restart calibration or start a new calibration for a different sensor.



2. **Calibrating sensor in real-time mode** - The basic operation is the same as calibrating the sensor directly with the Prop Tool cable. When calibration is complete, there will be a dialogue asking you whether you want to go back to motion capture mode. If so, reconnect the capture device by clicking **Yes**.



# 11. Appendix



### 1. Storage of equipment

- The Perception Neuron Anti-Mag container is made of special antimagnetic silicon steel material. It keeps the sensors from becoming magnetized by the environment. Store the sensors into the container when doing long distance transfers, long term storage, or exposure to strong magnetic field environments.

Keep away from the following devices when you are recording:

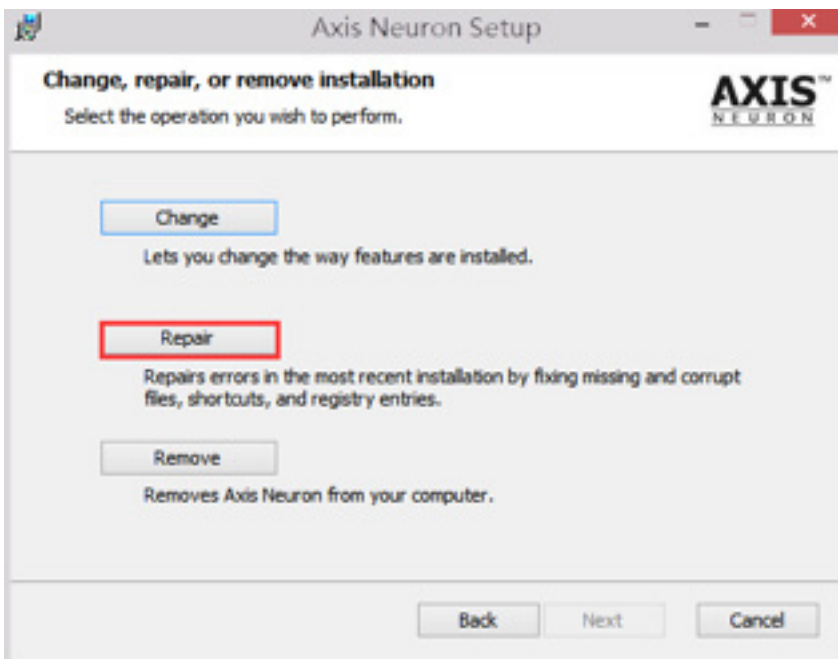
1. Electrical machine or generator (3 feet).
2. Any magnet or electrical magnet (3 feet).
3. Power box or high-tension line (6 feet).
4. Loudspeaker box, refrigerator, compressor, A/C Unit (3 feet).
5. Computer, keyboard, mouse, earphone, TV.

### 2. Common questions

- After installing Axis Neuron by overwriting the previous version, the program failed to launch.

#### Solutions:

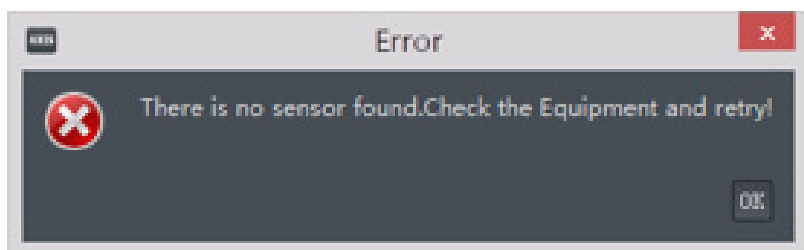
- Run Axis\_Neuron\_CLEAN.bat to clean Noitom registry or do it manually. (Path in registry is HKEY\_CURRENT\_USER -> Software -> Noitom.)
- Delete high version raw file in Noitom\Axis Neuron\Motion Files for low version Axis Neuron system may not analysis high version raw file.
- Reinstall. Click Repair then install.



## TIPS

- If not necessary, please do not use lower version of Axis Neuron to overwrite the higher version. And please backup the registry before you remove.

3) When connecting the device to Axis Neuron, it always hints, “No sensor found,” and all the BLN is in standby status.



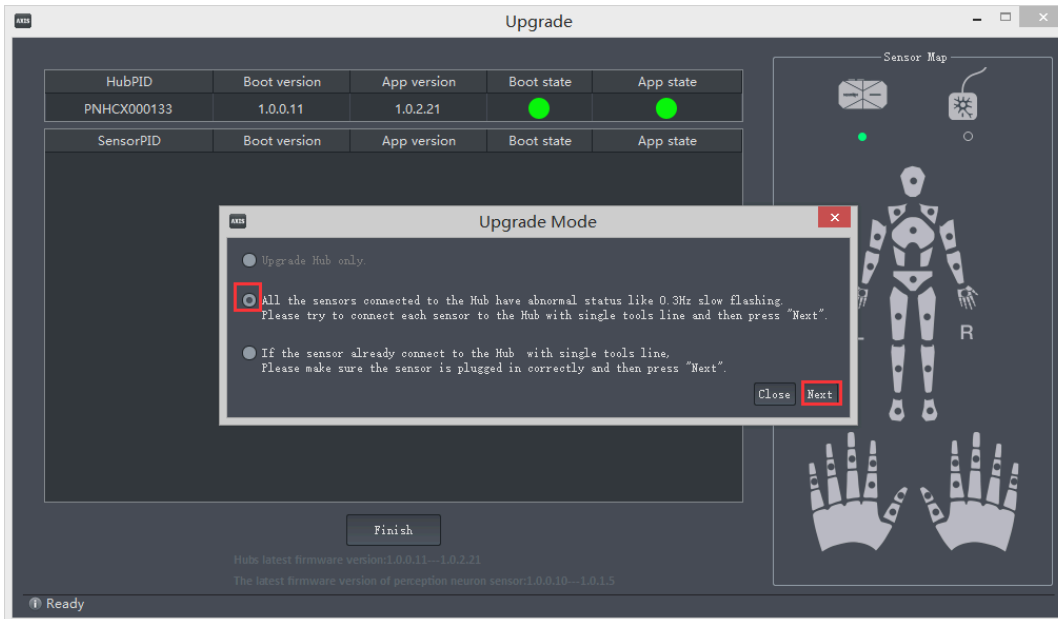
### Solutions:

- If you are using Single Arm mode, the dual pogo pin cable may have a faulty connection. Please replace the dual pogo pin cable and try to reconnect. If the problem persists, please check all adjacent straps individually by using the upgrade window.
- In Full Body mode, use the dual pogo pin cable to replace the main line of connection from the left hip pogo pin cable. Establish a connection using a dual pogo pin cable from any of the shoulder's pogo pin socket to the Hub. In Axis Neuron, reconnect to the Hub. If there is a successful connection then this means the main line of connection on the left hip pogo pin is faulty and has no contact. Once the Perception Neuron suit has been troubleshooted thoroughly and found to have a faulty Upper Body strap please contact customer service at [contact@neuronmocap.com](mailto:contact@neuronmocap.com)
- If you are connecting devices with Wireless mode, you could unplug the USB cable from 5V/2A port to power off then repower it. If the Hub LED is 5HZ flashing, click connect button in Equipment list. If the connect still fails, it might be Internet instability. Please change the router and try to reconnect.

After upgrading firmware, some sensor LED's mistakenly show 0.3HZ slow flashing status.

### Solutions:

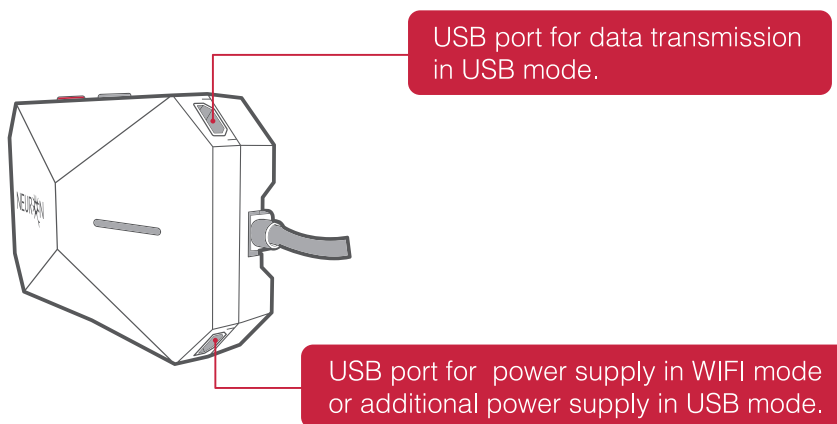
- Connect the sensor corresponding to the erroneous LED to Axis Neuron with the Single tools line. Force-upgrade its firmware in Tool -> Upgrade. Click Connect in Equipment list, then click Single Neuron Failed Safe Upgrade. If after upgrade the LED is in normal status, then this sensor can continue to be used.



4. The fingers sensor is always disconnected in real-time and the LED changes to standby status in 31-Neuron Full Body Mode.

#### Solutions:

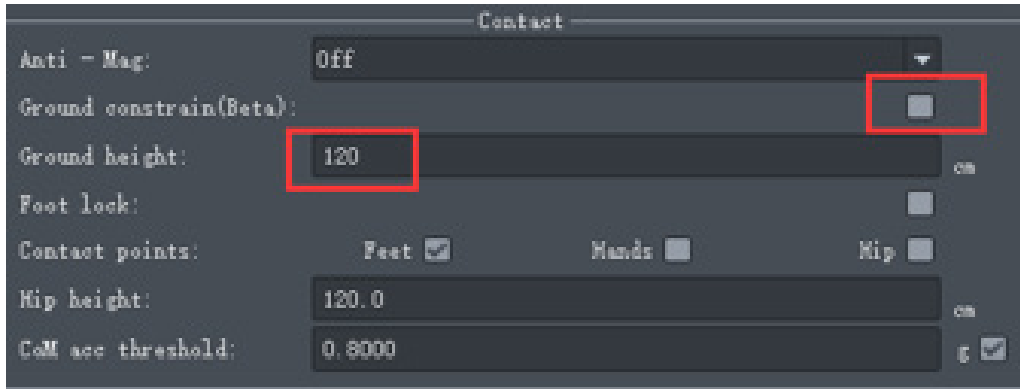
- Find a portable power source and connect the device to the 5V/2A port. (Laptops do not always provide sufficient power when more than 18 sensors are connected, for such cases we suggest using power bank as assistance.)
- Perception Neuron works in WIFI and USB mode. There are 2 mini USB ports on the Hub.
- For USB mode, use the upper port to link the Hub with your computer for data transmission and power supply. If more than 18 Neurons are used at one time, it is suggested to use the lower port for additional power supply by linking it with a USB power pack.
- For WIFI mode, use the lower USB port ONLY for power supply.



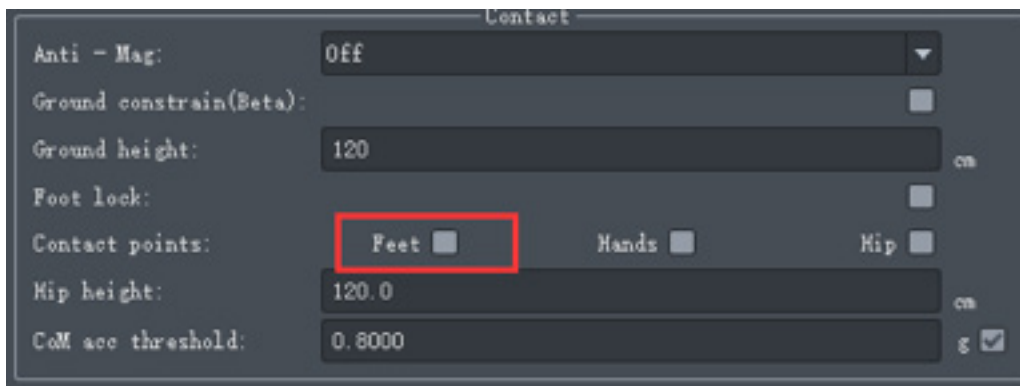
## 5. Capturing ascending motion.

**STEPS:**

- Measure the height of the stairs. When in real-time mode, set the Ground height to a specified value, then uncheck Ground constrain.



- When you playback this file, uncheck feet from Contact points.



6. When performing posture calibration, the S-pose or T-pose couldn't be selected.







**Solution:**

Only the Lower body or Full body mode require S-pose calibration. In that same regard, lower body mode does not require an A-pose calibration. If you need the motion of arms, please choose a corresponding mode.






7. Hardware LED indicator status.
  - Sensor LED status:

### NEURON LED STATUS

1Hz Flashing		Connection between the Neuron and the sensor socket is not good
Breathing		Standby mode
20Hz Flashing		Working mode
0.3 Hz Slow flashing		Firmware update mode
Other status		Neuron malfunctioned

- Hub LED status:

### HUB LED STATUS

5Hz Flashing		Connecting to WiFi or server PC
Breathing		Standby mode
20Hz Flashing		Working mode
Quick flash 3 times and off for 3s		Sleeping mode
0.3 Hz Slow flashing		Firmware update mode
Other status		Hub malfunctioned

## TIPS

- You can find this information in the last two pages of Help -> Quick Start Guide.

# AXIS NEURON

*Set Your World in Motion*



We are part of Noitom Ltd. and dedicated to the development of motion capture systems for entertainment, sports, science and medicine.

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