Nokov Motion Capture System

XINGYING3.2 Operation Process

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I. Introduction

1. System Introduction

- The Nokov Optical Three-Dimensional Motion Capture System covers the capture area in indoor space with motion capture cameras arranged in space. It precisely captures the three-dimensional spatial position of the reflective markers (Markers) placed on the capture target. Through advanced algorithm processing and computation, the system can obtain the three-dimensional spatial coordinates (X, Y, Z) of each reflective marker at different time measurement units. The target object can also be set as a rigid body. With further processing and computation through professional analysis software, precise location and posture data of the target object can be obtained. These data can be applied in fields such as virtual simulation, motion analysis, gait rehabilitation, simulation training, mechanical bionics, robots, drones, human-computer interaction, military industry, surgical plastic surgery, virtual reality, film animation, game production, etc.

2. System Composition

- Motion capture camera
- Camera fixing device
- Camera connection cable (including network cable and POE separator)
- Switch
- Calibration rod (L-type, T-type)
- Reflective markers
- Computer

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Partial System Components

POE Separator

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POE Switch

Reflective Markers

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II. System Connection

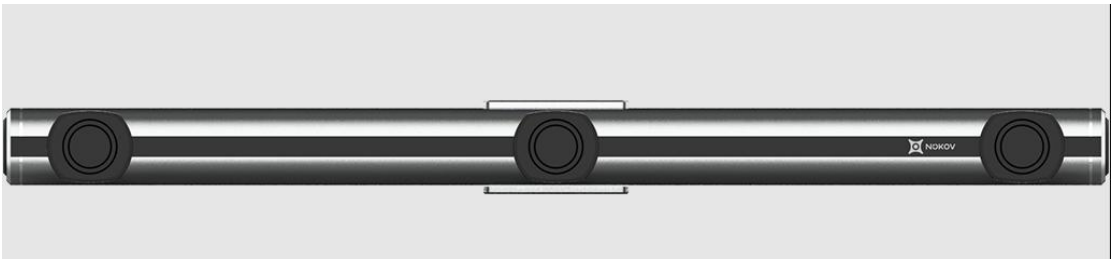
1. Camera Model

- Nokov Camera include the Mars series, which is oriented towards scientific applications and focuses on core motion capture capabilities; the Pluto series, which is suitable for entry-level, commercial, and consumer-level development integration; the Orbit series, which is plug-and-play, does not require calibration, and is suitable for desktop tracking; the underwater camera series that can be used both on land and underwater; and the VRT series, which is suitable for integration into virtual reality (VR). The products of each series are listed below:

Mars:

Pluto:

Orbit:



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Underwater Camera:

VRT:

2. Hardware Assembly

- Connect the three-way gimbal to the strong clamp or C-clamp, fix the quick release plate on the camera, and connect the camera to the three-way gimbal through the quick release plate. If you are using a truss, fix the strong clamp or C-clamp to the truss; if you are using a light stand or tripod, there is no need to

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connect the three-way gimbal to the strong clamp or C-clamp, you can directly fix the three-way gimbal to the light stand or tripod. The following picture shows the three-way gimbals (top two), strong clamp (bottom left), and C-clamp (bottom right) in sequence according to the number (2.2.1).

2.2.1

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3. Connection between Camera Placement and Switch

(1) Before installing the camera, please make sure that the three-way gimbal fixed on the truss is not loose.

(2) Connect the cameras to the three-way gimbal using the quick-release plate, then connect the three-way gimbal to the tripod or C-clamp (2.3.1). For easy debugging, the cameras can be arranged in the order of the IP addresses labeled on the back.

2.3.1

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(3) Plug the POE Separator into the RJ45 network port and DC power jack on the back of the camera; Connect each camera's POE Separator to the switch via network cable. There is no requirement for the order of the interfaces, but they cannot be connected to the LAN/NVR of the 8-port switch or the 25/26 interface of the 24-port switch.

(4) If it is an 8-port switch, use a network cable to connect the LAN port of the switch and the network port of the computer. If there are multiple 8-port switches, use a network cable to connect the LAN port of Switch A to the NVR port of Switch B, and then connect the LAN port of Switch B to the computer.If it is a 16-port switch, use a network cable to connect the 15th or 16th port of the switch to the computer. If there are multiple 16-port switches, use a network cable to connect the 15th port of Switch A to the 16th port of Switch B, and then connect the 15th port of Switch B to the computer.After powering on the switch, wait for about 20 seconds to confirm that each camera is powered on and lit up. The digital tube directly below the camera lights up and displays the last three digits of the IP address.

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4. Focusing and Aperture

- The camera's focal length and aperture have been set by technicians at the factory. If you need to refocus the camera or adjust the aperture during use, take the Mars 2H as an example (some camera models cannot adjust the focus and aperture. If the camera's focal length and brightness are abnormal during use, please contact our technical engineers in time). There are two rotating axes in the middle of the Mars 2H camera, the front one represents the focal length, and the back one represents the aperture. When adjusting the focus or aperture, rotate slowly while observing the image until the desired effect is achieved.

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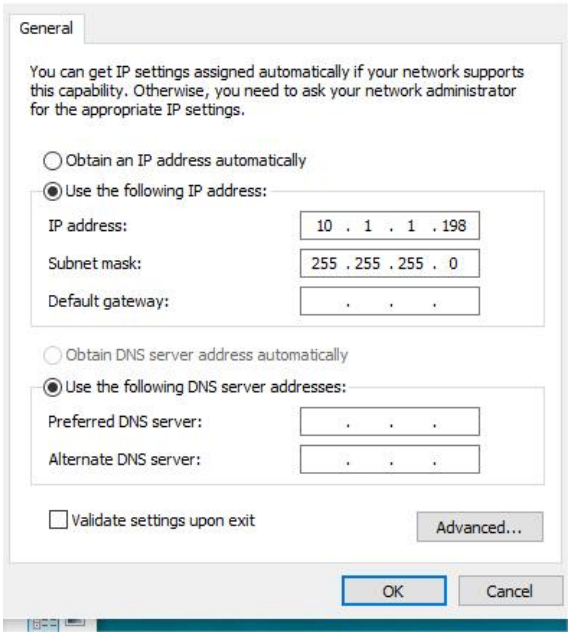
III. Software Installation and Launch

1. Network Settings

(1) Set up the local connection on your computer. Taking Windows 10 as an example, follow these steps: Click on "Control Panel" > "Network and Internet" > "Network and Sharing Center" > "Change Adapter Settings" > Right-click on "Ethernet" > "Properties" > Double-click on "Internet Protocol Version 4 (TCP/IPv4)" > "Use the following IP address". The IP address should be set to 10.1.1.198, and the subnet mask should be 255.255.255.0. There's no need to set anything else. Click OK (3.1.1).



3.1.1

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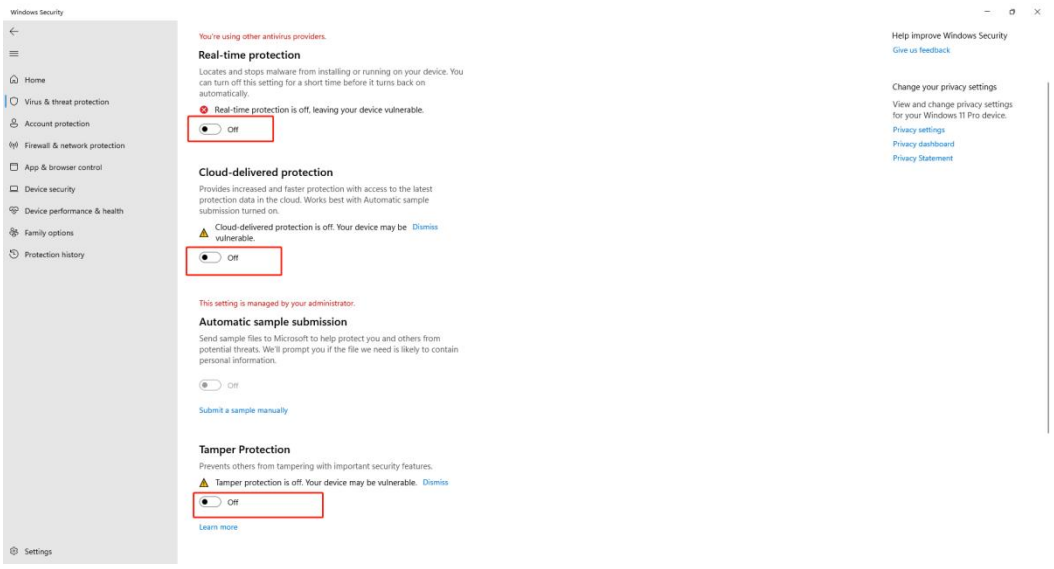
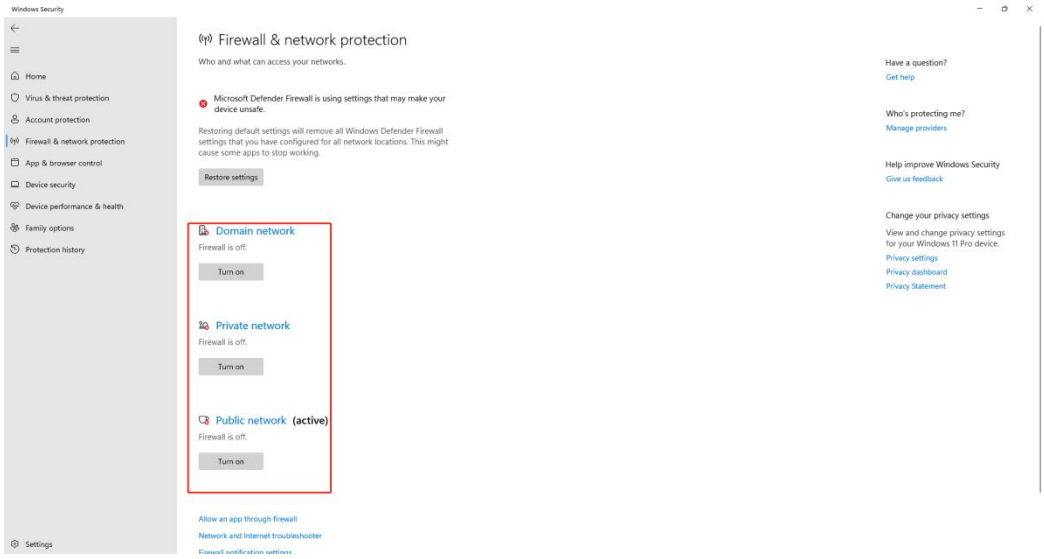
2. Firewall Settings

(1) In the "Firewall & Network Protection" settings on your computer, turn off the firewalls for all networks. Click on "Manage Settings" under "Virus & Threat Protection" and turn off all protection and defense settings (3.2.1, 3.2.2).



3.2.1



3.2.2

(2) Exit antivirus software on your computer (such as 360, Tencent PC Manager, McAfee, etc.).

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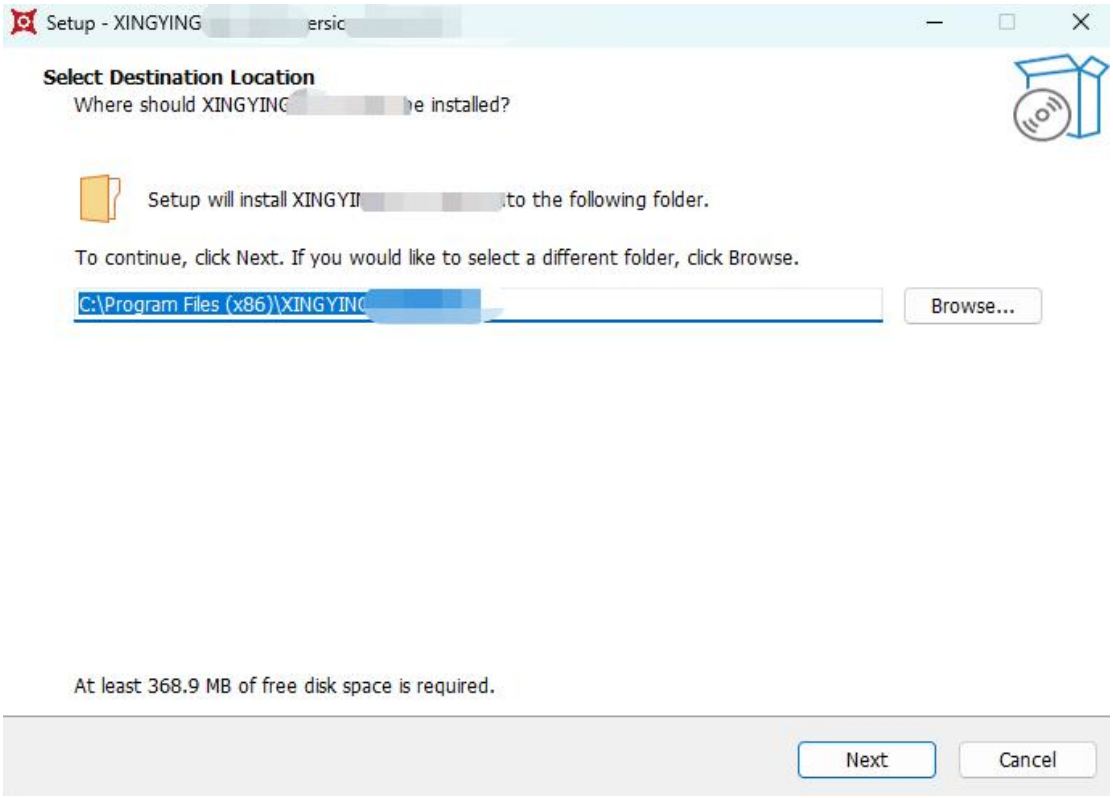
3. Software Installation

(1) Right-click and choose "Run as administrator" to run the "XINGYING 3.2.0.***exe" (3.3.1). An installation interface will pop up. You can choose the installation language according to your needs, then follow the prompts and click "Next" to proceed to the next step.

3.3.1

(2) Continue clicking "Next". Please note that you should not change the installation path (3.3.2).



3.3.2

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(3) After the installation is completed, the software icon will appear on the desktop (3.3.3).

3.3.3

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4. Software Launch

(1) Ensure the dongle is plugged into the operational computer.

(2) Right-click on the "XINGYING" icon on the desktop, select "Run as administrator" to open the software (3.4.1).

(3) For users who have already calibrated the system and saved the configuration file, you can directly switch the software's working path to the directory where the calibration file is stored. Click on "File - Load Calibration File", and select the .cal configuration file in the pop-up window to load. After successfully loading the calibration file, click on the first button from left to right at the bottom of the software to connect the camera. Wait for 1~2s, and a pop-up window will prompt you to confirm the number of cameras connected. Click on the second play button from left to right at the bottom of the interface to start the camera.

(4) After loading the calibration file, you can directly connect the camera for subsequent use of the software, as long as the working directory is not changed and the configuration file exists, the software will automatically load the configuration file.

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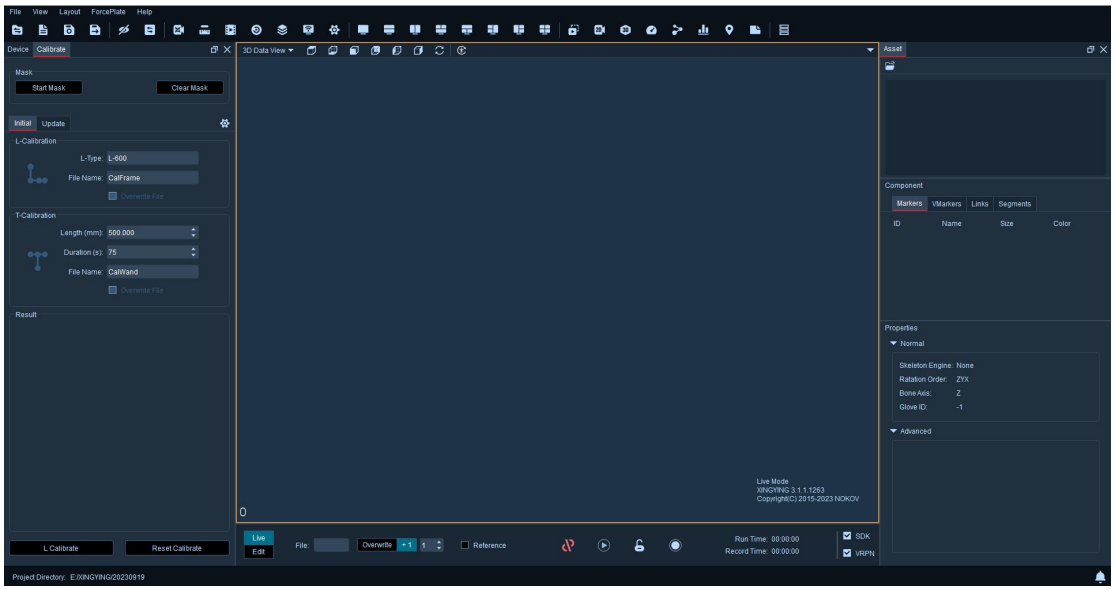

3.4.1

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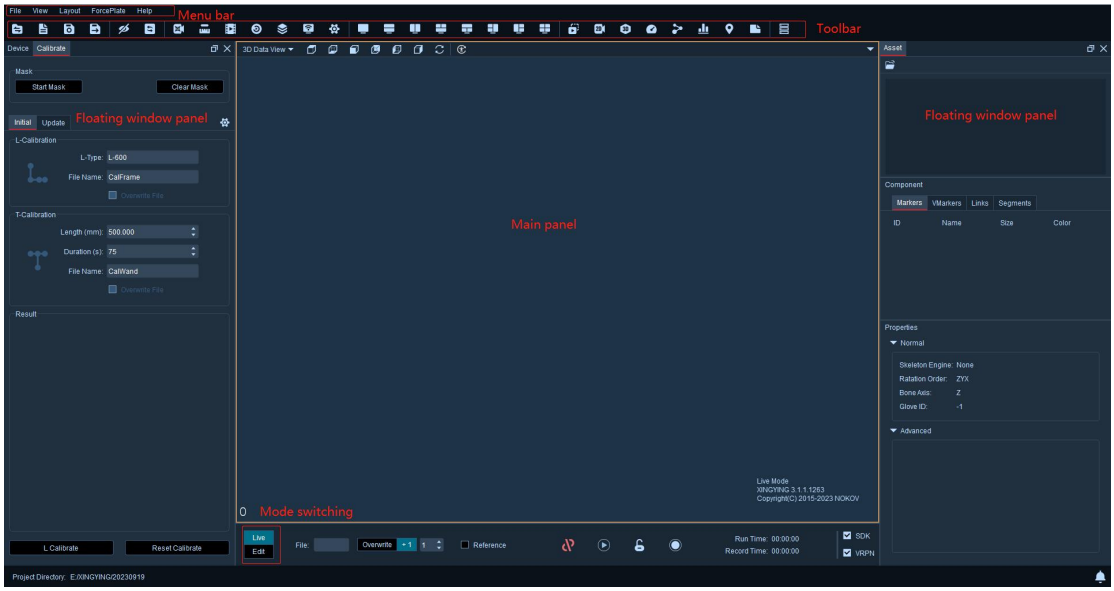
IV. Start XINGYING 3.X

(1) XINGYING 3.X software is divided into Live mode and Edit mode. The top part of both modes includes a menu bar and a toolbar. The main panel is located in the middle of the software. By default, a floating panel is displayed on the left side of the software, and the function buttons for Live mode and Edit mode are located at the bottom of the software. The following is a brief introduction to the interface of the XINGYING3.X software and the functions of each module (4.1.1).



4.1.1

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1. File Menu Bar

(1) In the "File" menu bar, you can choose the software working directory, load, save, and save calibration files. In Edit mode, click the "Load Capture File" button to choose to load the .cap motion capture data. In Live/Edit mode, click the "Load Markerset" button, and you can select the model file you want to add in the window. Click the "Import Model Asset" button to characterize the human binding model. Click the "Exit" button to exit the software.

2. View Menu Bar

(1) In the "View" menu bar, after clicking the "Hide All Panes" button, all floating panels on the software will be hidden. Clicking the "Reset Panes" will reset the currently displayed floating panels on the software and display the default floating panels. Clicking the "Devices Pane", "Calibration Pane", "Asset Pane", "Data Castting Pane", "Settings Pane" buttons will display the corresponding floating panels.

3. Layout Menu Bar

(1) Expand the "Layout" menu bar to set different split-screen layouts for the main panel in the middle of the software.

4. Force Plate Menu Bar

(1) Expand the "Force Plate" menu bar, click on the "ForcePlate configuration" button, and configure the parameters for the connected force plate in the pop-up settings window.

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(2) Click the "Analog Configuration" button and add the analog channel corresponding to the force plate model in the Analog Configuration window.

5. Help Menu Bar

(1) Click the "Help" button to get the current software version number, our contact information, and official website. Click on the official website address to quickly jump to the official website in the browser.

(2) Clicking on the "Operating Manual" will provide you with the manual for the current version.

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6. Toolbar

(1) The shortcut buttons in the toolbar are divided into six tool areas, each separated by vertical lines. The first tool area allows you to switch directories, open, save, and save calibration files as a different name.The second tool area is for hiding all and resetting floating panels.The third tool area opens the floating panels for devices, calibration, video calibration, quick playback, assets, and data broadcasting.The fourth tool area can set different split-screen layouts for the main panel.The fifth tool area can display the main panel in different view types.After successfully connecting the force plate in the software or playing the force plate data in Edit mode, click the force plate data button in the sixth tool area, and the window will display the FX, FY, FZ, etc., data of the force plate. Switching to Edit will add the display: quick id, track recognition, cut, cubic join, linear join, calculate, make unnamed, delete unnamed, smooth, cut outside, template identify, template track, exercise, rectify, undo, and other functions.Please refer to the following table for details:

ICON	Corresponding Function	ICON	Corresponding Function	ICON	Corresponding Function
	Select Directory		Two Views:Left/Right		Quick ID
	Open Capture File		Three:Split Top		Rectify
	Save Capture File		Three:Split Bottom		Track Recognise
	Save as Capture File		Three:Split Left		Cut

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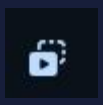
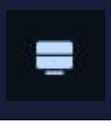
	Hide All Panes		Three:Split Right		Cubic join
	Reset Panes		Four Views		Linear join
	Assets Pane		Referencr Viedo		Calculate
	Calibration Pane		2D Camera View		Mark Unnamed
	ViedoCalibration Pane		3D Data View		Delete Unnamed
	FastPlay Pane		Analog Graphs		Smooth
	Assets Pane		Skeleton Graphs		Cut Outside
	Data Castting Pane		Analysis Graphs		Tempalte Identify
	Setting Pane		Vmarker View		Tempalte Track
	One View		Empty View		Exercise
	Two Views:Top/Bottom		Force Plate Data		Un Do

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7. Main Panel

(1) Click the inverted triangle button in the upper left corner of the main panel to expand it. You can choose to display the main panel in different view types. You can choose different observation angles for the 3D view on the top of the main panel. Clicking the last button will reset the observation angle of the 3D view. Right-click in the 3D view to set the display in the 3D view.;

8. Window Merging, Custom Drag and Drop

(1) Drag the floating panel to a specified window. A cross shape will appear on the window. Choose any direction (up, down, left, or right) on the cross shape, release the mouse, and the floating panel will be in the position of the chosen cross shape.

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V. Calibration

1. Calibration Settings

(1) Before calibration, you need to determine the axis direction of calibration. The set calibration axis determines the upward axis (Z or Y) in the Global Coordinate System after calibration. Set the type of L-bar for calibration according to the length of the L-bar you are using (if you are unsure about the type of L-bar, you can consult our technical engineers).

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(2) Click on "Calibration Pane" in the toolbar at the top of the window. In the calibration window, click the gear icon. Under the "Frame" option, confirm the needed coordinate system definition. You can choose whether the coordinate system is Z-axis up or Y-axis up through the "Up Axis" (5.1.2). In the "L-Frame Type" option, select the corresponding L-Type. The L-Type is related to the purchased L-Type rod. The size type of the L-Type rod can be determined by measuring the distance between the two Marker points at the farthest end of the long side of the L-Type rod. For example, if you measure the distance between the two Marker points at the farthest end of the long side of the L-Type rod to be 600mm or nearly, then the type of L-Frame you are using is "L-600". The meaning of the last letter in the L-rod type: S represents soft L-rod, R represents rigid L-rod (the default is rigid), and FP represents applications related to force platforms.You can also customize the L-bar type. Select "Manual" from the dropdown box. Customization requires you to manually enter the X, Y, and Z coordinates of each marker ball in the "Coordinates" table below.

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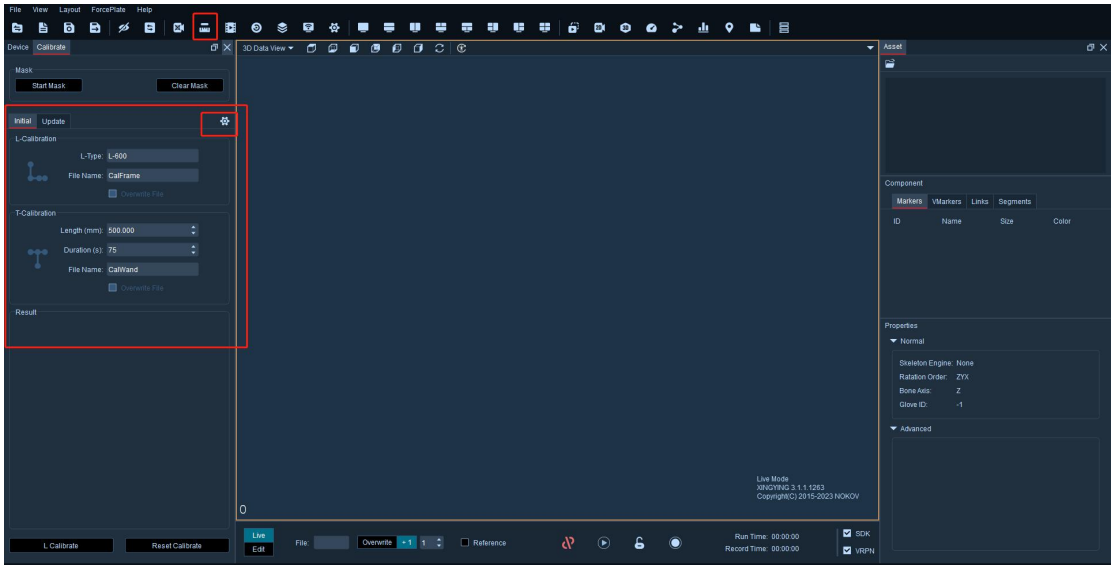
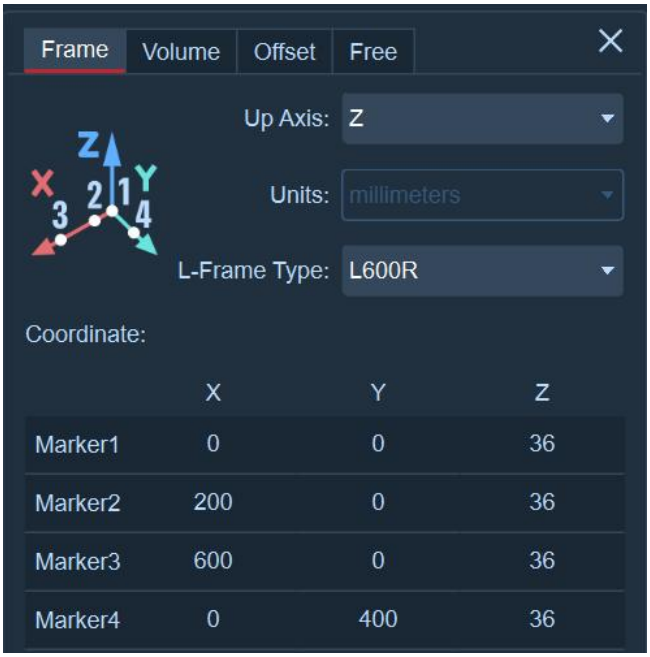


5.1.1



5.1.2

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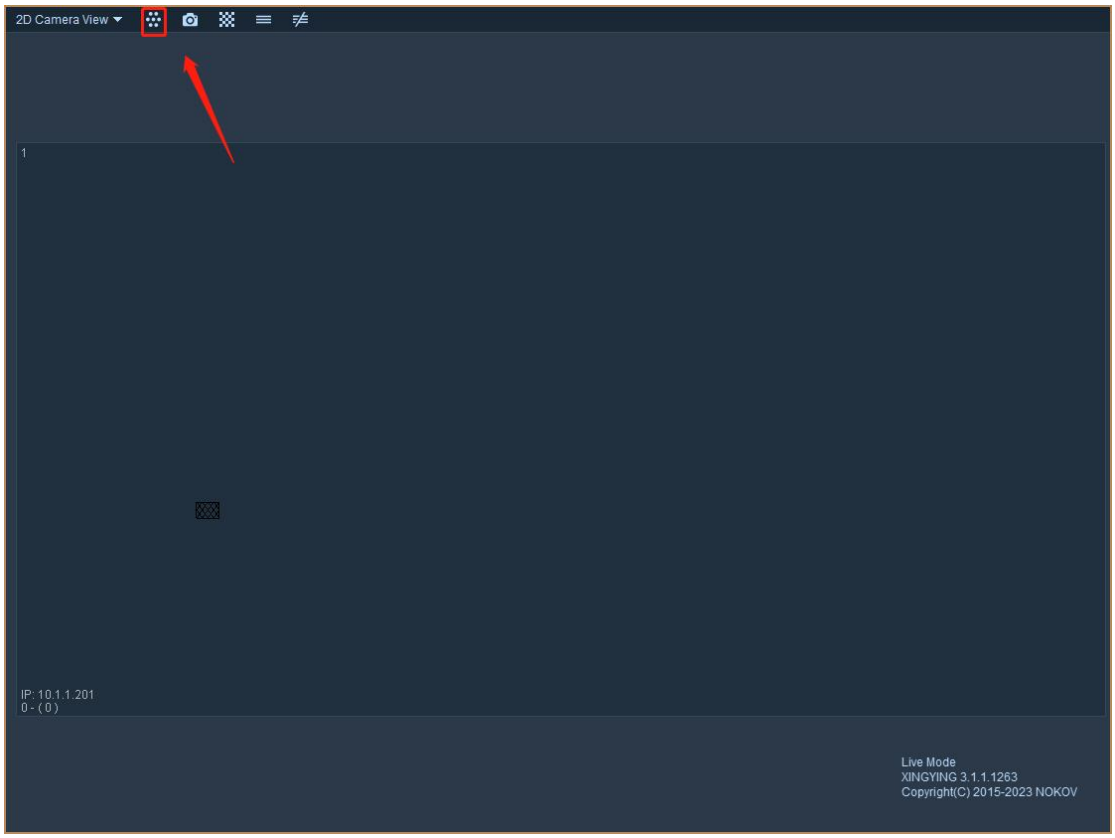
2. Calibration Steps

(1) Click the drop-down list above the main view. Select "2D Camera View" from the drop-down list to switch the main view to 2D view. You can display the imaging situation of each camera by clicking "show all camera" on the top of the interface, and you can see the reflections and noise points of each camera in Live (5.2.1).



5.2.1

(2) In the 2D view, right-click and select "Show Grayscale" to open the grayscale image. You can also use the shortcut button in the toolbar above the view to open the grayscale image of a camera.

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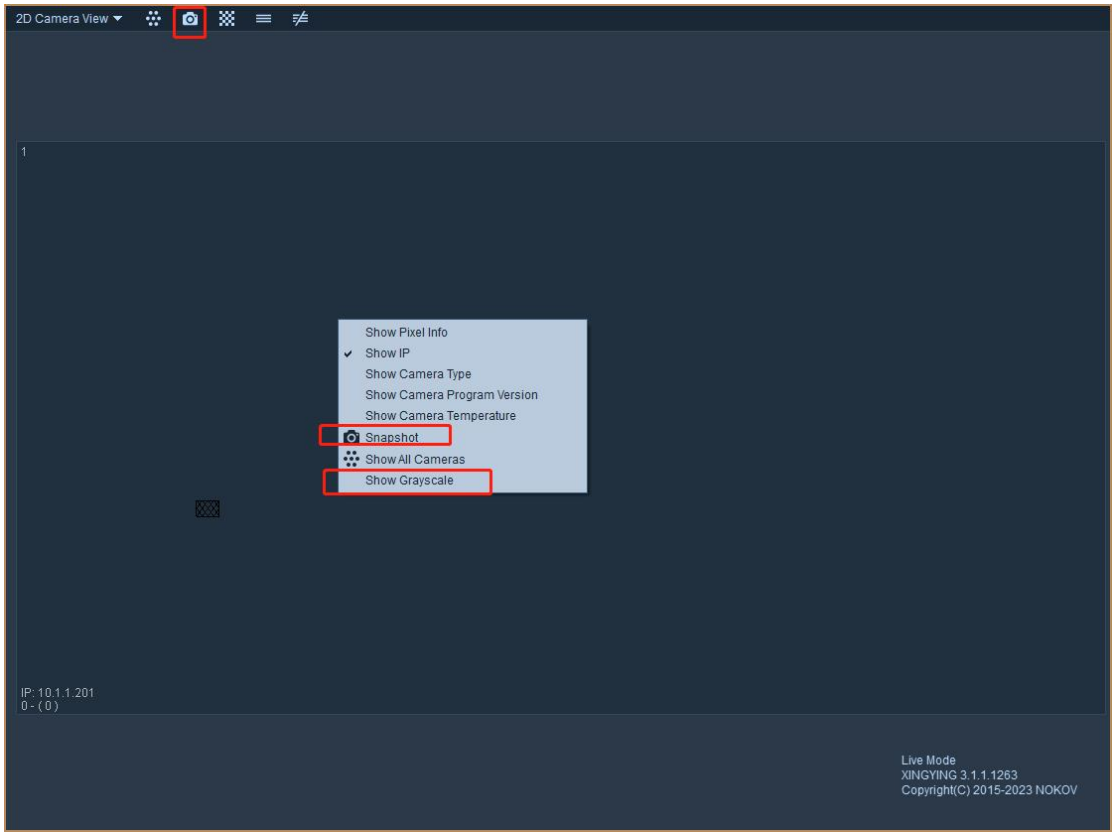
(3) If you need to capture the grayscale image of a single camera, switch to single camera display and click the camera button to capture the grayscale image. After capturing, the software will display a popup window with the save path (5.2.2).



5.2.2

(4) In the 2D view, right-click to select and display the IP of each camera.

(5) Prepare the L-shaped calibration rod (5.2.3) and T-shaped calibration rod (5.2.4), and first place the L-shaped calibration rod in the center of the motion capture field.

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5.2.3

5.2.4

(6) Adjust the position of each camera by adjusting the three-way gimbal. Usually, the four marker points on the L-shaped calibration rod are positioned slightly below the center of the camera (to ensure that each camera has a large enough observation range in both horizontal and vertical directions) (5.2.5). You can also place some reflective markers at the edges of the required capture area according to the actual activity range of the specific object being captured, which can more intuitively reflect the area seen by the camera (the range that each camera can actually capture can be seen from the captured multiple edge points, so the camera can be adjusted more accurately to make the entire system capture a larger and more stable range).

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5.2.5

(7) Refer to "8. Calibration Classification" in this manual to select different types of calibrations. Generally, basic calibration is sufficient.

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VI. View Introduction

1. Device

■ **Motion Capture Camera**

(1) Connect the camera, and click on the device at the top of the software to view the properties of each camera (6.1.1).

(2) Serial Number: After connecting the camera, the number of cameras in the field will be sorted under the motion capture camera. Clicking on a particular serial number will also display information of only this camera in the 2D view.

(3) IP: Display the IP of the camera used in the field, corresponding to the digital tube below the camera.

(4) Type: Displays the model of the camera corresponding to this view.

(5) Threshold: Under multiple cameras, the threshold of each camera will be displayed, and the threshold of individual cameras can also be modified.

(6) Brightness: The camera's brightness can be adjusted by changing the numerical values, and the brightness of individual cameras can also be modified.

(7) Status: Shows whether the camera is online. There are three states: online, frame drop, and offline.

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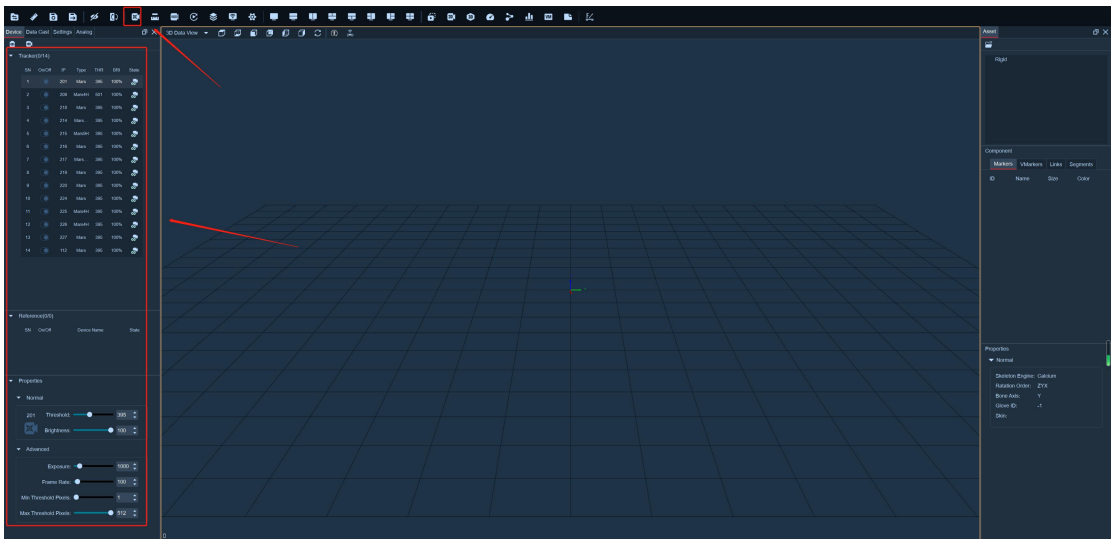

6.1.1

■ Reference

(1) Upon plugging a USB camera into the computer running the motion capture software, once connected in XINGYING software, the device name, resolution, frame rate, and status of the USB camera will be displayed in the reference video list in the device panel. The software can connect up to four USB cameras.

(2) Select 'Reference Video' on the main panel of the software to display the reference video screen. If multiple USB cameras are connected, all reference videos from the USB cameras will be displayed. Double-click the reference video view that you want to examine to enter the single view mode, and double-click again to exit the single view mode of the reference video.

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6.1.2

■ **Properties**

(1) Normal: Adjusting the threshold can clear unnecessary noise points in the field. After adjusting the threshold when a single camera view is opened by double-clicking a camera's 2D view, the threshold of that camera is set to the adjusted threshold, while the thresholds of other cameras remain unchanged. During the process of connecting the camera and adjusting the threshold, changes in the 2D view (increase or decrease of noise points, blanking) can be observed. The same principle applies to brightness.

(2) Advanced: When the camera is connected, adjusting the exposure will result in observable changes in the 2D view. For instance, using a larger value like 1/60 will result in more black shadows. The actual frame rate of the recorded file is the same as the set frame rate.

(3) Maximum/Minimum Treshold Pixels: Setting the 'Maximum/Minimum Point Diameter' can filter the diameter range of 'markers' in the 2D view.

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2. Assets

■ List

(1) When the software is opened for the first time, assets will be displayed on the right side of the software interface. The asset list will automatically load the mars files that were loaded last time. The list will automatically classify and display the mars files of rigid bodies and human bodies. If no mars files have been loaded, the list will be empty.

(2) Click on 'Load Assets' at the bottom to load .mars files. After loading the project directory, click on 'Load Assets', and in the pop-up window, clicking on the name can select all .mars files to be loaded at once; you can also check the box in front of the name to load .mars files. After checking, you can see the name of the loaded files in the list (6.2.1). To load .mars files in the assets, the software needs to be paused first.

(3) Click on the name of the mars file you need to view in the asset list, and the model belonging to that mars file will be highlighted in the 3D view.

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■ **Components**

(1) In the Components section, you can view the information of the mars file selected in the Asset List.

(2) Markers: Displays the sequence number, name, size, and color of the constituent points of the template.

(3) VMarkers: Displays virtual maker points, applicable only to human figures.

(4) Lines: Displays the line number, name, and color between each maker.

(5) Segments: Displays the skeletal information of rigid bodies or human figures.

■ **Properties - Normal**

(1) After selecting a mars file in the asset list, the skeleton type, Euler angle order (default ZYX), and skeleton direction of the mars file will be displayed in the Properties - Normal list. If the selected template is a human body with gloves, then the glove's number will also be displayed in this list.

■ **Properties - Advanced**

(1) When you select a skeleton name in 'Component - Segments', the 'Properties - Advanced' list below will display the various properties of this section of the skeleton.

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3. Data Castting

■ **SDK Broadcasting Data (6.3.1)**

(1) Click on 'Data Castting' at the top of the software interface. The default network card address for XINGYING software is '10.1.1.198'. The IP address can also be changed in the drop-down box.

(2) XINGYING software supports SDK secondary development, allowing data broadcasting for usage on the same machine or other computers within the same IP segment. The IP address can be changed in Live through the drop-down box in 'Network Card Address'. The set network card address is the address from which the server sends data. To receive data from motion capture, the client computer needs to remain in the same network segment as the server.

(3) The software supports dynamic IP acquisition, eliminating the need to restart the software. It can work in tandem with C++/C# and other plugins to acquire motion capture data in real time. Please consult our technical engineers to get the plugin version.

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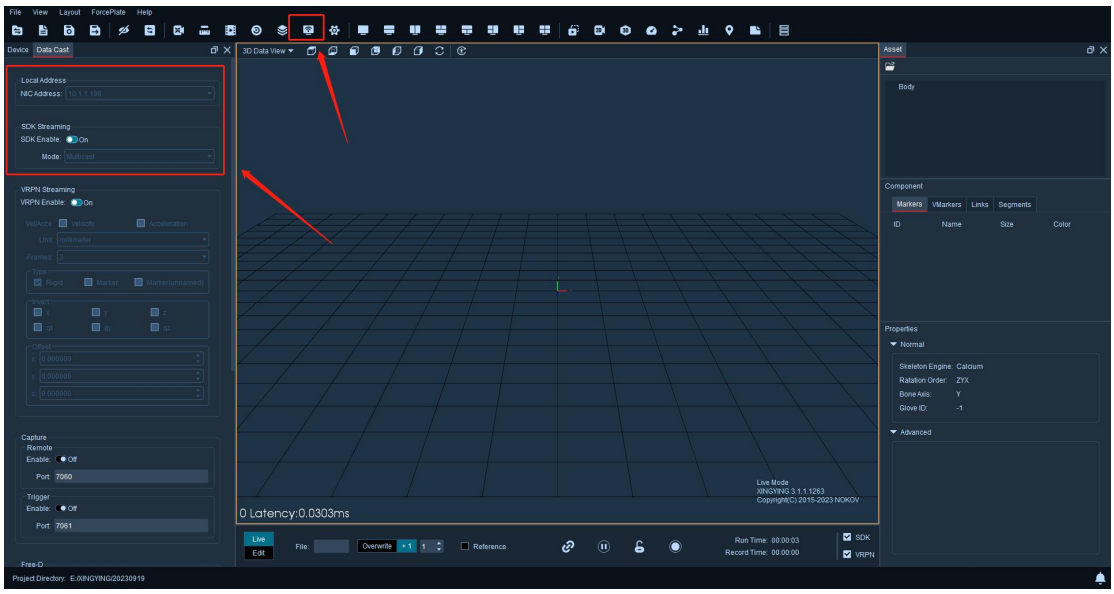
(4) SDK Streaming: The 'SDK Enable' option is not selected by default. This feature can be selected when the camera is not connected or pause.After selecting SDK, the software will save this configuration, and the SDK will be selected by default when the software is subsequently started. After enabling SDK, motion capture data will be broadcasted externally through the set network card IP address using the SDK protocol. The 'Mode' underneath is set to 'Multicast' by default in the software and cannot be changed.



6.3.1

(5) After selecting the SDK option, the lower left corner of the 3D view in Live mode can display the delay time and unit in real time (6.3.2). If the SDK function is turned off, the delay time information will not be displayed. The SDK delay time will not be displayed in real time in the Edit mode.

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6.3.2

■ **VRPN Streaming (6.3.3)**

(1) Please pause the software or enable VRPN in 'Data Castting' when the camera is not connected before turning on VRPN. After enabling VRPN, motion capture data will be broadcasted externally through the set network card IP address using the VRPN protocol.

(2) VRPN can be divided into three types: 'Rigid', 'Marker', and 'Marker(Unnamed)'. Both Live mode and Edit mode can use VRPN to transmit data. Before using VRPN, you can use our 'NokovVrpnClient.exe' test tool to verify whether VRPN data can be obtained. You can also use open source code or tools to obtain the VRPN data in our motion capture. Below is a brief introduction on how to use the NokovVrpnClient test tool to obtain different types of data (please consult the technical engineer if you need this test tool).

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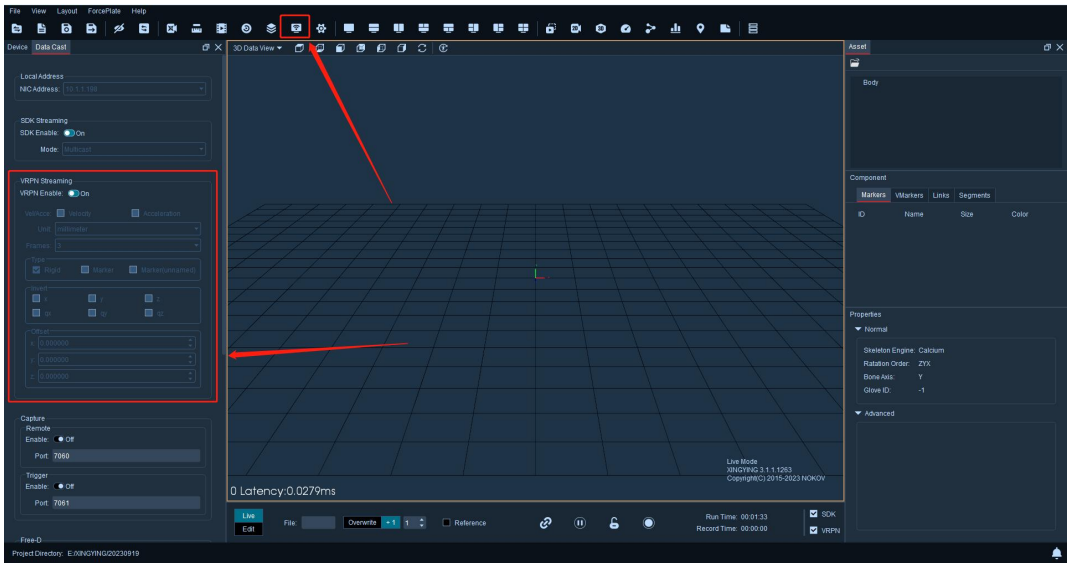
(3) Checking the 'Rigid' type indicates sending information data about the rigid body. The naming method in the test tool is 'Rigid Body Name @10.1.1.198'. Check 'Rigid' and 'VRPN Enable ', and after checking, click play to put the camera into play mode. Use the cmd command to enter the path where the NokovVrpnClient.exe file is located in the terminal, input the command '.\NokovVrpnClient.exe Tracker0@10.1.1.198' and press enter (6.3.4), you can obtain the rigid body data in motion capture, where 'Tracker0' corresponds to the name of the rigid body in the motion capture software.



6.3.3

6.3.4

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(4) The naming method for the human body is 'MarkerSet Name_Skeleton Name'. For example, to get the information of the human head skeleton, input the command '.\NokovVrpnClient.exe Body0_SHead@10.1.1.198' and press enter, you can then obtain the head skeleton data of the human body named Body0. 'SHead' represents the name of the human head skeleton. If you want to get information on other human skeletons, you only need to replace 'SHead' with the corresponding skeleton name.

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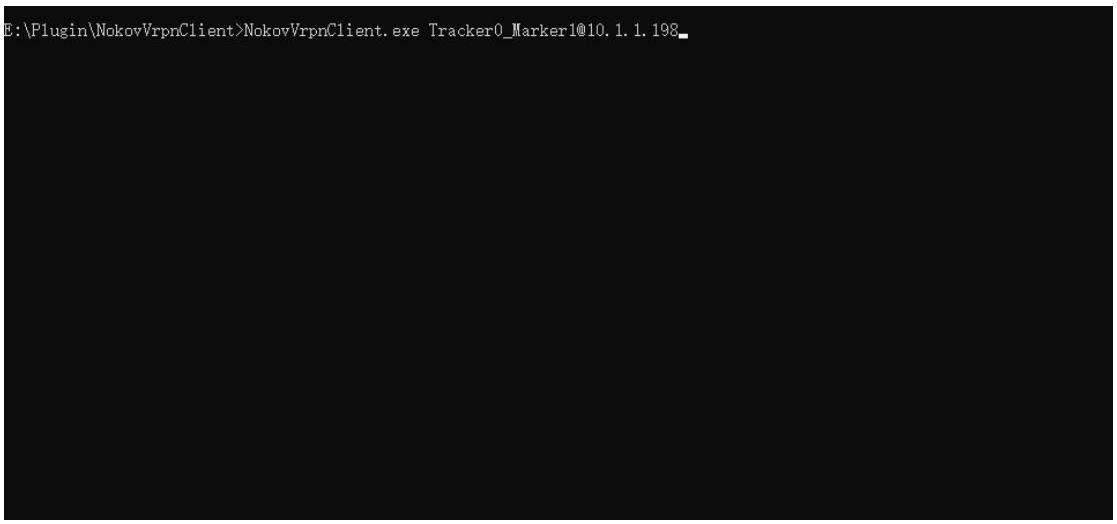
(5) 'Marker' type indicates sending information data about named Marker points. The naming method in the test tool is 'Rigid Body Name_Marker Name @10.1.1.198'. After checking 'Marker' and 'VRPN', click play to put the camera into play mode. Use the cmd command to enter the path where the NokovVrpnClient.exe file is located in the terminal. For example, to get the data of the point 'Marker1' belonging to the rigid body 'Tracker0', you can run the command '.\NokovVrpnClient.exe Tracker0_Marker1@10.1.1.198' and press enter (6.3.5), then you can get the information data of the point 'Marker1', where 'Tracker0' corresponds to the name of the rigid body in the software, and 'Marker1' represents the name of the point belonging to the rigid body 'Tracker0'. The specific names of the points of the rigid body can be seen in the Assets - Component - Markers list.



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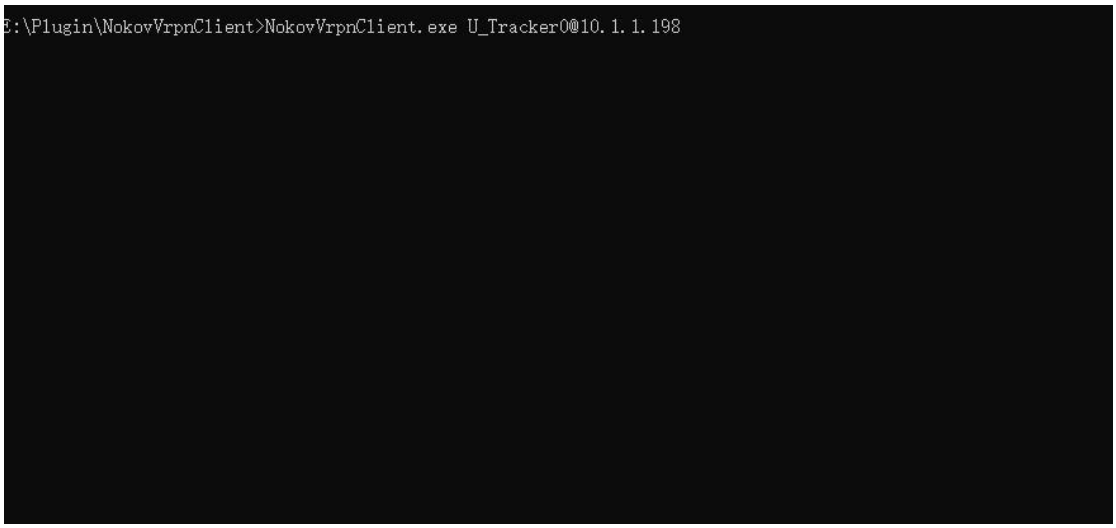
(6) 'Marker(Unnamed)' refers to sending information data about unnamed Marker points. The naming method is 'U_Tracker+Unnamed Marker Index (starting from 0) @10.1.1.198'. Check 'Marker(Unnamed) and 'VRPN Enable', and after checking, click play to put the camera into play mode. Use the cmd command to enter the path where the NokovVrpnClient.exe file is located in the terminal, input the command '.\NokovVrpnClient.exe U_Tracker0@10.1.1.198' and press enter (6.3.6), you can then obtain the information data of the unnamed Marker points. Here, 'U_Tarcker0' represents the first unnamed point. If you want to get the information data of the second unnamed point, change 'U_Tarcker0' to 'U_Tracker1', which represents the second unnamed point.



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(7) The 'Unit' option box represents different units. In the option box, you can change the unit of data, including 'millimeter', 'centimeter', and 'meter'. After changing the unit, the data in VRPN will also increase or decrease with the change of the unit.

(8) In 'Invert', checking x, y, z coordinates means to reverse the sign of the variables checked in 'Type'. 'qx, qy, qz' represent the rotation data of the rigid body. After checking 'Rigid Body' and running '.\NokovVrpnClient.exe Tracker0@10.1.1.198', 'quat' can display the rotation data of the rigid body 'Tracker0'. After checking 'qx, qy, qz', the coordinate values of 'quat' will be inverted. The 'quat' value only displays the rotation of the rigid body and does not display the rotation information of variables 'Marker' and 'Marker(Unnamed)' .

(9) In 'Offset', you can set the 'x, y, z' coordinate offsets for the variable data. After adjusting the offset values, VRPN will add these modified values to the original coordinate values.

(10) 'Velocity' and 'Acceleration', when checked, will output corresponding data in VRPN. 'Frames' is used for speed calculation; adjusting the frame factor can make the actual speed value close to the output speed value.

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VII. Settings

1. Recording Setting

(1) Click on the settings button on the toolbar above the software and select "Record Setting" (7.1.1);

(2) **Duration:** The default setting for recording duration is 60s. If the "Limit Time" check box is selected, it indicates that the set recording duration is enabled. When recording dynamic capture data, when the recording duration displayed below the software reaches the set recording duration, the software will automatically stop recording;

(3) **Split record**: When it is necessary to record data for a long time, we recommend that users use the split record function. Split record can package the data that needs to be continuously recorded according to the preset duration. This can avoid recording big data that cannot be loaded properly due to computer performance issues during Edit..

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(4) Check the "Split record" function to automatically record data, and manually enter the duration of the split. The default is ten minutes; The time unit for split is minutes. After the split recording reaches the set duration, it will automatically shard for the next file recording. The recording file name will increase from 1, and the split recording file will be saved in the current working path until the stop recording button is manually clicked, and the recording will not end. Alternatively, it can be used in conjunction with "Limit Time" for more convenience.

(5) **Name Index**: The function of adding serial numbers to the recorded file name can be set, and the name serial number function is checked by default; If you do not need to increase the number when recording a file, you can open XINGYING Settings>Recording Setting>Name Index. Uncheck the name number function. After unchecking this function, users can enter the name of the recording file themselves. After recording, the file will no longer have a name number increase, and the number increase function displayed on the software interface will also disappear;

(6) Please note that after canceling the name and serial number, it is not allowed to check the split record. After checking the split record, the name and serial number cannot be cancelled

(7) **Video Type**: XINGYING supports two formats for recording reference videos: "AVI" and "MP4". It is necessary to connect a USB camera to the computer and check "Reference Video" during recording;

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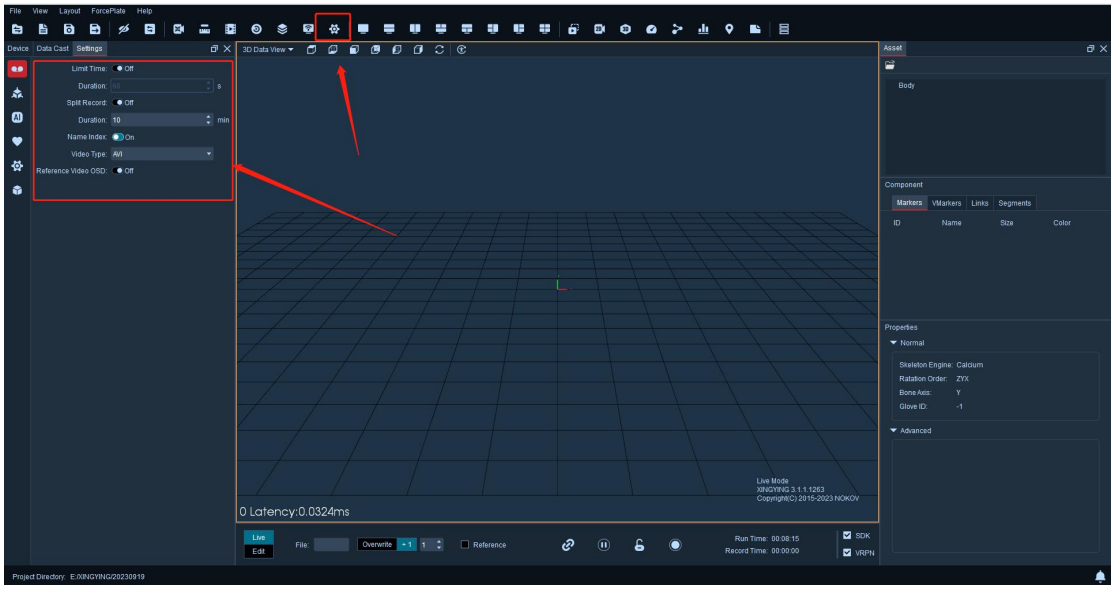
(8) **Reference Video OSD**: when selected, the resolution and frame rate of the USB camera will be displayed in the reference video view.



7.1.1

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2. View Setting

(1) Click on the settings button on the toolbar above the software and select "View Setting" (7.2.1);

■ **Camera View**

(1) **Show pixel Info:** When enabled, hovering the mouse over a 2D view will display pixel size;

(2) **Show Camera IP:** When enabled, the IP of the camera will be displayed in the lower left corner of each view in 2D view, and the IP displayed in the 2D view is consistent with the LED of the camera installed on the actual site;

(3) **Show Camera Type:** When enabled, In 2D view, the camera model will be displayed;

(4) **Show Camera Version:** When enabled, In 2D view, the camera firmware version will be displayed;

(5) **Show Camera Temperature:** When enabled, the camera's temperature will be displayed in the lower left corner of the 2D view. Note: Pluto and Mars1.3HW do not display temperature;

(6) **Show Calibrate Traject:** This feature is not checked by default in the software. When enabled, during T-shaped calibration, the 2D view will display the calibrated trajectory. If the swing is repeated in an area, the trajectory will be stacked repeatedly (7.2.2). When the set swing duration ends, the calibration trajectory on the stacked 2D views will also disappear;

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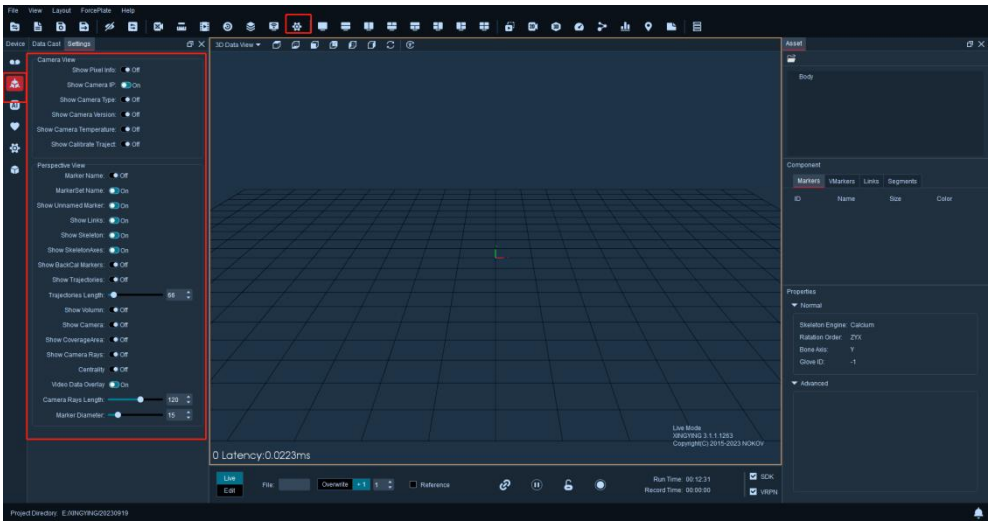
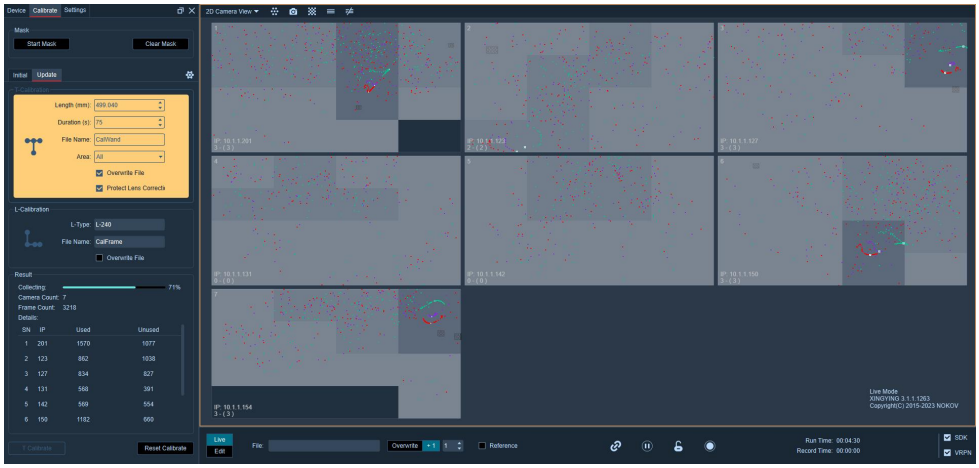


7.2.1



7.2.2

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■ **3D Perspective View**

(1) **Marker Name**: when enabled, selecting a named point in the 3D view will display the name of the Marker;

(2) **MarkerSet Name**: when enabled,, all Markersets in the 3D view will display their names;

(3) **Show Unamed marker**: After enabled, unnamed points will be displayed in the 3D view. (No special requirements, please do not change the default settings in the 3D view display settings window);

(4) **Show Links**: After enabled, the connected links of the MarkerSet in the 3D view will be displayed;

(5) **Show Skeleton**: After enabled, the skeleton of MarkerSet is displayed in the 3D view;

(6) **Show SkeletonAxes**: After opening, the coordinate axis of the skeleton will be displayed in the 3D view;

(7) **Show BackCal Markers**: After opening, reverse calculation points will be displayed in the 3D view;

(8) **Tracking Quality:** When enabled, displays the tracking quality of the rigid body in the 3D view.

(9) **Show Camera**: After opening, a suspended camera will be displayed above the 3D view, and the camera position will be consistent with the actual camera placement;

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(10) **Show Trajectories**: After opening, select the Marker point in the 3D view that needs to display the trajectory, move the selected Marker, and you can see the motion trajectory of the Marker point. Both Live mode and Edit mode can use the trajectory function. Drag the module on the progress bar below to increase/decrease the length of the trajectory displayed in the 3D view;

(11) **Show CoverageArea**: After opening, the "coverage area" of the camera will be displayed in Live in the 3D view. After processing, if "coverage area" is checked, the 3D view will not display the camera's coverage area;

(12) **Show Camera Rays**, Turn on "Show Camera Rays" in a non frozen frame and software playback state, select a named point in the 3D view, and a ray will be displayed between the point and the camera participating in the reconstruction of this Marker; Change the length value of the camera's field of view angle ray to change the length of the camera's field of view angle ray suspended above the 3D view;

(13) **Centrality:** After creating a full body model of Helen Hayes in Live mode, turn on the centroid, and the centroid of the Helen Hayes model will display in the 3D view;

(14) **Camera Rays Length:** The default length is 120mm, and the ray of the camera model above the 3D view will also change after modifying the length.

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(15) **Marker Diameter:** The default Marker diameter is 15mm (there are no special requirements, we suggest that users do not change the value here. Please consult our technical engineer before making changes). If the user is using a Marker ball of 8mm or other specifications, and the reconstructed Marker points in the 3D view are shaking or unstable in recognition, the Marker diameter value can be modified to 8 or set according to the size of the Marker ball used; The larger the Marker diameter value set, the larger the diameter of the Marker point in the 3D view, and vice versa;

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3. AI Settings

(1) Click on the Settings button on the toolbar above and select "AI Settings" (7.3.1);

(2) **Speech Recognition:** Select the "Speech recognition" checkbox, and the software can recognize language commands issued by the user, such as "Connect the camera, start play, disconnect the camera". After successful recognition, the software will automatically execute the corresponding commands;

(3) **Voice prompt:** Check the 'Voice prompt' and the software will provide voice prompts when users operate on the software;

(4) **Auto execute:** Check the automatic execution. After the software restarts, it will automatically execute the operation of "connect", "load markerset" and "play" commands;

(5) **Minimize to tray:** Check the "Minimize to Tray" function, and the software will automatically minimize to the system tray in the lower left corner of the desktop after startup. Only after checked the "Auto Execute" function "Minimize to Tray" function can take effect;

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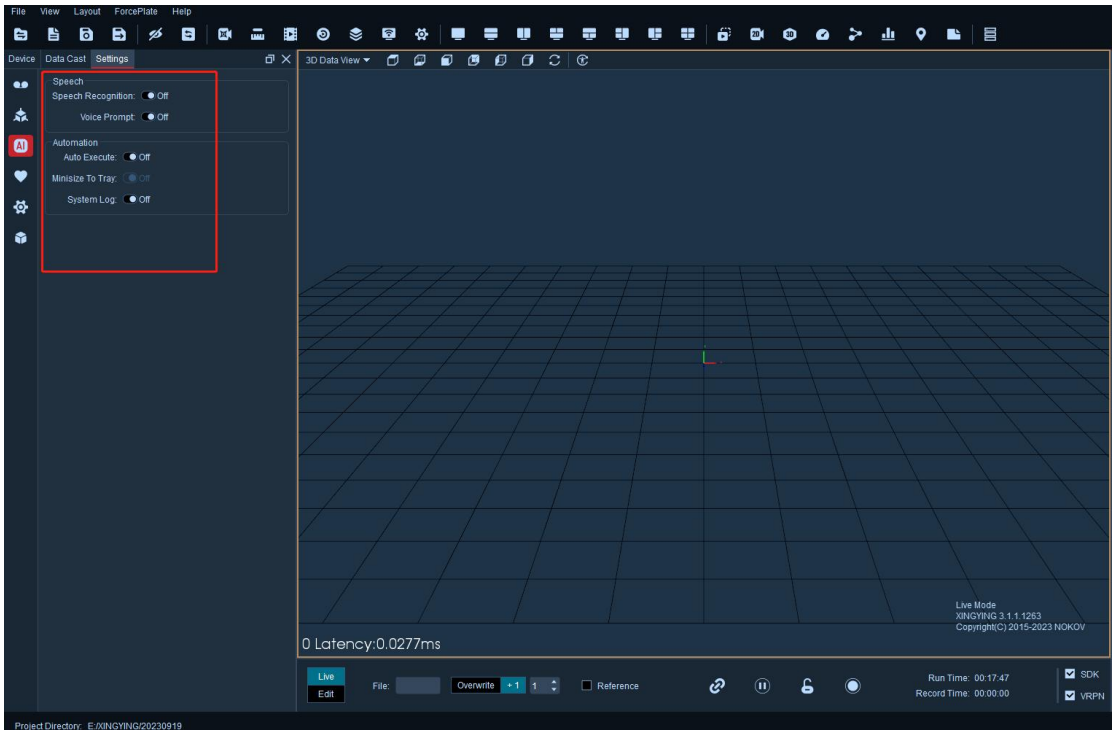

7.3.1

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4. Preference setting

(1) Click on the settings button on the toolbar above the software and select 'Preference setting' (7.4.1);

(2) **language:** In the drop-down box, you can choose the software language. XINGYING currently supports switching between four languages: "Chinese, English, Japanese, and Thai";

(3) **Theme:** Different theme styles can be switched, and the color of the software interface will change after switching;

(4) **Shortcut keys:** In Live mode or Edit mode, you can click the "Shortcut Keys" button in the preference settings to set function shortcut keys. In the shortcut key window, you can select any key position to set function shortcut keys such as "Record, Play, Cut, Play/Pause, View Type, Curve/Line Connection", and select one of "Ctrl, Alt, Shift" as the control key. After setting, Use shortcut keys (combination keys: control keys+edited keys) in the 3D interface to quickly use functions.

(5) After the installation of the software, the default shortcut keys in the system are: "Ctrl+<" → Edit data playback backwards, "Ctrl+>" → Edit data playback forwards, "Ctrl+Spacebar" → Play/Pause.

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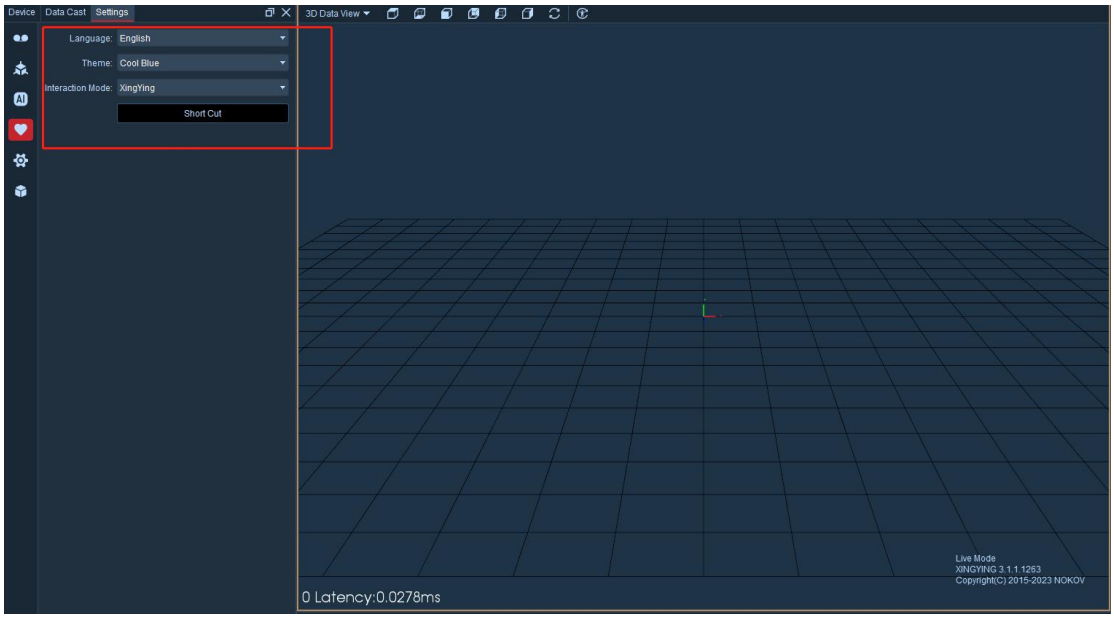
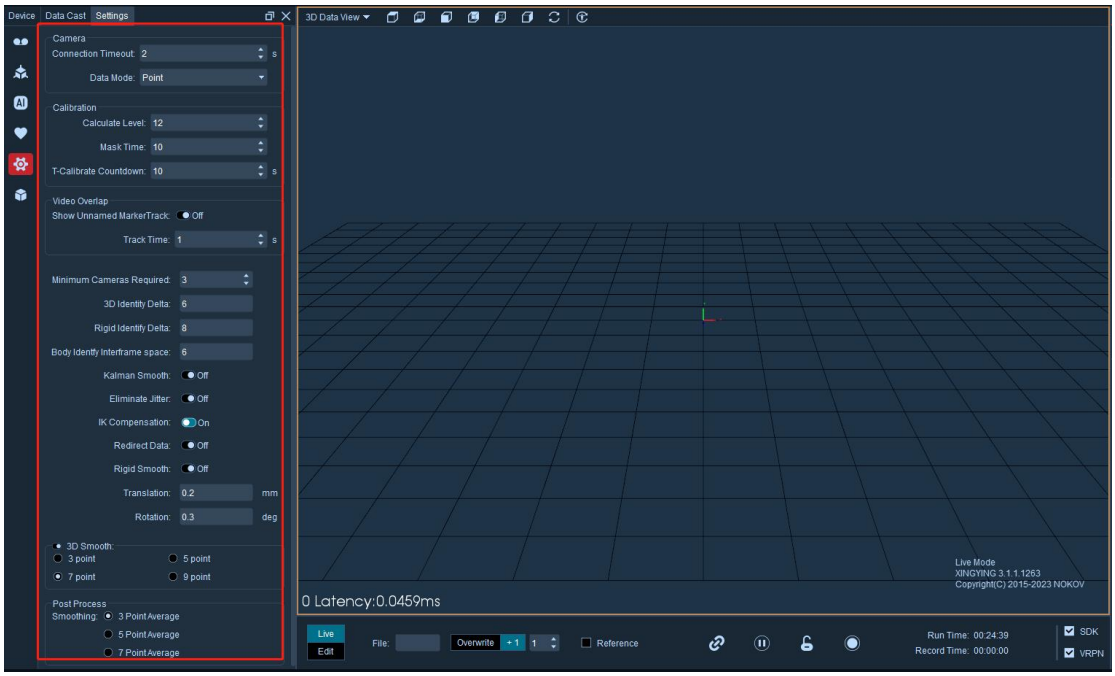


7.4.1

5. Other settings

(1) Click on the Settings button on the toolbar above the software and select "Other Settings"（7.5.1）；



7.5.1

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■ **Camera**

(1) **Connection timeout:** The default connection timeout is' 2 'seconds. In environments with a small number of cameras, the duration of connecting the camera can be set to 2-4S. For larger numbers of cameras, the duration of connecting the camera can be set to 4-8S (do not make manual modifications unless necessary). Before making modifications, please consult technical support engineers for guidance and minimize the operation to the tray;

(2) **Data mode:** Can switch between "point mode and line mode", the software defaults to "point" mode (no special requirements, please do not change this function at will);

■ **Calibration**

(1) **Calculate level:** Before calibration, the "Calculate Level" parameter can be set. The default value of " Calculate Level" is 12. The larger the " Calculate Level" parameter is set, the longer the calibration calculation takes and the higher the accuracy of the calculation. The smaller the parameter is set, the opposite is true;

(2) **Masking Duration:** On the calibration interface, when selecting the automatic masking function, it specifies the duration for which automatic masking persists.

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(3) **T-calibrate Countdown:** After clicking on T calibration in the T-shape, a countdown will appear on the interface. The countdown can be set according to the user's own needs, with a default countdown of 10 seconds;

(4) **Minimum Cameras Required:** The default is "3". The minimum number of cameras for 3D reconstruction can be set to 2, meaning that at least 2 cameras are needed to simultaneously view this point for creating a 3D point. Unless necessary, please do not adjust this setting. Consult a technical engineer before making changes.

(5) **Rigid Body Integrity Entrance Threshold:** Default value is '85'. When the number of marker points at the time of rigid body creation multiplied by the Rigid Body Integrity Entrance Threshold is less than the current number of points extracted in real-time for the rigid body, the rigid body is displayed normally. When it exceeds the current number of points extracted in real-time for the rigid body, the rigid body is lost, and white dots are displayed.

■ **Smooth**

(1) **3D smooth:** You can choose one of the four smoothing levels "1, 2, 3, and 4" from the average number of smoothing points. At the same time, open the XYZ chart and select a point in the Market in Live mode to make the fluctuation amplitude of the coordinate curve of that point smaller than that without 3D smoothing;

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(2) **Kalman smooth:** when enabled, Kalman filtering is used to smooth the rigid body;

(3) **Eliminate Jitter:** eliminate jitter of all rigid bodies when rigid bodies are stationary;

(4) **Rigid smooth:** After creating a rigid body in Live mode, check Rigid Body Smoothing and set the displacement and rotation thresholds for Rigid Body Smoothing. After setting the threshold, the rigid body will be shaken according to the set displacement and rotation thresholds;

(5) **Edit smoothing:** You can choose "3 point smoothing, 5 point smoothing, and 7 point smoothing" to smooth the Marker points in Edit mode;

(6) **Note:** Not all scenes require the use of smooth anti shake function. In special scenes, when the shaking amplitude of points or rigid bodies in the 3D view is large or needs to be reduced to meet the requirements, the above function can be correspondingly checked (do not set it unless necessary, please consult a technical engineer before setting it). When using VR scenes, 3D smoothing and Kalman smoothing can be combined to smooth the rigid bodies in our 3D view, reducing jitter in the VR scene;

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(7) **IK Compensation:** In Live mode, when there is skeleton loss in the human Markerset, IK compensation calculates the position of the lost skeleton. If this function is not checked, IK calculation of the lost skeleton position will not be enabled after the skeleton is lost;

(8) **Redirect Data:** This function is generally used to create a human body model and characterize it. After selecting the "Retarget" checkbox, the characterized human body data will be broadcasted and sent through the SDK;

■ **Video overlap**

(1) **Show unnamed Marker Track:** After the calibration of the reference video is completed, place an unnamed marker into the field, check the "unnamed point trajectory" option, which is the unnamed point trajectory display function. At this point, move the unnamed point, and the trajectory of the unnamed point can be displayed in the reference video view (7.5.2). Note: When observing the trajectory, it is necessary to ensure that there is only one unnamed marker point in the field. If multiple unnamed points appear, the trajectory cannot be displayed;

(2) **Track Time:** Indicates the display time of the trajectory. You can click the arrow on the right to adjust the time in seconds, with a maximum of 5 seconds and a default of 1 second. The longer the time, the longer the unnamed point's trajectory will appear in the view;

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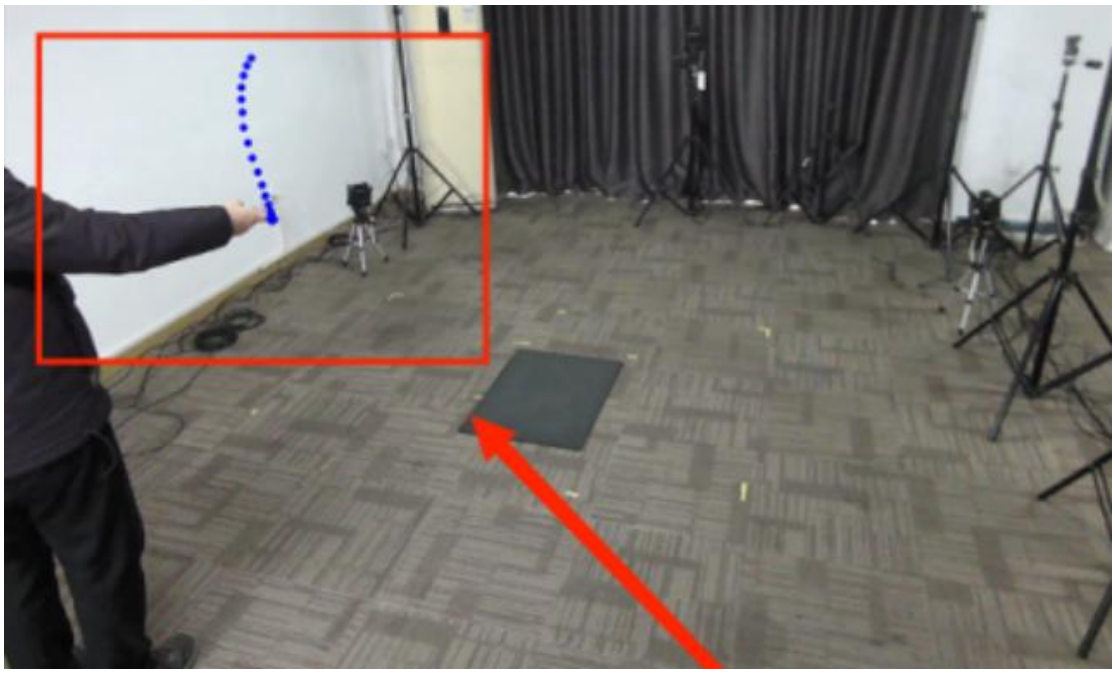

7.5.2

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VIII. Calibration Classification

1. Preparation for calibration

(1) Firstly, connect the camera to place the software in playback mode, switch to 2D view, confirm that the L-shaped calibration rod has been placed in the center of the field, and block or remove other reflective markers within the field;

(2) You can click the "Show all cameras" button above the 2D view and observe all shots at the same time, or double-click each shot in the 2D view to only observe the specified shots; The number in parentheses at the bottom left corner of each cameras represents the number of reflective marker points that the cameras can see, ensuring that only the four reflective marker points on the L-shaped pole are visible in the 2D view of each cameras;

(3) Confirm the clutter of each camera, subtract the number in parentheses from the actual number of reflective marker points in the scene (4 points on the L-shaped calibration pole) to obtain the number of clutter points;

(4) Remove miscellaneous points from the site, which often occur:

- sunniness;
- Metal tables, chairs, shelves, and reflective flooring;
- Reflective stickers/logos, jewelry on clothing, shoes, and hats;
- Scattered reflective markers in the captured scene.

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(5) The following are methods for removing impurities:

- Pull up the curtains to block out the sunlight;
- Remove reflective objects from the scene
- Adjust the aperture of the camera
- Adjust the threshold parameters of the device in the 2D view of the software (usually between 200 and 600)
- Adjust the brightness of the cameras in the 2D view of the software
- Using software for mask processing.
- The maximum and minimum values can be set in the "minimum point diameter/maximum point diameter" section below the device panel to filter the diameter range of the "marker" in the 2D view

(6) Mask Processing

- Manual mode: Double-click the cameras to be processed in the 2D view to zoom in on a single screen. Press and hold the mouse wheel in the "2D view" to drag and drop, frame the area with impurities, and the impurities will be shielded. You can repeatedly select boxes multiple times until all the miscellaneous points in the view in the box are removed

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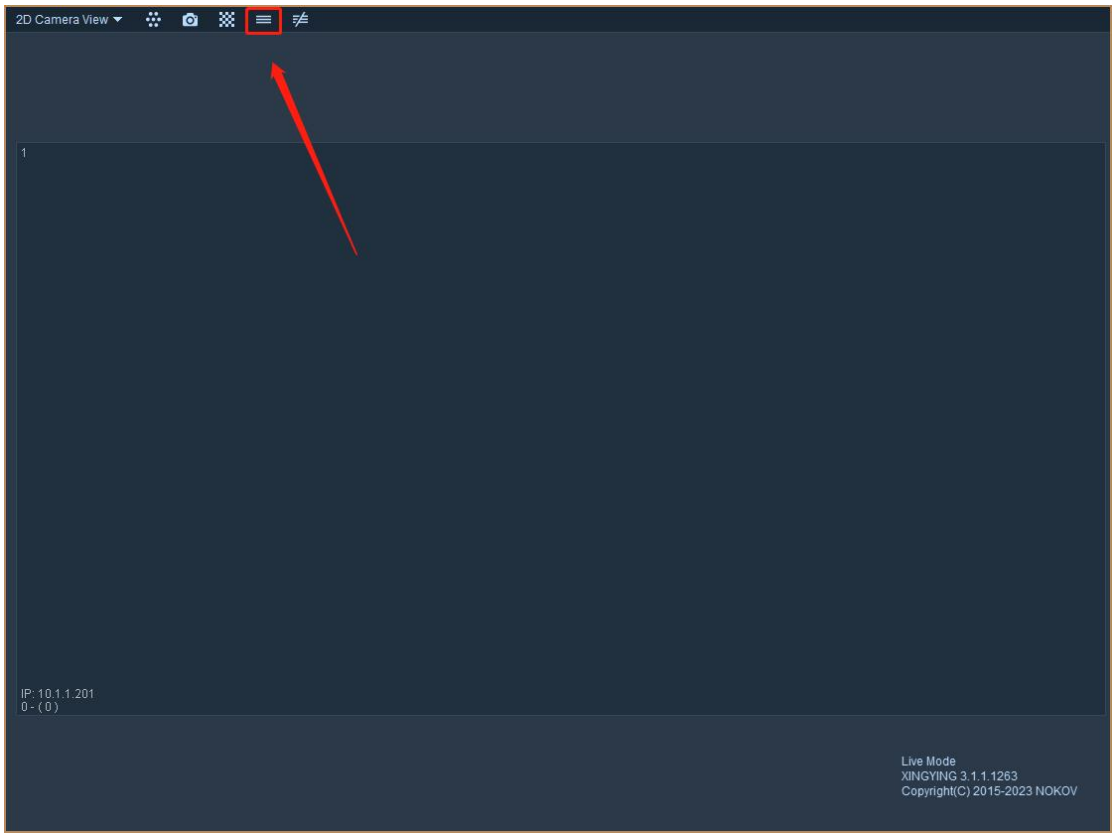
- Automatic mode: Click the automatic masking button in the toolbar above the 2D view, and all 2D points in the 2D view will be masked. Click Clear Mask, and all masks will be deleted. Using Clear Mask in a single view will only clear the mask in the current view (as shown in the figure); When selecting an automatic mask, it is necessary to clear useful and real reflective markers within the venue;



8.1.1

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- To delete a specific area in the mask box caused by incorrect operation, click the left mouse button to select the area, and then click the right mouse button

(7) After the above operations are completed, the calibration personnel can first hold the T-shaped calibration rod and swing it in the field. Another person can observe whether there is a number greater than 3 in the bracket at the bottom left corner of the 2D view. If so, it indicates that there are impurities in the field of view of the cameras. Steps 5 and 6 can be repeated for processing until the cameras reaches the optimal calibration state.

(8) For incorrect box selection caused by incorrect operation, if you want to delete a specific area in the box, click with the left mouse button to select the area, turn red, and then click with the right mouse button;

2. Initial Calibration

(1) Keep the camera in Live playback mode, click the "Calibration" button in the toolbar above the software to open the calibration panel, and select "Initial Calibration" in the calibration window. Click on the gear button on the right to open the calibration settings , select the calibration axis (Z/Y) in the "Frame", select the L calibration rod you are using (L-600/L-450/L-240) in the "L-Type", and "Manual" is the custom L-shaped rod type.;

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(2) Next, perform L calibration and place the L-shaped rod selected in step 1 in the center of the field. Confirm the coordinate orientation (when the Z-axis is upward, the long side direction of the L-rod is in the positive X-axis direction, and the short side direction is in the positive Y-axis direction; when the Y-axis is upward, the long side direction of the L-rod is in the positive Z-axis direction, and the short side direction is in the positive X-axis direction). Before performing L-type calibration, confirm that the number in the bottom left parentheses of all 2D views is stable at 4. Click "L-calibration" at the bottom of the panel. If L-calibration is passed, the window will become a T-calibration window, and the "Next" button in the window is clickable. If L-type calibration is not passed, a prompt "L Calibration Field" will appear, and the "Next" button is gray and cannot be clicked, possibly due to the presence of miscellaneous points in the calibration site, Repeat the above impurity removal operation until it passes the L calibration;

(3) L calibration results can be divided into three categories:

- All Passed: All lenses pass calibration, and the calibration result graph displays in green.

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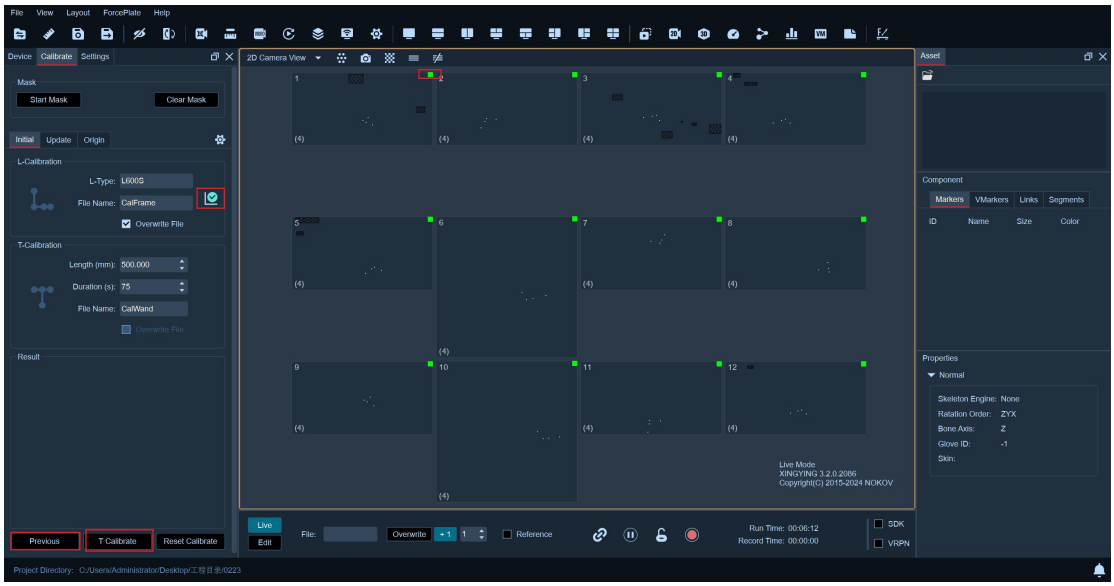
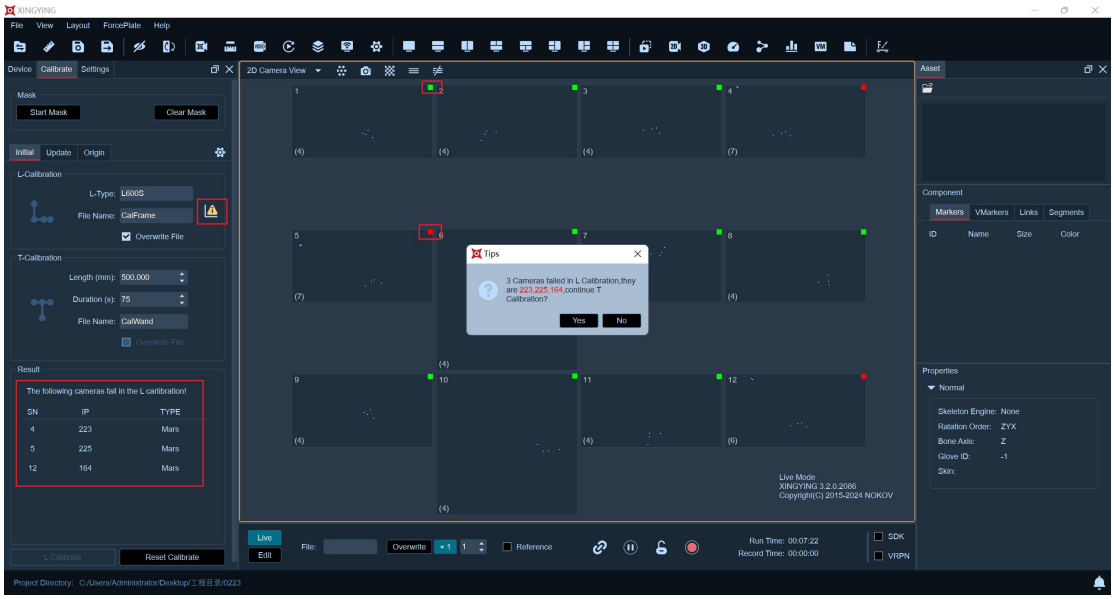


8.2.1

- Partial Pass: The proportion of lenses that pass calibration exceeds 1/8 of the total number of lenses, and the quantity is ⩾2. The calibration result graph displays in yellow.



8.2.2

- L Calibration Failure: The calibration result graph displays in red.

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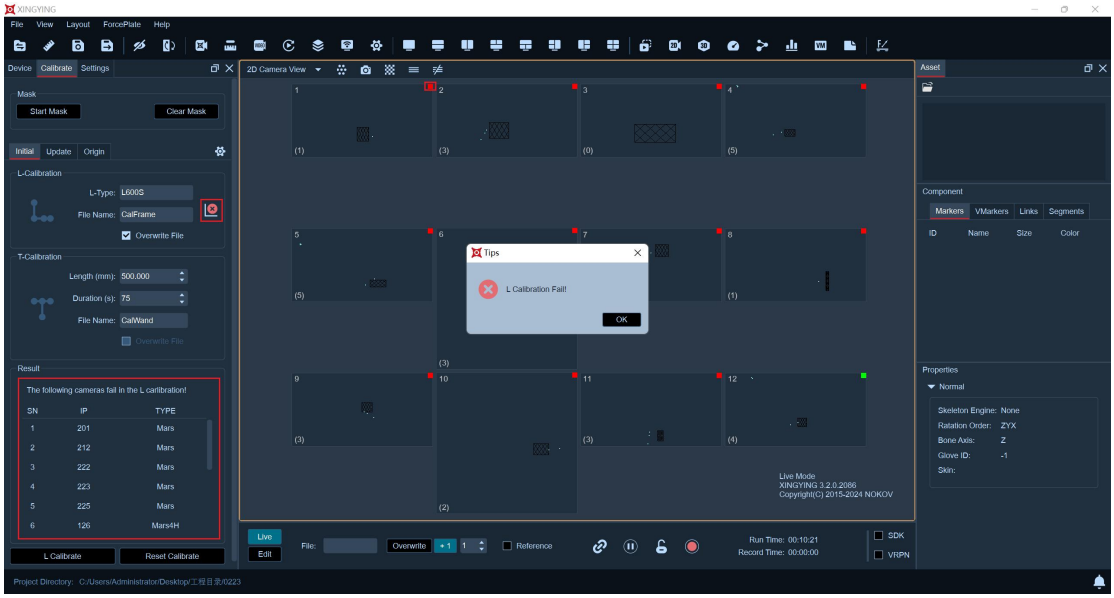

8.2.3

Only when all pass or partial pass occurs can T calibration proceed; otherwise,

L calibration needs to continue until L calibration passes.

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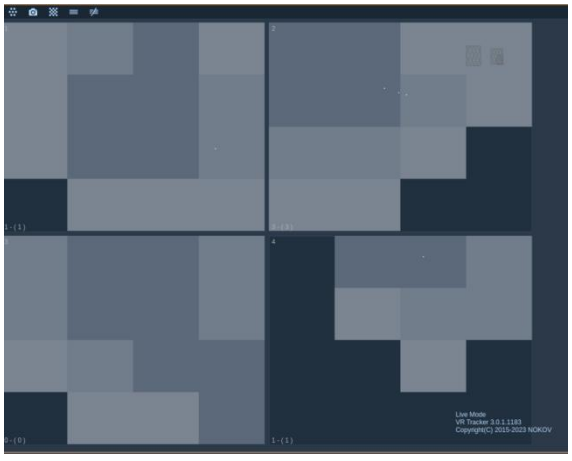
(4) After passing the L calibration, move the L-shaped calibration rod out of the capture area to ensure that no camera can observe it, and bring the T-shaped calibration rod into the capture area;

(5) Perform T calibration. In the basic calibration T calibration window, "pole length" represents the distance between the reflective marker points at both ends of the T-shaped pole used. Enter the number marked on the label on the T-shaped pole, and "duration" represents the calibration time, usually 60-120 seconds, After setting up, click the "Next" button. The swing personnel hold the T-shaped calibration rod and repeatedly swing it within the capture area. If the camera collects valid data, the corresponding area will turn gray, ensuring that the effective data amount of each camera is sufficient. As the collected data amount increases, the color of each camera will change from light to dark (8.2.1);



8.2.4

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(6) A progress bar is displayed in the 5 T calibration, which gradually moves forward with the swing time. When the progress bar reaches 50%, the background color of the T calibration will change from orange yellow to green. Wave the T-bar to cover every corner visible to the camera as much as possible, In the 2D view of all cameras, at most three markers of the T-shaped bar can be seen (i.e., the number in the bottom left corner of the 2D view of all cameras is less than or equal to 3, try to make as many camera numbers as possible equal to 3). During the calibration process, the 2D interface displays the area scanned by the calibration bar, which can display the available data amount and impurities in Live. When the dialog box displays the predetermined frame number, that is, when the progress bar reaches 100%, a calculation button appears below the floating window, Click Calculate and the software enters the calculation process. After the calculation is completed, the software will provide feedback on the calibration results (evaluated as poor, normal, good, or very good). Different icons will also be displayed on the right side of T calibration based on the calibration results; (If the calibration result shows "poor", it is recommended to recalibrate, otherwise it can be saved and used normally.) Click "Save Calibration File" to input the file and click Finish;

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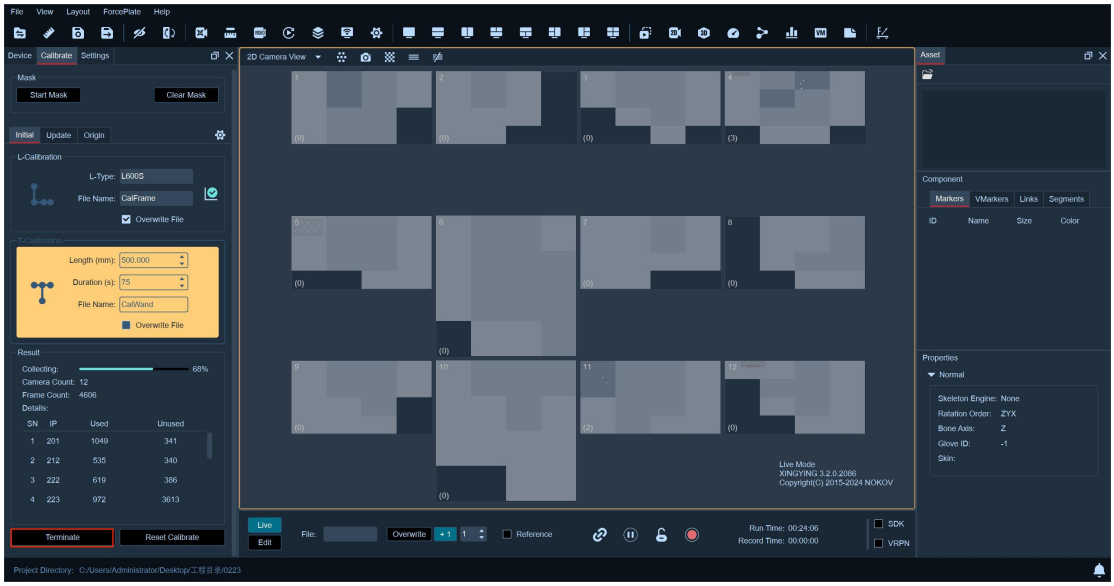
(7) During the T calibration swinging process, you can click the 'Terminate' button at any time to stop the swinging process; after stopping, you can click 'T Calibration' again to start the swinging process; after swinging is completed, if you are not satisfied with the swinging data, you can click the 'Previous' button to return to before the swinging action of T calibration started and start the swinging operation again.



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(8) During the calculation process, you can click the 'Terminate' button at any time to stop the calculation process. If the calculation result is poor or average, you can directly click the 'Previous Step' button on the page to return to the previous page before calculation and recalculate the result. Alternatively, you can click the 'Previous ' button twice to return to the state before the T swinging started, and redo the swinging.

(9) Click on "3D Data View" in the toolbar to display the 3D view(8.2.2). This 3D interface can be rotated, panned, and zoomed in by Ctrl/Shift in conjunction with the left/middle/right mouse buttons; Simultaneously click the play button at the bottom of the interface to put the camera in Live operation mode; In the 3D view, holding down the left mouse button and dragging the view allows for free rotation of the 3D view. Clicking the right mouse button brings up the function menu. Use of key combinations: Hold down Shift+left mouse button in a non frozen frame state to select a named point. Hold down the middle mouse button to drag the view, and scroll the middle mouse button to zoom in or out of the view. Crtl+left mouse button can rotate the view in a fixed direction. Space bar restores the original 3D perspective with one click.

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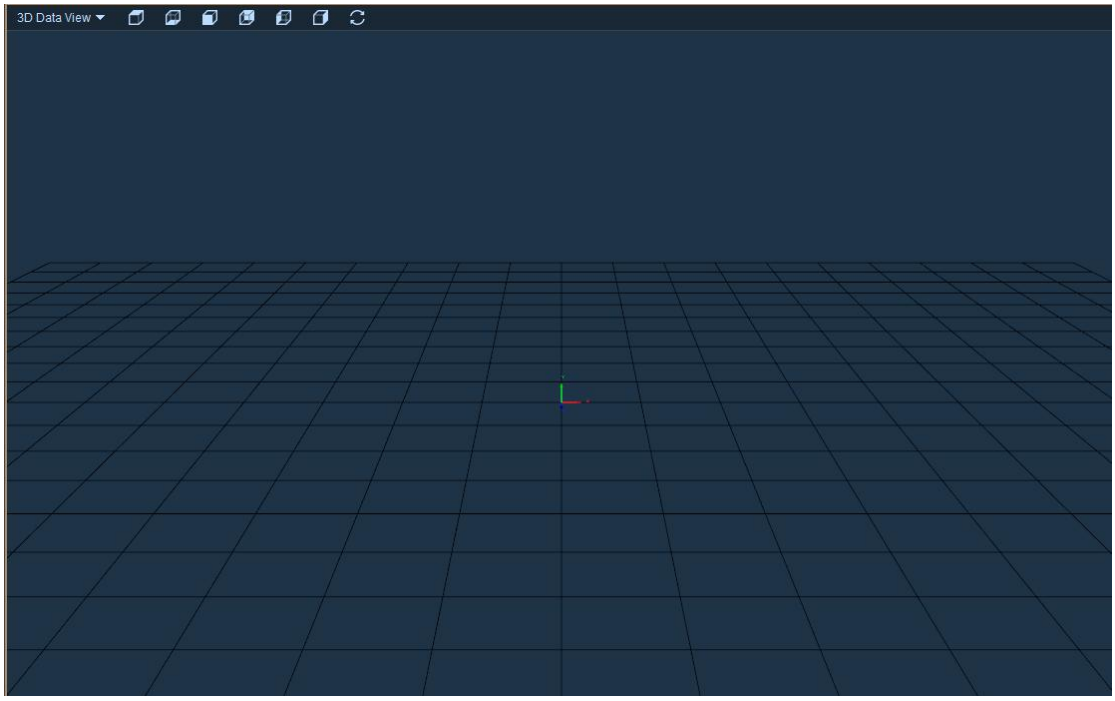

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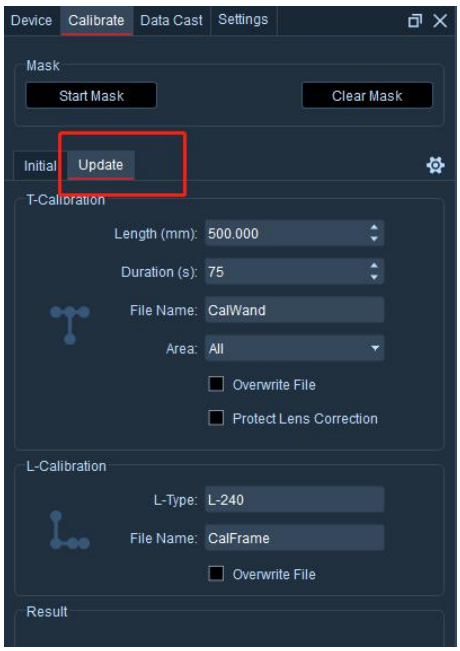
3. Update calibration

(1) After the calibration is completed, if the splitting effect of the "marker" point in the 3D view is not good, or if the calibration time is too long apart from the usage time, resulting in poor results, you can update the calibration to keep the camera in Live playback mode. Open the "Calibration Pane",and select the "Update" option (8.3.1) in the window. Updating the calibration does not require placing an L-shaped rod first, But it is necessary to ensure that there are no other miscellaneous points in the field of view except for the T-shaped pole. If there are any miscellaneous points in the camera's field of view, you can repeat the steps of "Preparation for calibration";



8.3.1

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(2) Click "Next" and proceed to the T-calibration. In the T-calibration window, if you are loading a calibration file that has been merged with partition calibration, select the area number for updating calibration in "Area". If you want to update the entire area for calibration, select "All" and check the "Protect Current Camera Correction" option to prevent camera parameters from being modified during the update calibration process;

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(3) Repeat steps 4 and 5 of 'Initial Calibration' to perform T-calibration. After the calibration time is up, click "Next" and the software will automatically calculate. After completion, the calibration result will be displayed in the window (such as "Poor", "Normal", "Good", "Perfect", if the calibration result shows "Poor", it is recommended to recalibrate, otherwise it can be saved and used normally). Click "Next" to perform L-type calibration;

(4) Place the L-shaped rod into the field and ensure that there are no other miscellaneous points except for the four points of the L-shaped rod. Click "Next" to perform the L-shaped calibration. After the calibration is successful, click the "Finish" button to complete the calibration. Click the "File Save Calibration File" option in the bottom right corner of the software interface to save the updated calibration configuration file. If the L-shaped calibration fails, a pop-up window will prompt;

(5) L-type calibration failure may be due to:

- In addition to the four points of the L-shaped pole, there are other miscellaneous points in the field that cause the software to be unable to correctly recognize the L-shaped pole;

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- During the update calibration, perform L-shaped calibration. The position of the L-shaped rod should be aligned with the position of the L-shaped rod during system calibration, and the difference between the two should not be too large;
- The selected L-shaped rod length parameter is inconsistent with the actual L-shaped rod length parameter. For specific settings of L-shaped rod length parameters, please refer to the instructions in "Calibration Settings";

(6) Solution to L-type calibration failure during update calibration:

- Eliminate environmental factors and remove other miscellaneous points in the site except for the four points of the L-shaped pole;
- Is the L-shaped rod parameter in the self-test software setting consistent with the actual L-shaped used;
- Click Previous to return to the previous step and perform the L-type calibration again;
- If the calibration still fails, please consult the technical engineer.

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(7) When updating the calibration, if the user does not need to update the coordinate system position in the 3D view after the T-shaped calibration is completed, there is no need to perform L-shaped calibration. Click Finish to save the updated calibration file. After the L-shaped calibration is completed, the coordinate system in the 3D view will be consistent with the placement position of the L-shaped rod during the L-shaped calibration.

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4. Origin Calibration

(1) For the existing calibration files, without calibrating the entire motion capture system (i.e., without performing T calibration), you can perform L calibration individually to update the coordinate system origin. After the calibration is complete, the original position of the coordinate system origin on the 3D view will be updated;

(2) Before calibrating the origin, please determine the new origin position to be updated. Place the L-shaped calibration bar in the motion capture area. In the 2D view, at least 1/4 cameras should be able to capture all four Marker points on the L-shaped bar completely, and there should not be any noise points in the 2D view except for the four Marker points on the L-bar;

(3) Open the calibration panel, select origin calibration, click on the gear to open calibration settings and set the type of L-bar used for this origin calibration. Do not modify the "Calibration Axis";

(4) Close the origin calibration settings, click the "Origin Calibration" button at the bottom of the calibration panel. After calibration is completed, click the "Finish" button and save the calibration file from this origin calibration separately. If you need to recalibrate, you can click the "Reset Calibration" button;

(5) You can refer to the L calibration steps in section "VIII. (ii) Basic Calibration" of this manual;

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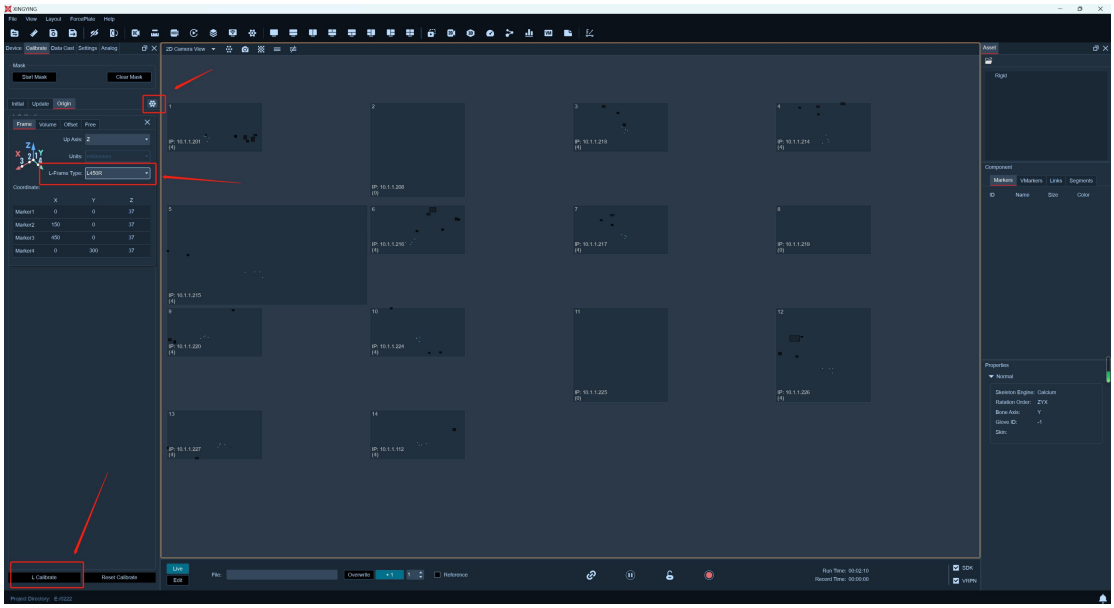
(6) Switch to the 3D view, and the origin position will be updated to the location where the L-bar is placed.



8.4.1

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5. Calibration-free (anchor calibration)

(7) Before using this function, please perform a basic calibration of the entire system. After the calibration is completed, place a Marker point in the 3D view to create the aiming point;

(8) Create anchor: Please place Marker points around the edge of the captured scene, ensuring that the position of the placed Marker point is at the edge of the captured scene and that the placed Marker point can be reconstructed in the 3D view. Next, click on the freeze frame to freeze the 3D view, right-click and select "Create Anchor". After the anchor is created, the Marker in the 3D view will change from white to red;

(9) If you want to delete an anchor point, you need to pause the software playback, open the calibration panel, click the gear button on the right side of the panel to open the calibration settings, select no calibration, and click the "Delete Anchor Point" button to delete the anchor point (8.5.1);

(10) After creating the anchor point, open the calibration panel, click the gear button on the right side of the panel to open the calibration settings, select "calibration free", and click the "use calibration free" button. The software will update the calibration every hour, and the calibration file in the work path will also be updated. The "calibration free" interface will display the latest update time.

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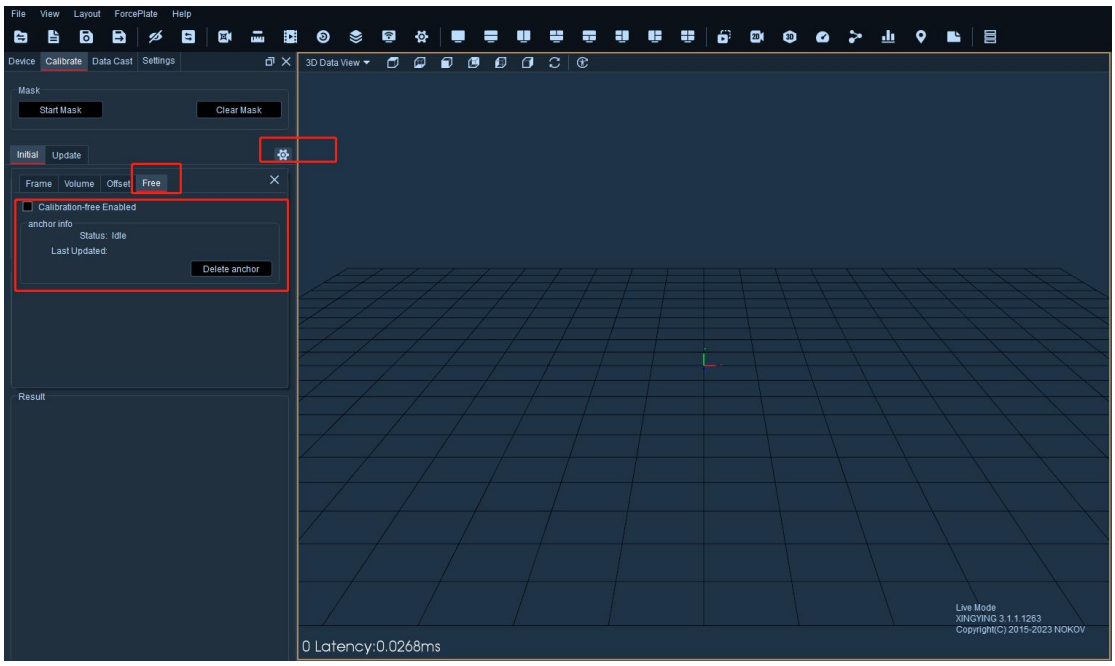
(11) After successfully creating anchor points, please do not arbitrarily change the position of the anchor points to ensure that the anchor points created in the 3D view during the calibration free period are correctly recognized;



8.5.1

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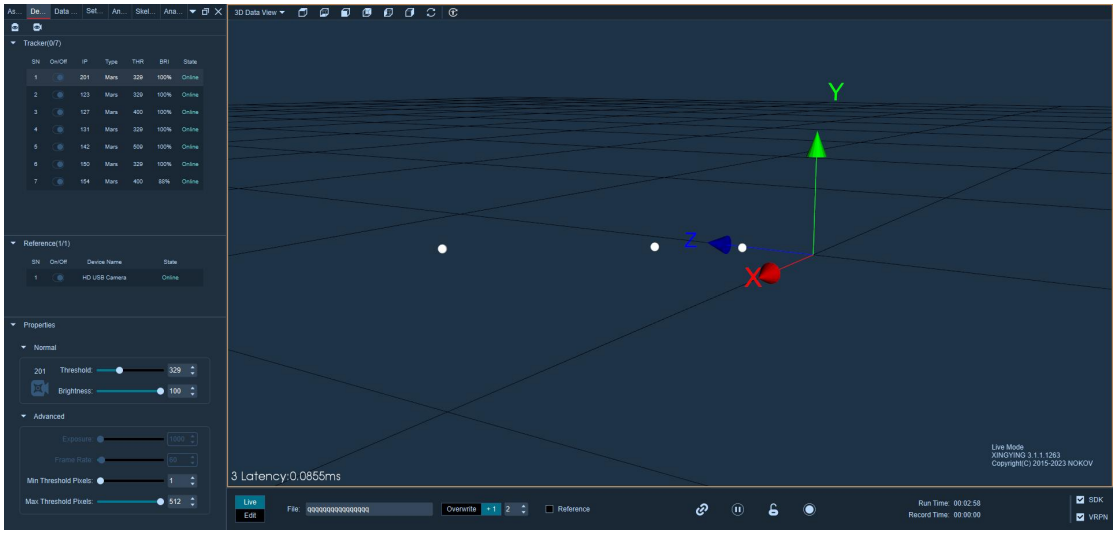
IX. Create Markerset

1. Rigid

(1) The XINGYING software supports the creation of Markersets in Live, requiring objects with already attached reflective markers to be placed on the site, and each reflective marker point to be visible in the 3D view of the software (9.1.1);



9.1.1

(2) Confirm that the software is in play, click the "Freeze" button at the bottom of the software interface to freeze the 3D view ;

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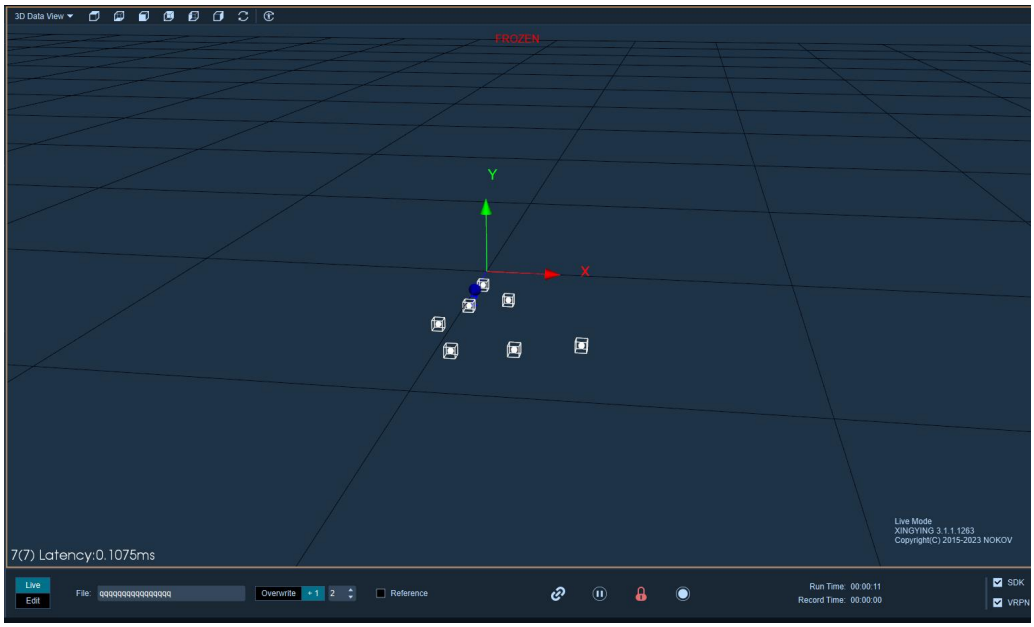
(3) There are the following methods for selecting reflective marker points in the 3D view: by holding down the Shift key while holding down the left mouse button and dragging the box selection, select the reflective marker points that need to create a rigid body to create the rigid body. You can also hold down the Ctrl or Shift keys and use the left mouse button to select the reflective marker points that need to be created for the rigid body one by one. Use the mouse to select multiple reflective marker points attached to the surface of the rigid body in the 3D view. A rigid body must have at least 3 reflective marker points (9.1.2). After selecting unnamed points in the freeze frame, the number of unnamed points in the frame will be displayed in Live in the lower left corner of the 3D view, The numbers in parentheses represent the number of boxed points, while the numbers to the left of parentheses represent the total number of Marker points in the 3D view;



9.1.2

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■**create a single rigid body**

(1) In the 3D view, select the highlight points that need to create rigid bodies and freeze frames (the number of marker points for creating rigid bodies is between 3 to 19). Right-click with your mouse, choose "Create Rigid Body," in the rigid body creation window, you can customize the name of the created rigid body. （9.1.3）After customizing the name of the rigid body, choose to create either a "single" or "multiple" rigid bodies.

(2) Choose "single," then click on create. Multiple points will form a Markerset, and the reflective markers will be named and connected. For the rigid body creation direction, towards (9.1.4), the software defaults to creating in the positive Y-axis direction.

■**create multiple rigid bodies**

(3) The function of creating multiple rigid bodies is mainly used for scenes with a large number of rigid bodies, such as drone swarms. This function allows for quick creation of multiple rigid bodies. Before using this function, it is important to evenly distribute the objects in the scene. The distance between the objects should be kept as consistent as possible, and the spacing between the reflective markers on each object should also be consistent.

(4) You do not need to select the reflective markers. In the rigid body creation window, choose "multiple," set the bone direction and field radius, then click create. Multiple rigid bodies will be successfully created.

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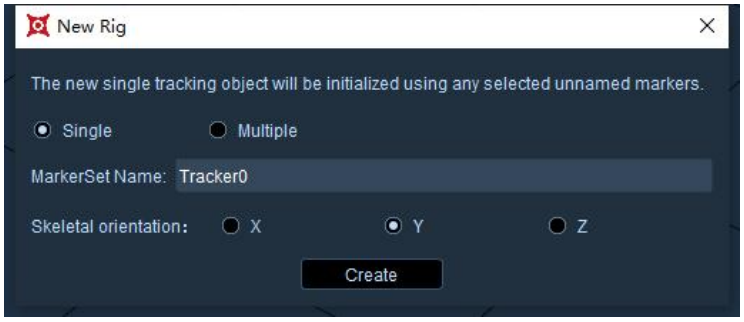
■**Note**

(5) In the software, it is not allowed to have rigid bodies with the same name. If there is a duplicate name during rigid body creation, the "create" button will appear grayed out and cannot be clicked. Please change the rigid body name to proceed with the creation, or alternatively, delete the duplicate .mars files in the current working directory before creating a new one.

(6) When there are non-sequential numbered rigid body names in the working directory, the software will prioritize generating rigid body names with lower numbers by default when creating rigid bodies.

(7) Without modifying the names of the rigid bodies, creating a single rigid body will default to incrementing from "Tracker0, Tracker1..." onwards, while creating multiple rigid bodies will default to incrementing from "MTracker0, MTracker1..." onwards.



9.1.3

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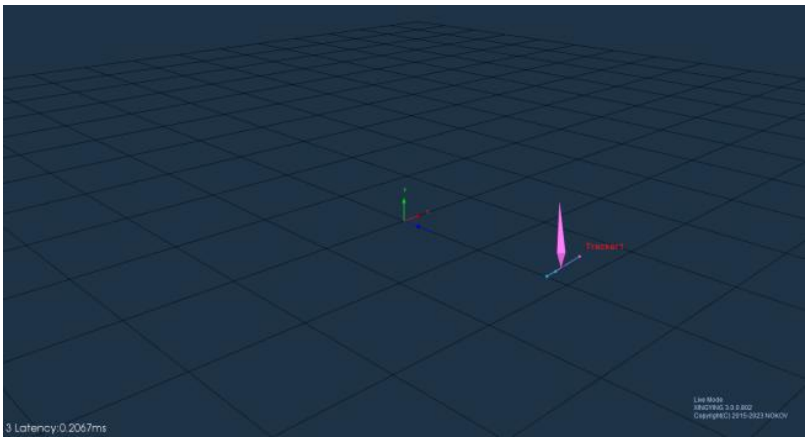
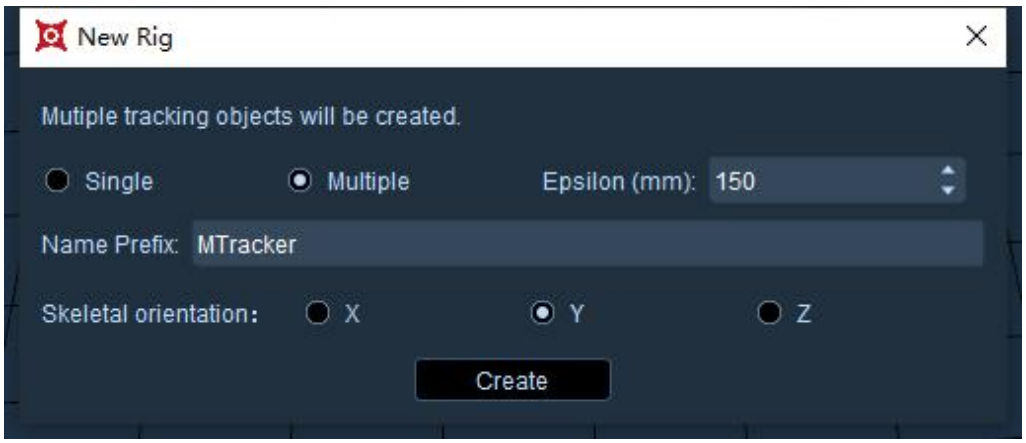


9.1.4



9.1.5

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(1) After selecting three or more points, right-click and select Create Rig. In the pop-up window, you can customize and modify the name of the created rigid body (9.1.3). The software does not allow rigid bodies with the same name. If the custom rigid body name is duplicate, the "Create" button is grayed out and cannot be clicked. When duplicate rigid body names appear, you need to manually delete the. Mars file with the duplicate name from the working directory. Rigid body names with discontinuous serial numbers in the working path will be generated first by the software when creating rigid body names. If the rigid body name is not modified, it will default to incrementing from "Tracker0, 1, 2...". Multiple points will form a Market, and reflective identification points will be named and connected, while creating a rigid body in the positive Y-axis direction (9.1.4);

(2) The maximum number of rigid bodies created is 100. When the 101st rigid body is created, the software will pop up a prompt;

(3) Click on the "Freeze" button to unfreeze the 3D view. At this point, the active captured object can be seen, and the MarkerSet will follow the activity of the captured object in real time. In this state, data can also be directly collected;

■ **Two points determine the orientation of the rigid body**

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(1) Creating a rigid body can customize the orientation of the rigid body. The specific operation method is: after freezing, press the Ctrl key, and select the Marker point in the 3D view with the left mouse button. After successful creation, the orientation of the rigid body will be pointed from Marker1 to Marker2, which is to determine the orientation of the rigid body based on the first and second Marker points selected with the Ctrl key.

■ **Change 6DOF of Rigid**

(1) After creating a rigid body, the skeleton of the rigid body can be displaced and rotated;

(2) Click the freeze button, select the skeleton name of the rigid body in the asset, and click on the X/Y/Z axis offset below. You can see that a cross (9.1.5) will appear in the center of the rigid body skeleton in the 3D view. Dragging an axis of the cross can achieve displacement of the skeleton, or you can click on the center point of the cross to drag the skeleton in any axis;

(3) In the frozen frame state, skeleton can also be rotated. Click on the rotation axis X/Y/Z of the skeleton, and the center of the skeleton will display a rotating three-dimensional ring. Drag the ring to rotate the skeleton (9.1.6);

(4) If you need to exit editing the displacement and rotation of skeleton, press Ctrl to exit the editing state, and the cross and circle will also disappear. After unfreezing, the displacement and rotation of skeleton will change in the 3D view.

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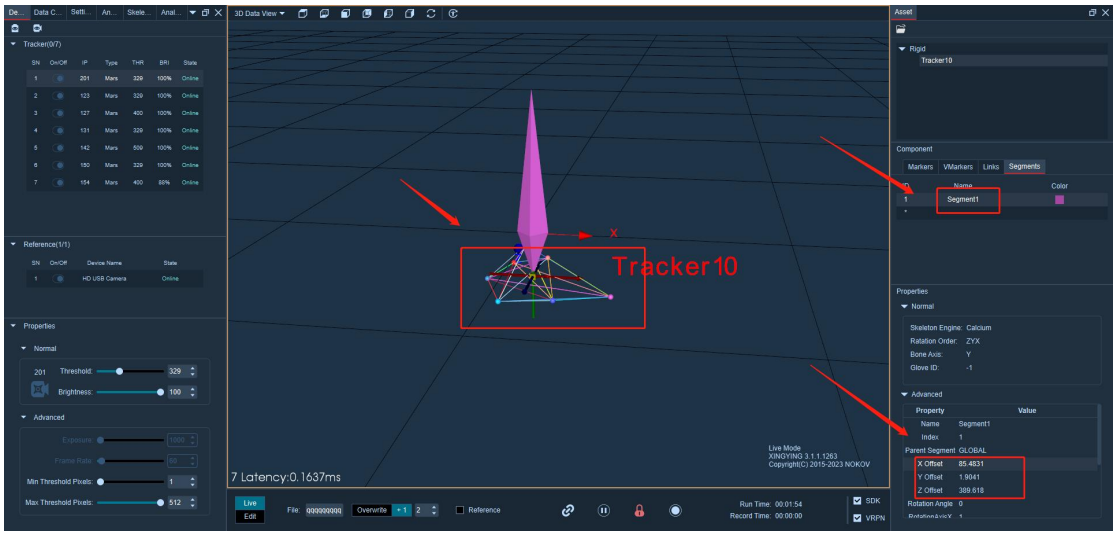
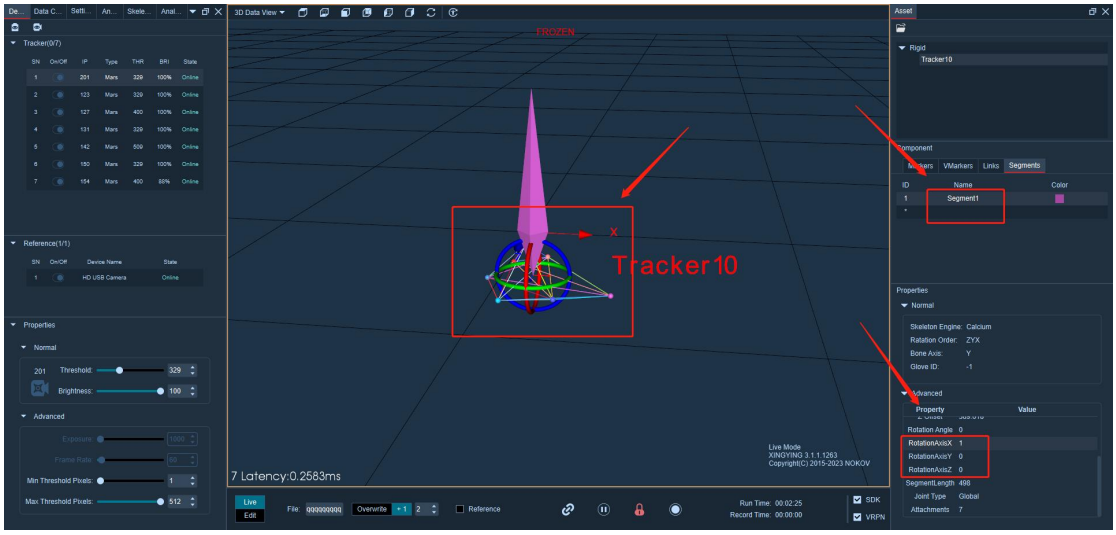


9.1.5



9.1.6

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■ **The rigid body skeleton moves to the specified marker point.**

(1) In live or edit mode, the rigid body can be moved to a specified marker point.

(2) Under Live mode: while in freeze frame, select the rigid body's skeleton, click on "X Offset" in the asset panel, and then click on a specific marker point of the rigid body in the 3D view. The skeleton will then move to the specified marker point.

(3) Under Edit mode: right-click to enter Model Pose mode, click "X Offset" in the asset panel, click on a specific marker point of the rigid body in the 3D view, in Model Pose, the skeleton will then move to the specified marker point. Exit the Model Pose mode, click solve, and after the solve is complete, the skeleton will move to the specified marker point.

2. Body

■ **Baseline+Toe,Headband(53)**

(4) To create a 53 point human body in Live mode, the model needs to wear a motion capture suit and correctly attach the 53 reflective markers. Each reflective marker can be seen in the 3D view and there are no other miscellaneous points in the venue. For creating a 53 point human body, please make sure that the number in the bottom left corner of the 3D view is 53 (9.2.1), and stick the points according to the stick map and guidance video (if sticking is difficult or there are other problems, please contact a technical engineer);

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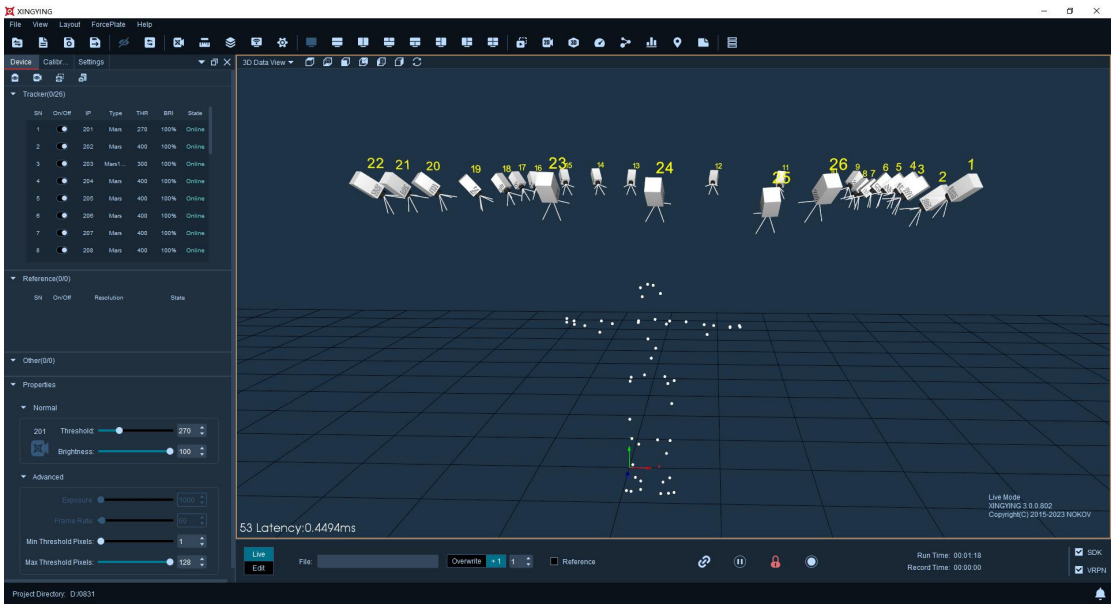

9.2.1

(5) Confirm that the software is in play, and the model is standing with TPOSE. When the calibration file is in the Y-axis, the model faces the Z-axis (when the Z-axis is up, facing the Y-negative axis), and the arm is parallel to the X-axis. Click to freeze it. In the 3D interface, right-click and select "Create Human Body". In the drop-down box of the "Create Human Body" window, select "Baseline+Toe, Headland (53)". Place the mouse cursor on the pasted image, and scroll the mouse wheel, You can view the placement of the sticking points from different angles (9.2.2). After confirming that the actual sticking points are consistent with the sticking point images, click "Create" to create a human model;

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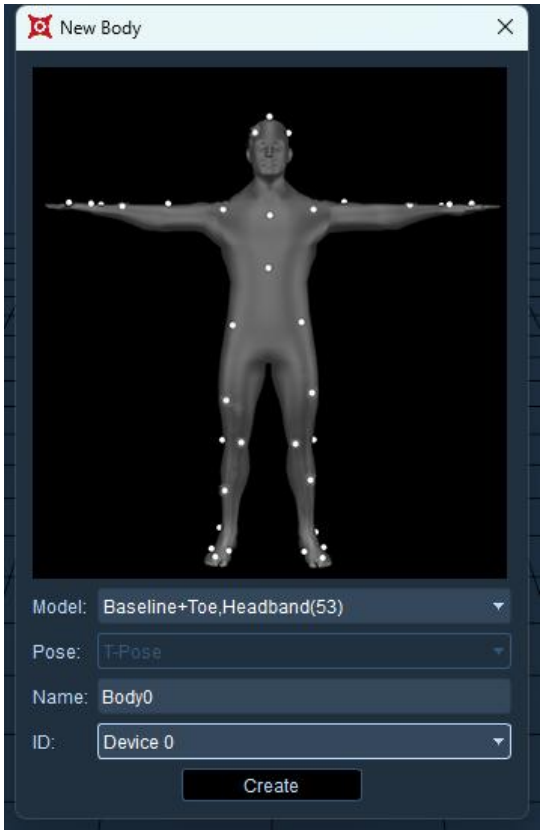
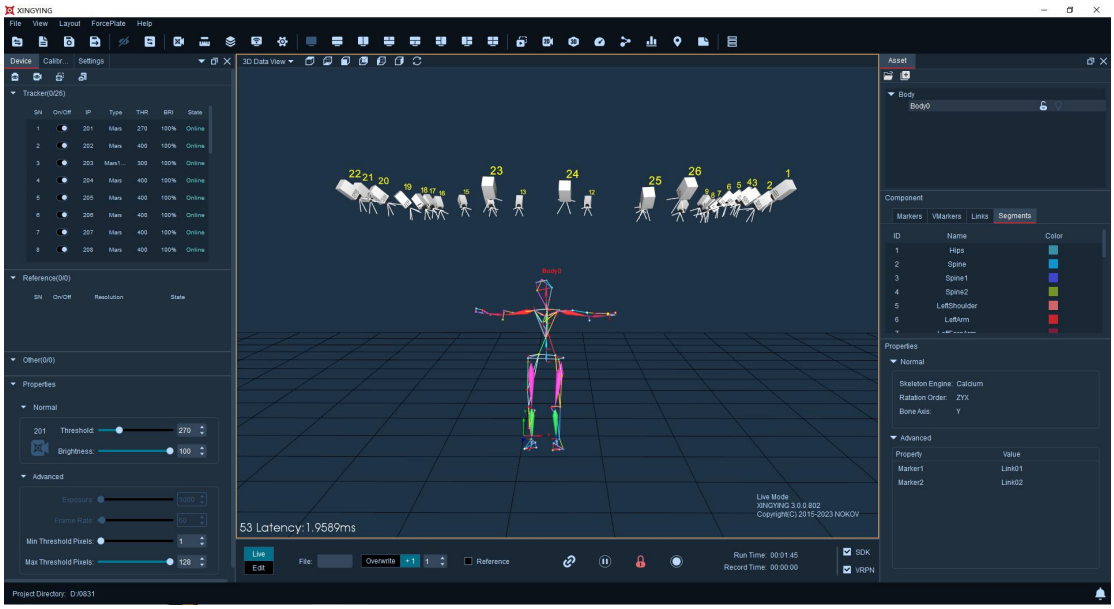


9.2.2

(6) The human model with 53 dots (9.2.3) can be re recognized by clicking the "Reset IDs" button (9.2.4) above the 3D view in Live mode;



9.2.3

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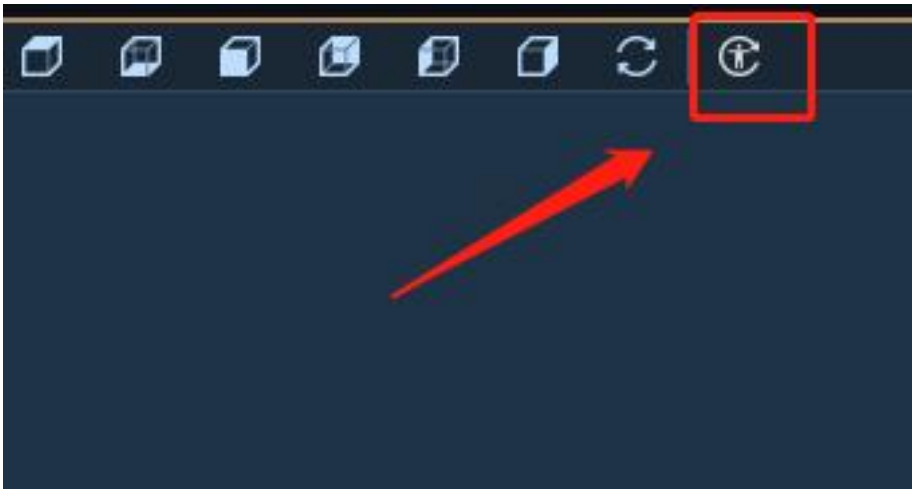

9.2.4

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(7) If creating multiple human body templates, it is necessary to create a human body template. After the model completely exits the venue, another model enters the venue again, ensuring that there are only 53 Marker points on the human body in the 3D view. Repeat the above steps; Multiple people can also stand in the capture field at the same time, T-Pose, and create a human body by selecting the Marker point in the box.

(8) Release the frozen state of the 3D view. At this time, the model can move freely and the human MarkerSet will follow the model's activity in Live. In this state, data can also be directly collected.

■ **VR Body**

(1) Create a VR Body in Live mode. The model is required to wear a rigid rig board with reflective markers on the back of their hands, on the outer sides of their arms, on the back of their waist, chest, top of their head, and on the backs of their feet, and tighten it to prevent the rig board from moving during movement and affecting the human body effect after creating the human body. In the 3D view, each reflective marker point on the rig board can be seen and there are no other miscellaneous points on the site. To create a VR body, please make sure that the number in the bottom left corner of the 3D view is the total number of reflective markers points on each rig board. The number of reflective markers on each rig board should not be less than three (9.2.5);

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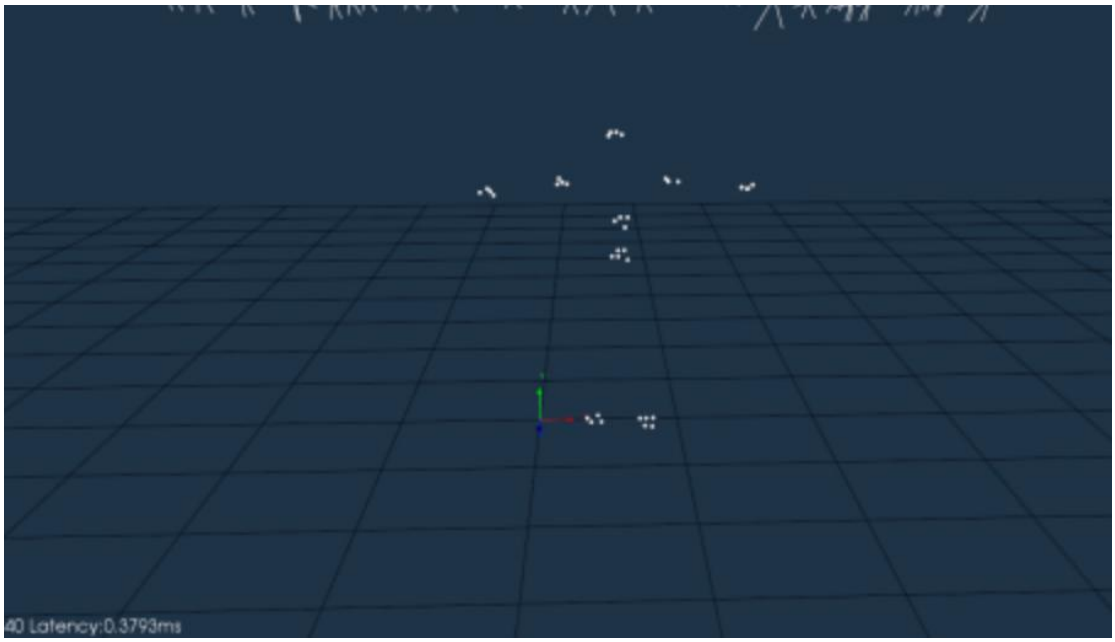
(2) Confirm that the software is in playback mode, click the "Freeze" button to freeze the 3D view. After successful freezing, the button will display "Unfreeze"; The model stands with TPOSE, with the calibration file facing the Z-axis (when the Z-axis is up, facing the Y-negative axis), and the arm parallel to the X-axis. Click on the freeze frame, right-click on the 3D interface, and select "Create Body". In the drop-down box of the "Create Human Body" window, select "VR Body";



9.2.5

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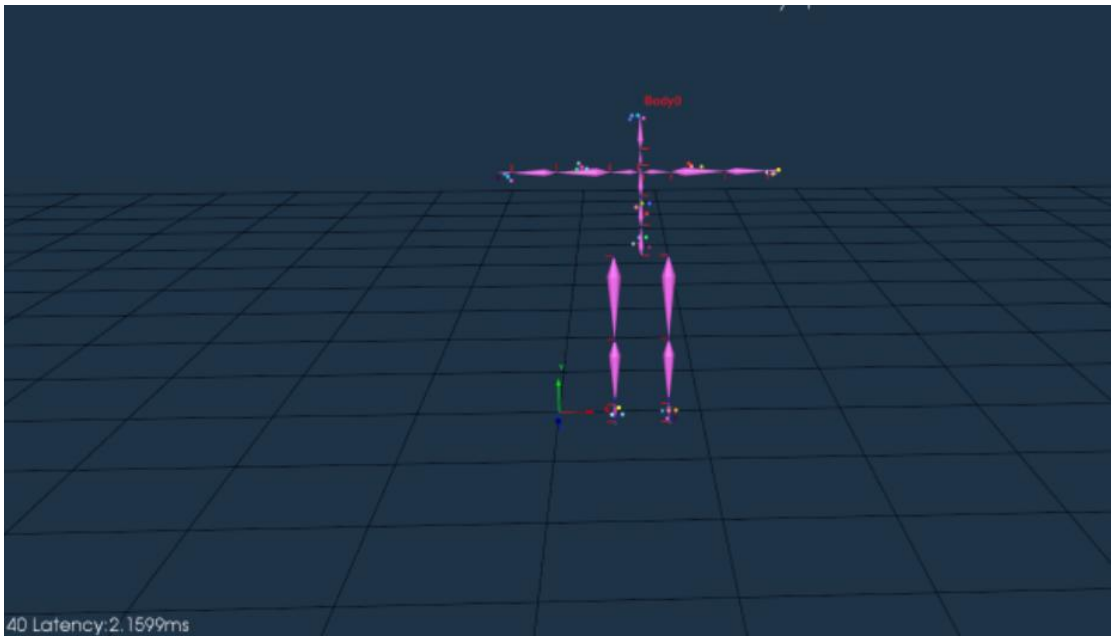
(3) The VR Body created is shown in the following figure（9.2.6）.



9.2.6

■ **Helenhayes Body**

(1) XINGYING can create three types of Helen Hayes mannequins in Live mode, namely Helen Hayes FullBodyWithHead (29 Static), Helen Hayes FullBody (26 Static), and Helen Hayes LowerBody (19 Static). When pasting points, double-sided adhesive can be used to directly stick the Marker points to the skin. The specific placement of the points can be referred to the sticker icon in the Create Human Window. If you have any questions or other issues with the sticker points, please contact the technical engineer.

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(2) After creating the Helen Hayes model, the software will automatically generate a static Helen Hayes model and a dynamic Helen Hayes model. Please pay attention to distinguishing between static and dynamic models. The default naming rule for the static model software is "body name+_static", while the naming rule for the dynamic model is "body name+_dynamic". After creating a static model, if you need to use a dynamic model, please remove the two Marker points on the inner ankle of the model's legs and the two Marker points on the inner knee of the model. Then, use the "Add/Remove" button above the software to remove the static model file and recognize the dynamic Helen Hayes model.

(3) **Helenhayes FullBodyWithHead(29 Static)：** 29 markers full body static Helen Hayes model, with the Marker point attached to the corresponding position on the body, the model should stand with TPOSE. If the calibration file is Y-axis up, face the Z-axis (Z-axis up, face the negative Y-axis direction), and the arms should be parallel to the X-axis (the arm position should not be lower than the two Marker points on the front waist). Click to freeze, right-click on the 3D interface, and select "Create Body", Select "Helen Hayes FullBodyWithHead (29 Static)" in the dropdown box of the "Model Creation" window, place the mouse cursor on the sticker image, scroll the mouse wheel, and view the sticker positions at different angles. After confirming that the actual sticker is consistent with the sticker image, click "Create" to create the 29 points static and dynamic Helen Hayes model (9.2.7, 9.2.8)；

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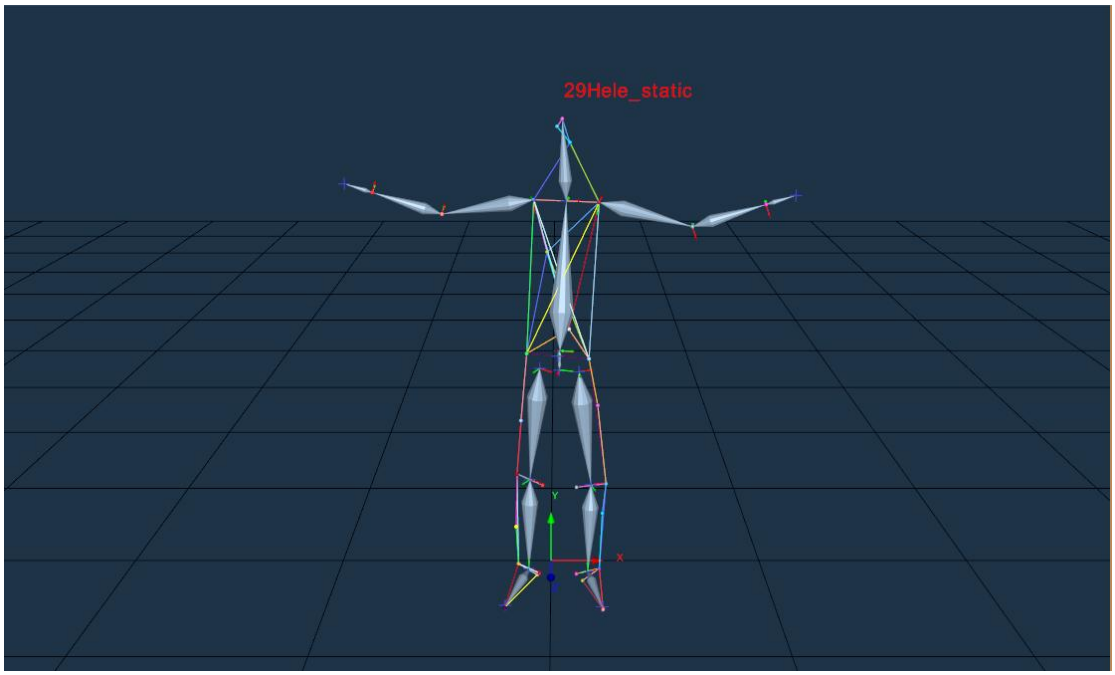
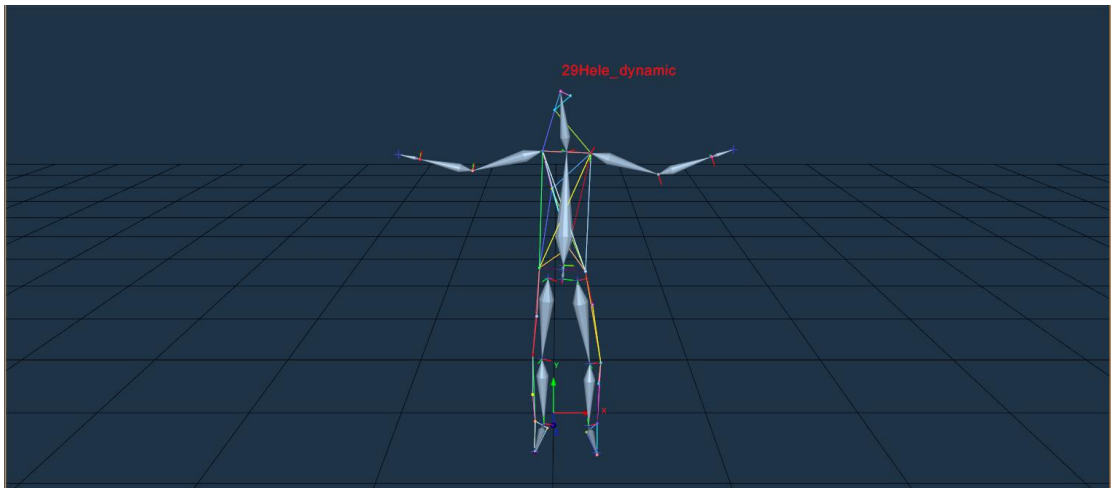


9.2.7



9.2.8

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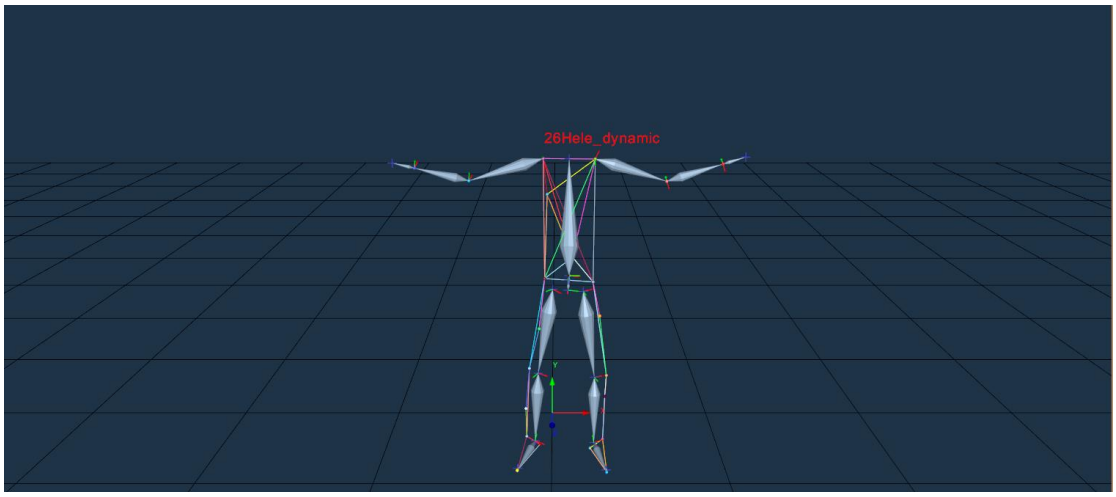
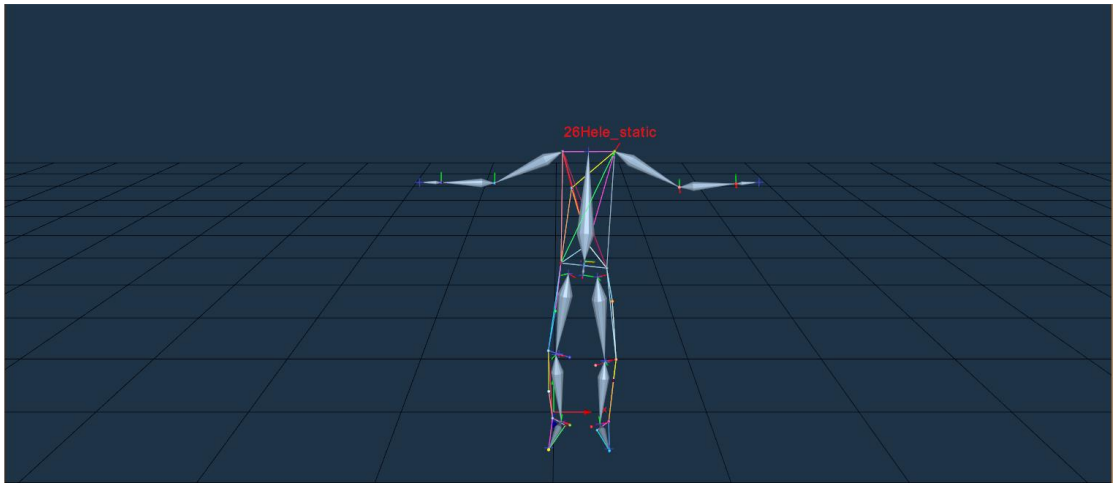
(4) **Helenhayes FullBodyWithHead (26 Static):** The 26 points static Helenhayes model removes three Marekr points from the head compared to the 29 points model. The remaining positions are aligned with the points on the 29 points Helenhayes model. In the dropdown box of the "Model Creation" window, select "Helenhayes FullBody (26 Static)". 26 point static and dynamic Helen Hayes model (9.2.9, 9.2.10).



9.2.9



9.2.10

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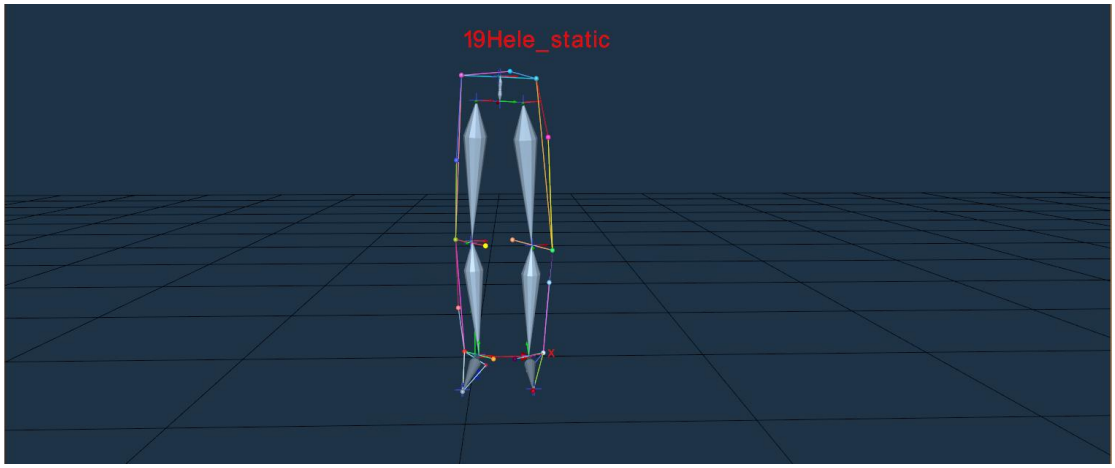
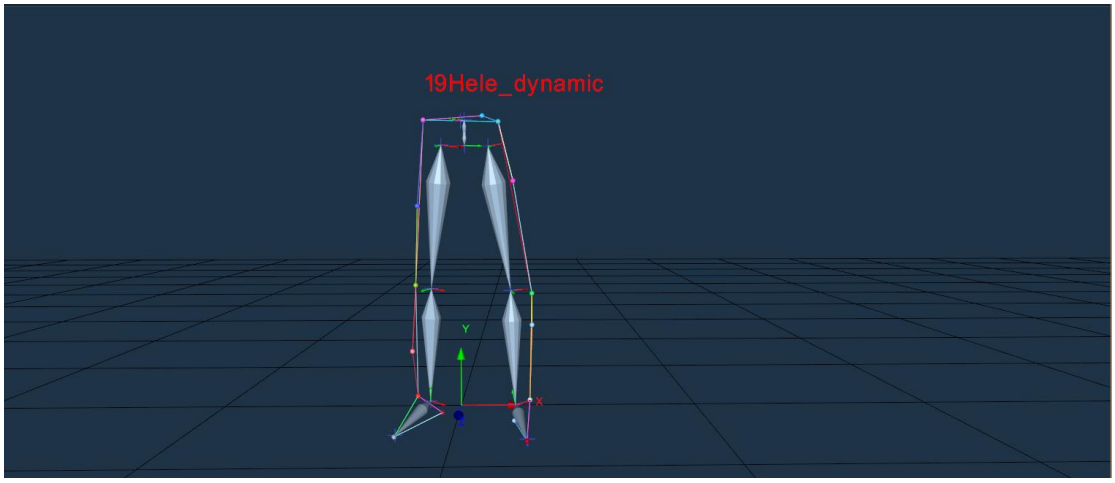
(5) **Helen Hayes LowerBody (19 Static):** Compared to the 29 points model, the 19 points model removes all the Marker points in the upper body (except for the three points on the waist), and the other positions are consistent with the attachment points of the 29 point Helen Hayes model. In the dropdown box of the "Model Creation" window, select "Helen Hayes LowerBody (19 Static)". 19 point static and dynamic Helen Hayes model (9.2.11, 9.2.12).



9.2.11



9.2.12

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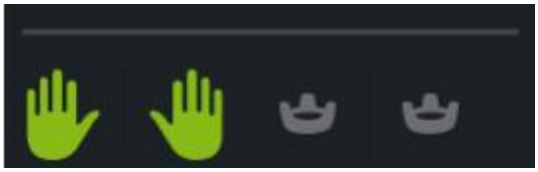
(6) If the arm cannot bend and extend normally or the thigh cannot stand normally when creating a Helen Hayes model in Live mode, we suggest using a custom Helen Hayes template for Edit. Please consult our engineer to obtain a Helen Hayes human body template.

■ **Baseline+Toe+Hand，Headband(53)**

(1) 1. Start the VRTRIXGloveServer software, pair the gloves, and after the software displays ready, correct the gloves (9.2.13).



9.2.13

(2) Open XINGYING, connect the camera to play, and the model stands in the motion capture venue, wearing motion capture clothing, data gloves, and correctly attaching reflective markers. In the 3D view, each reflective marker point can be seen and there are no other miscellaneous points in the venue. To create a glove with 53 markers, the number in the bottom left corner of the 3D view should be 53 without any obstruction points, Stick points according to the stick map and guidance video (if it is difficult to stick points or there are other issues, please contact the technical engineer)；

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(3) Requirements for wearing gloves for T-Pose:

- Four fingers together, keeping a straight line with the wrist
- Thumb naturally extends outward at an angle of approximately 45 ° to the horizontal of the index finger
- Thumb naturally extends outward, with an angle of approximately 20% perpendicular to the index finger

(4) After wearing gloves, adjust the thumb joint and finger gap. You can open the data glove server software ->Display 3D view function options, open advanced settings, and make adjustments(9.2.14)

9.2.14

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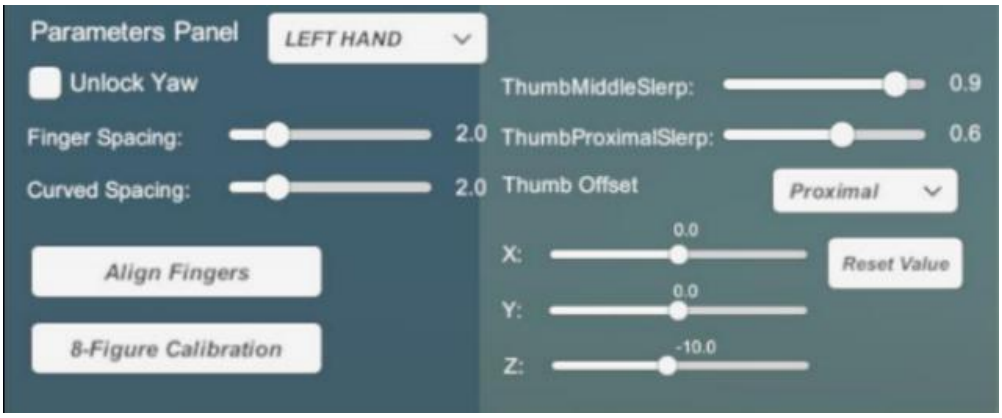
(5) The status bar of the data glove is displayed on the right side of the above figure. From top to bottom, it shows the wireless communication signal strength of the data glove, the calibration level (which can be understood as magnetic field interference state), the percentage of remaining battery power, and the frame rate of data packets sent by the data glove per second. The 'Trigger Haptics' button below represents triggering the vibration, while the' Reset 'button refers to resetting the glove direction in the 3D view to the straight ahead position.



9.2.15

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- After clicking and checking "Advanced Panel", the data glove algorithm fine-tuning box in the figure above will appear. In this box, the current shape of the data glove can be fine-tuned.

- Unlock Yaw: The heading angle of the data glove is unlocked. When checked, the function of opening the five finger heading of the data glove can be unlocked. However, please note that when this function is turned on, gloves should be kept away from magnetic objects, including but not limited to iron objects, mobile phones, computer cases, speakers, etc.

- Finger Spacing ": When the five finger heading opening function is not required, the angle between the fingers can be fixed, and fine adjustments can be made according to different models. The larger the angle setting, the greater the degree of finger opening.

- Curved Spacing ": represents the distance between the five fingers when clenching. Usually, we hope to have a certain angle when the five fingers are straight, but when the five fingers are clenched, they are basically in a closed state. This parameter is used to adjust this state.

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- Thumb Proximal/Middle/Digital Offset ": represents the deviation values of the three thumb joints, which can be toggled through the drop-down box. This deviation value is mainly determined by the deviation between the skeleton and the real skeleton during 3D model binding. Generally, only adjusting the Thumb Proximal Offset can make the thumb joints normal.

- Reset Value ": used to reset the deviation values of all thumb joints to their initial values.

- Align Fingers ": Due to different user hand types and sensor assembly deviations, if you feel that the degree of finger bending during use varies, you can close and straighten your five fingers and click this button to calibrate. This calibration is similar to T-Pose calibration, but this function is used to calibrate the left and right hands separately, making it convenient for single person operation.

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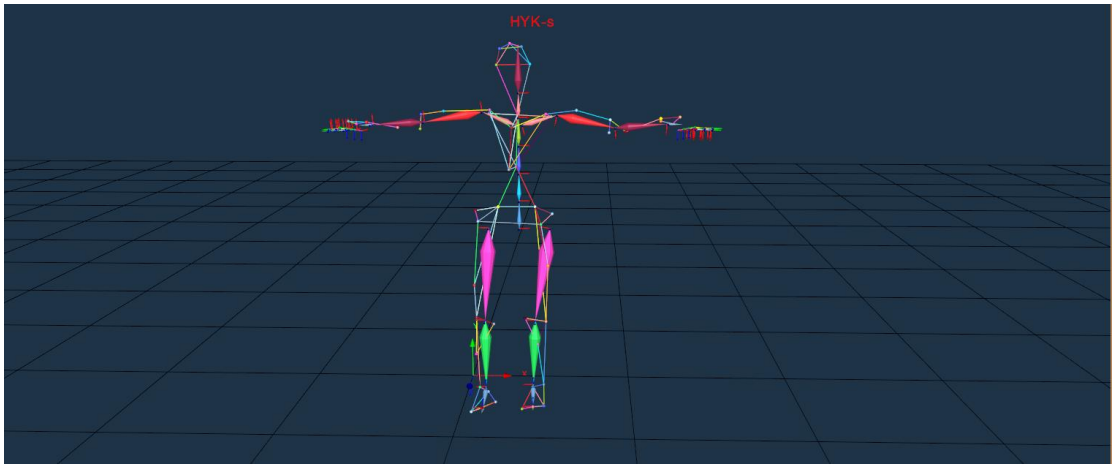
(6) Confirm that the software is in playback mode; The model stands with TPOSE, with the calibration file facing the Z-axis (when the Z-axis is up, facing the Y-negative axis), and the arm parallel to the X-axis. Click on the freeze frame, right-click on the 3D interface and select "Create Human Body". In the drop-down box of the "Create Human Body" window, select the human posture of "Baseline+Toe+Hand, Headband (53)". Place the mouse cursor on the sticker image, scroll the mouse wheel, and view the sticker positions at different angles, After confirming that the actual sticking point is consistent with the sticking point image, click "Create" to create the human body. After the glove human body is successfully created, subsequent use will be consistent with the human body application;

(7) After creating a 53 point human glove model, the small coordinate system (9.2.16) corresponding to the finger skeleton can be observed in the Live mode 3D view. Clicking the "Reset IDs" button can re recognize the human model;



9.2.16

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3. Custom template

■ Helenhayes

(1) First, please follow the Helen Hayes model's marker placement method in real-time mode and record a set of unnamed marker data. During data recording, ensure that all markers are visible and unobstructed. You may perform some simple actions, such as twisting the waist, waving a hand, lightly lifting a leg, side-kicking, back-kicking, rotating the wrist, turning the ankle, nodding, tilting the head left and right, squatting, etc.

(2) After recording, load this data set in post-processing mode and make sure the data is at frame one.

(3) Next, add the Helen Hayes template provided by us to the assets panel, and use "Quick Identification" to identify the unnamed markers in the first frame of the data. When all markers are identified, ensure that all markers in the first frame are correctly recognized.

(4) Make sure the data is paused at the first frame and highlight all frames on the data axis; click the "Correct" button to correct and identify markers on all frames. After the correction, markers in all frames should be recognized. Then, drag the data axis to check whether the markers in all frames have been correctly identified.

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(5) If markers are not correctly identified in a certain frame, use "Quick Identification" to recognize the unnamed markers. If the same marker is not identified across a range of consecutive frames, select this range, use "Quick Identification" on the first frame within the selected range to identify the unnamed markers, and after identification, click the "Track Identification" function to recognize the unnamed points in the selected range of consecutive frames.

(6) After all markers are identified in all frames, jump to the first frame, click the "Solve" button, and after the solving process, the links between points, the human skeleton, and the "V Markers" in the template will be displayed.

(7) If there are still anomalies in the data, please refer to the "Data Processing" section, subsections four, five, six, and seven, for instructions on how to use the data repair functions to fix the data.

(8) Click "File" -- "Save As Model". In real-time mode, load the saved model, have the model walk into the motion capture area, and the Helen Hayes model will be displayed in 3D.

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■ **Baseline+Toe，Headband(53)**

(1) Record unnamed marker data for the 53-marker full-body model in real-time mode. During data recording, ensure that all markers are visible and unobstructed. You may perform some simple actions, such as twisting the waist, waving hands, lightly lifting a leg, side-kicking, back-kicking, rotating wrists, turning ankles, nodding, tilting the head left and right, squatting, etc.

(2) Load this group of recorded unnamed marker data in post-processing mode, and load the human body template provided by us in the assets panel.

(3) Follow the same operations as mentioned above for customizing the "Helenhayes" human body template.

■ **Creating Custom Templates**

(1) Custom templates can be created by applying markers to objects such as robotic arms, robotic dogs, jump ropes, badminton rackets, etc. After creating a custom template, post-process the data and then load the custom model file in real-time mode for data collection and analysis.

(2) Apply markers to the object that will be captured. Keep the markers at a reasonable distance from each other and avoid regular patterns to prevent misidentification.

(3) Bring the marked object into the motion capture area and collect a sequence of its movement. Ensure that there is no loss or obstruction of markers during the recording. Afterward, load the recorded data in post-processing mode.

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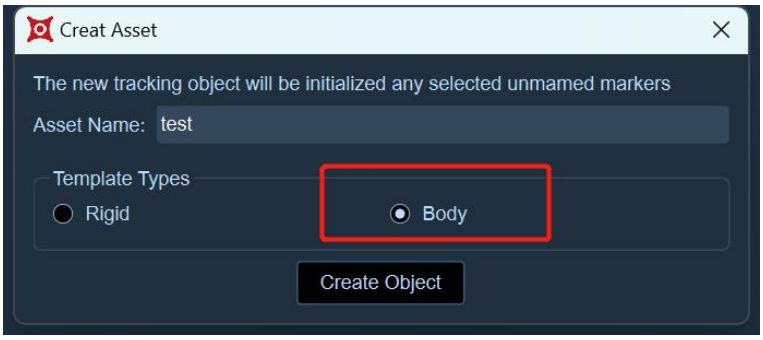
(4) Open the assets panel, click the "Add Asset" button to create a new asset, enter the name of the asset, select "Human," and then click "Create Object." (9.3.1)



9.3.1

(5) Create marker names on the "Markers" tab of the assets panel. Jump to the first frame of the data, select all frames, and open the "Quick Identification" dialog to identify the unnamed points on the object. After identification, create Links between points.

(6) Decide whether to create a skeleton based on your needs. For instructions on how to create a skeleton, refer to "Twelve, Data Processing (II) Establishment of Markerset (Rigid)."

(7) Jump the data to the first frame, select all frames, and click "Track Identification". All points on the object will be identified in subsequent frames. If a skeleton has been created, click on "Solve", and the skeleton will be displayed in all subsequent frames.

(8) While playing back the data, if some frames have points that are not recognized, please refer to sections four, five, and six in "Twelve, Data Processing" for instructions on how to repair the data.

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(9) After repairing the data, click to save the model and the motion capture data. Switch to real-time mode, load the repaired model file in the assets panel, connect the cameras, and play the footage. When you place the object into the capture area, the 3D view will display the model.

(10) If the model recognition is unstable in real-time mode, this may be due to a sudden increase in the distance between named points on the object during motion. Should this problem occur, collect another set of data where named points tend to change abruptly or exhibit anomalies. Remedy the data again in post-processing mode.

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4. Intelligent Agent

(1) The XINGYING software comes with built-in "drone" and "unmanned vehicle" intelligent agent models. After creating a rigid body in real-time mode or loading .cap data in post-processing, an intelligent agent can be bound to the specified rigid body. The intelligent agent's dashboard includes "main dashboard, speedometer, pitch and roll angle dashboard, and yaw angle dashboard" (9.4.1). Once a rigid body is bound on the intelligent agent's dashboard, the timing in the chart begins, and all gauges start operating to display detailed data.

9.4.1

(2) Here are two methods for connecting drones to the XINGYING system, along with the precautions:

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■ Local Connection

- First, configure the data forwarding port of the drone. Once the port is set, power on the drone.
- Insert network cable A into the LAN1 port of the router (9.4.2), and connect the other end of network cable A to the switch where the motion capture cameras are located. Insert network cable B into the LAN2 port of the router, and connect the other end of network cable B to the network port on the motion capture computer (if the computer does not have enough network ports, you can use a USB Ethernet adapter as an extension and insert network cable B into the adapter).

9.4.2

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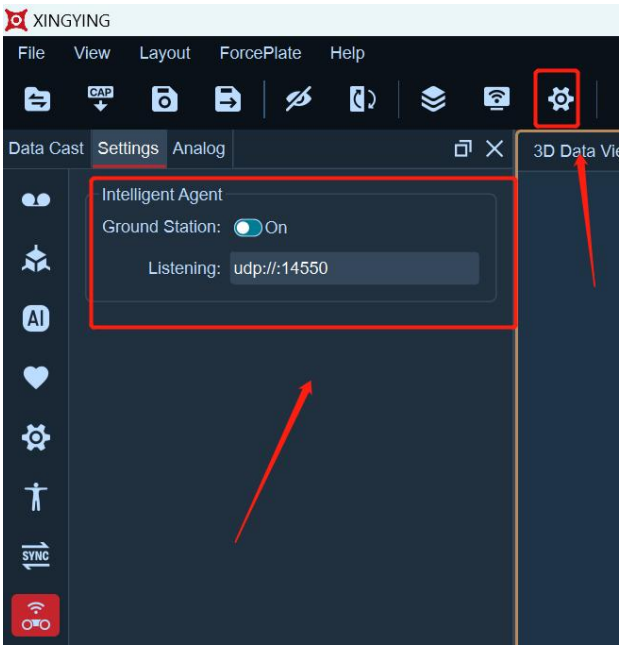
- Open XINGYING, go to software settings, select "Agent Settings," and set the listening port (9.4.3). The listening port should match the data forwarding port set on the drone.



9.4.3

- Connect the cameras and play back the footage, then create a rigid body. At this point, you can bind an intelligent agent model (9.4.4).

- Open an intelligent agent dashboard (9.4.5), bind the created rigid body, select the device number (if there are multiple drones, multiple numbers will be displayed in the dropdown list), choose the type as a drone, and a drone icon will be displayed in the middle of the yaw angle dashboard.

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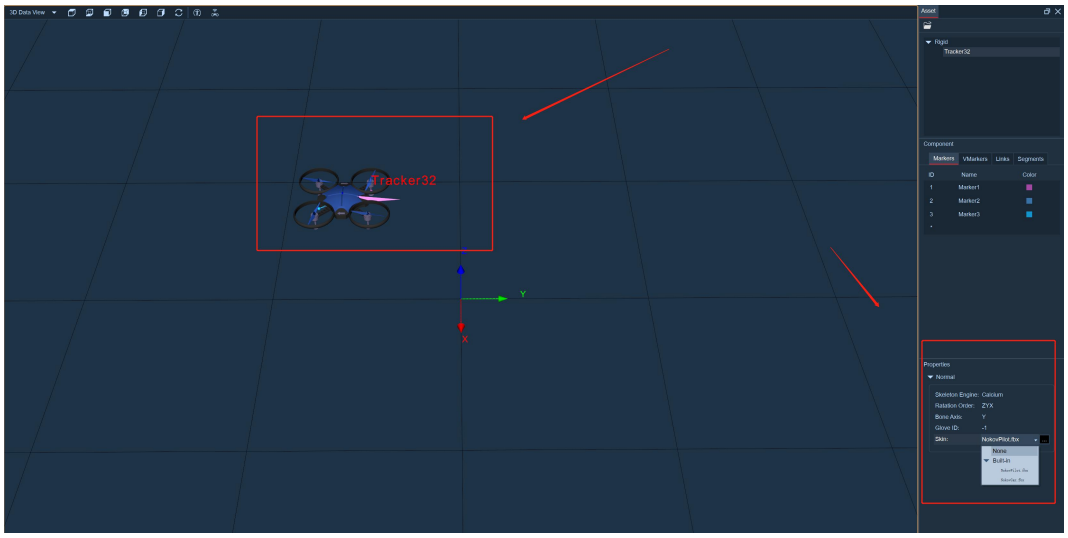
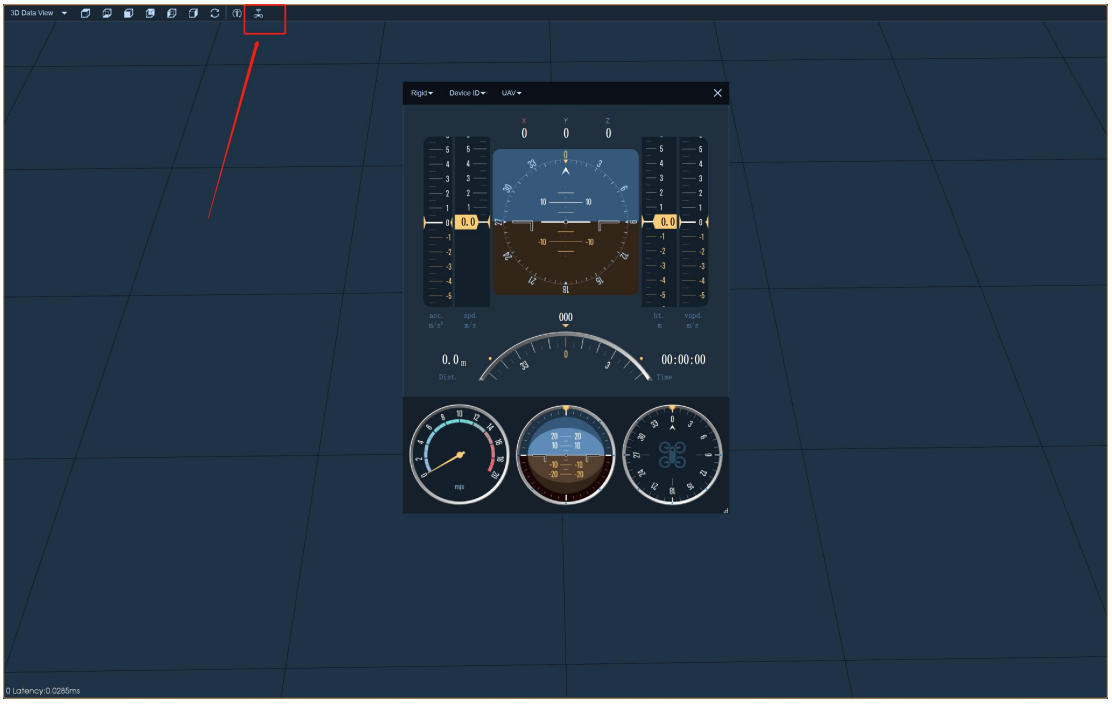


9.4.4



9.4.5

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- At this point, the various gauges in the intelligent agent window will display data (9.4.6). The top right corner will show the real-time battery level of the drone. In Edit mode, the intelligent agent dashboard will not display device numbers or battery levels. You can resize the window by dragging the button at the bottom-right corner of the dashboard.

9.4.6

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- **Local Area Network (LAN)**

  - First, configure the data forwarding port of the drone and then power it on.

  - To connect the drone via LAN, ensure that the drone's IP address and the motion capture computer's IP address are on the same subnet. If not, configure the drone's IP address accordingly and set the data forwarding port for the drone.

  - On the motion capture computer, open a terminal and enter ssh pi@192.168.2.253 to access the onboard computer of the drone; "192.168.2.253" is the IP address of the drone.

  - Open another terminal and input roslaunch mavros px4.launch gcs_url:="udp://@192.168.2.124:14550". "192.168.2.124" is the IP address of the motion capture computer, and "14550" is the drone data listening port set in the XINGYING software, which should match the data forwarding port set on the drone (9.4.7).

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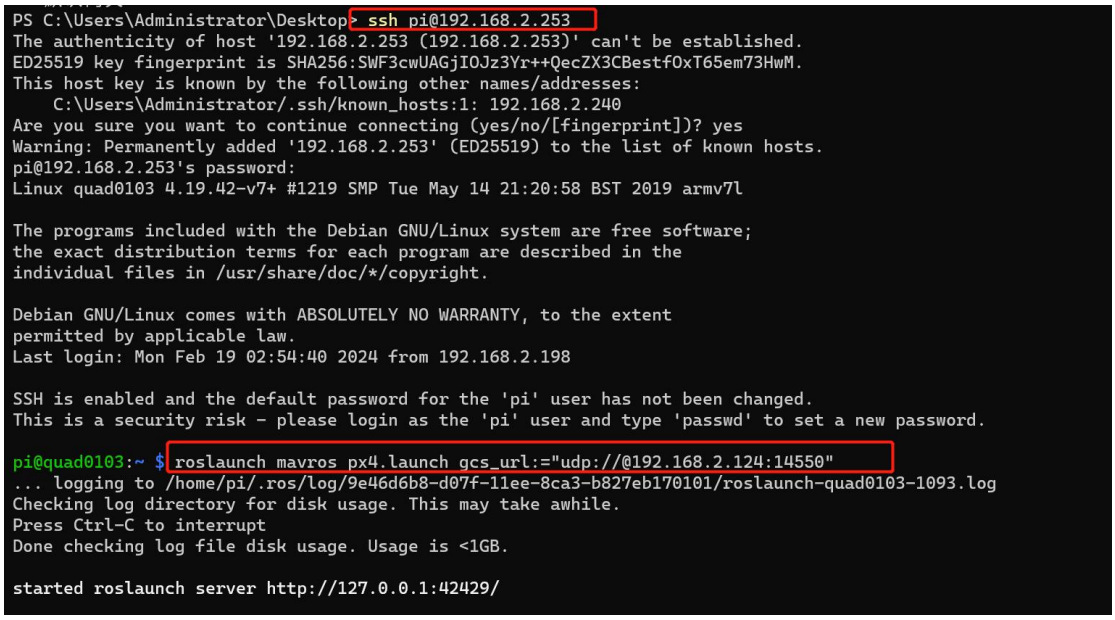

9.4.7

- Open XINGYING, go to software settings, select "Agent Settings," and set the listening port. The listening port should be consistent with the data forwarding port set on the drone. Turn on the ground control station switch.

- Connect the cameras and play the footage, create a rigid body, open an agent window, and bind the created rigid body. Select the device number, specify the type, and then the various gauges in the agent window will begin displaying data, with real-time battery level of the drone showing in the top-right corner.

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■ Precautions

- When switching between live and edit modes, all intelligent agent dashboards in the software interface will be cleared. To restart the agent view, you need to reconfigure the options.
- Please use the intelligent agent function in an environment where the calibration axis (coordinate system origin upward axis) is the Z-axis.
- If the device number is not displayed, please check the following:
- When using a LAN, verify that the IP of the drone and the motion capture computer are on the same subnet.
- Check if the XINGYING ground station is turned on.
- Confirm that the receiving port in XINGYING matches the data forwarding port of the drone.
- Perform a self-check to make sure the drone is working properly.

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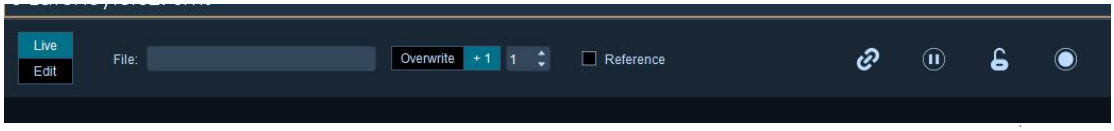
X. Data Record and Fast Playback

1. Data Record

(1) Before recording data, it is necessary to ensure that the software has loaded the configuration file, which can be loaded through the "File -Load Calibration File" option, or a new configuration file can be generated through calibration;

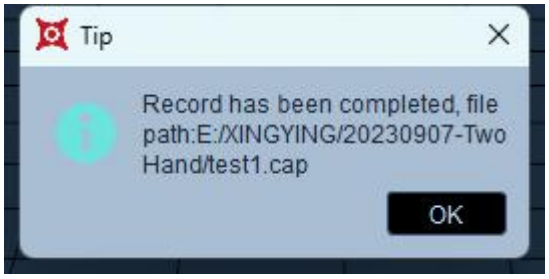
(2) Attach reflective markers to the captured object and place it in the field;

(3) Enter the name of the data file to be collected in the "File Box" below the software interface, avoiding Chinese characters or special symbols. After confirmation, click Enter (10.1.1);



10.1.1

(4) After entering the file name for recording data, click the red recording button below to start recording data, and then click the button to stop recording. At this time, a pop-up window will prompt that the data has been recoreded (10.1.2);



10.1.2

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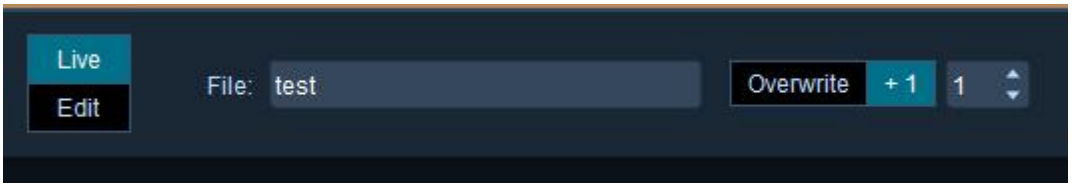
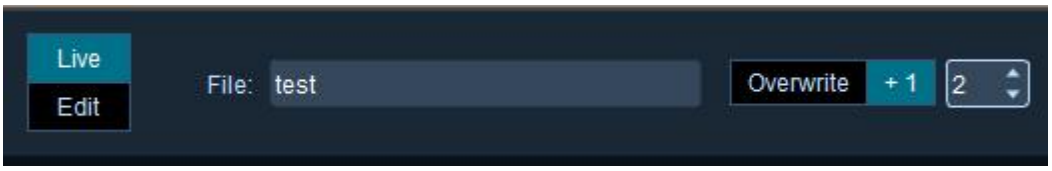
(5) After recording a set of data, the number on the right side of the "File" input box will change to 2, indicating that it is about to record the second set of data with that file name. With the file name unchanged, the number will gradually increase after each set of data is recorded (10.1.3, 10.1.4);

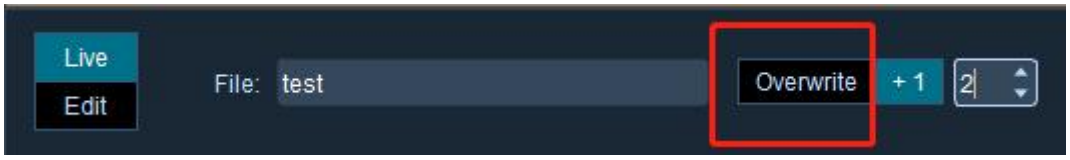


10.1.3



10.1.4

(6) If there are problems recording the second set of data, or for other reasons, you want to re record that set of data by changing the number to 2. At the same time, click on the "Overwrite" button on the left and click on the recording button to re record (10.1.5). You can also do the same for other sets of data;



10.1.5

(7) When recording, XINGYING will be checked to see if there are calibration files used in the current recording directory. If there are no calibration files in the current recording directory, the last loaded calibration file will be automatically copied to the current recording directory;

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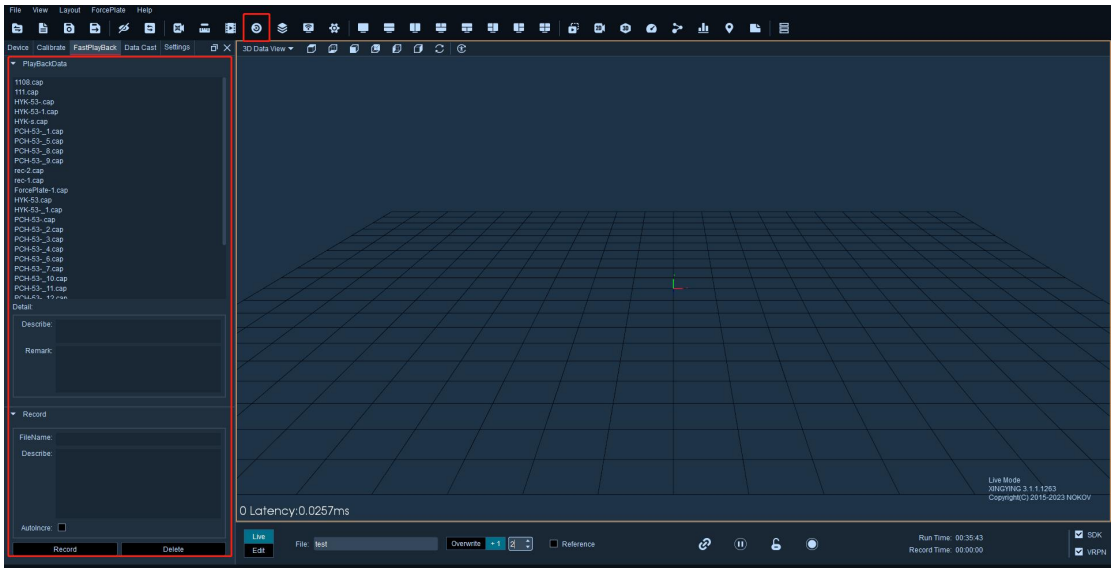
2. Fast Playback

(1) After recording data in Live mode, the fast playback function can be used to playback the recorded data to see if the desired recording effect has been achieved. It can be used for scenes such as studio and virtual shooting. In the quick playback side window, you can also record, delete, add/delete notes and descriptions of data. When recording data, you can also record reference videos. Below is a brief introduction to the various functions in quick playback:

(2) Open Fast Playback:

- After recording motion capture data in Live mode, click the "Fast Playback Pane" button on the toolbar above the software to open the Fast Playback panel (10.2.1).



10.2.1

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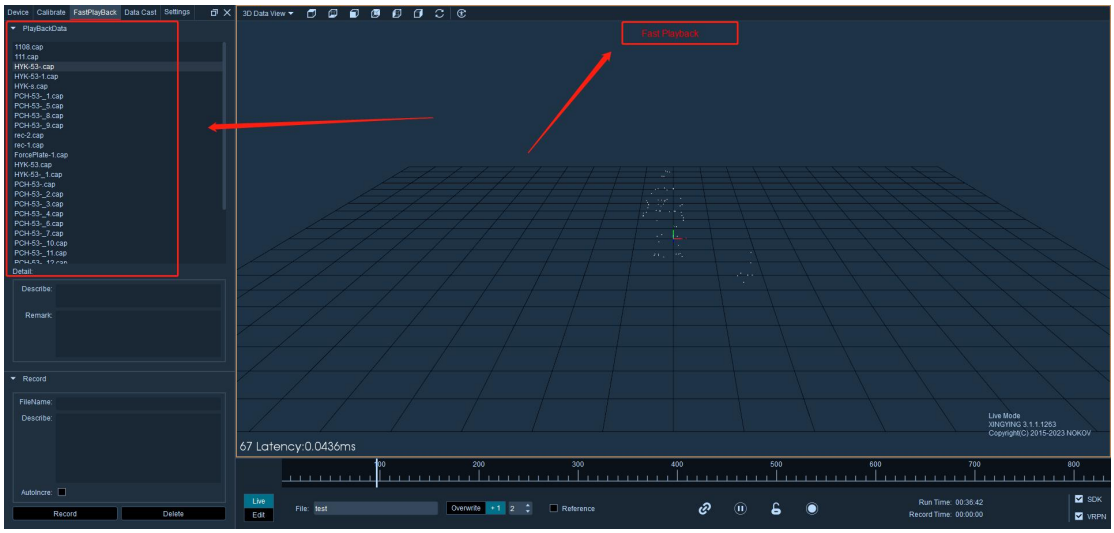
(3) Playback data

- In the "Playback Data" list, all files in the current working path will be displayed Cap file name, the sorting of cap files is based on the recording time of the file, double-click on one Cap file for quick playback of this set of data.

- During quick playback, a red text prompt "Fast Playback in progress" will appear above the 3D view, and the progress bar below will also play forward (10.2.2).

- During the fast playback process, users can pause playback or drag the pointer on the progress bar. After dragging the pointer to a certain frame, the data played in the 3D view will also display the data of that frame synchronously.



10.2.2

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(4) Notes:

- During fast playback, templates cannot be added or removed. To add or remove templates, please exit fast playback first and double-click the name of the played. Cap file again to exit fast playback and return to Live mode.
- When playing back quickly, it will automatically match the loaded Mars file. If the Mars file is not loaded, the MarkerSet will not be displayed in the 3D view.

(5) File Description and Remarks:

- After double clicking on a. Cap file in the "Playback Data" list, you can add descriptions and comments to the cap file in the "Detail" section. The added descriptions and comments will be bound to the cap file. The next time this cap file is played back, the content of the last added description and comment will be displayed in the description and comments section.

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(6) Recording:

- In the quick playback window, you can also perform data recording operations by entering the recorded file name in the file name. You can choose whether to automatically increment the recorded file name. Before recording data, you can enter a description for the recorded data, which will be bound to the recorded file. Click the record button below to start recording, After recording, double-click the. Cap file that was just recorded in the "Playback Data" list. The description box will display the description content entered before recording (10.2.3).

10.2.3

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(7) Delete:

- Manage cap files in the "Playback Data" list. After double-clicking a cap file, you can use the delete button to delete the selected cap file. Except for the Mars file and calibration file that this cap belongs to, all other files will be deleted (please use this function with caution, once the file is deleted, it cannot be restored).

(8) Recording and playback of reference videos:

- If you need to record a reference video, deselect the "Reference Video" checkbox below the software in the quick playback panel before recording data. Click the record button in the quick playback panel or the third record button in the middle of the software to start recording.

- Before recording data, you can also describe the recorded reference video. Enter the description content in the description section of the quick playback panel. After recording, double-click the recording file to start playback, and open the reference video view. The description content entered during data recording will be superimposed on the reference video (10.2.4);

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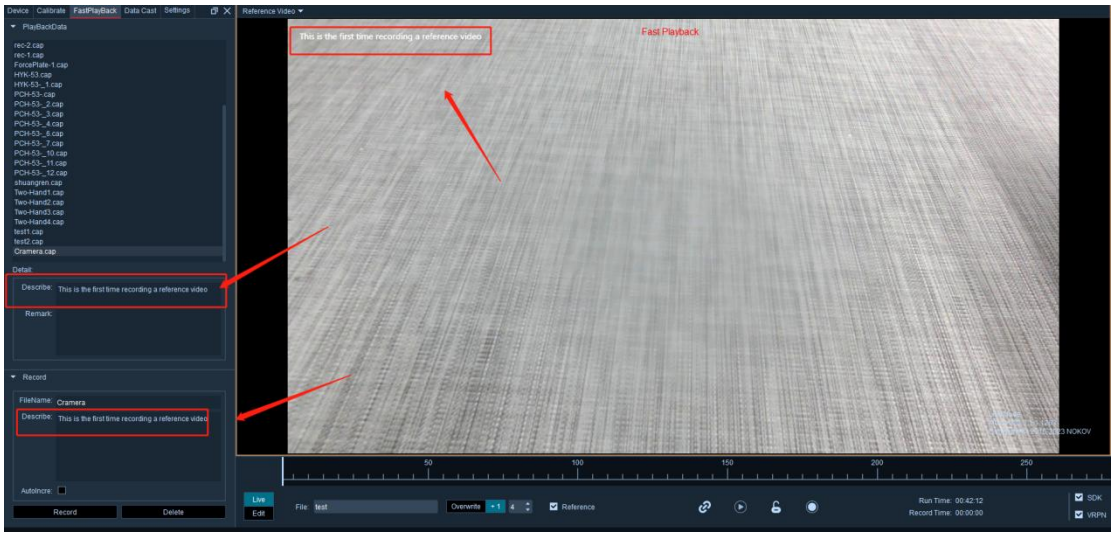

10.2.4

(9) Record files:

- After recording data in Live mode, a recording file will be automatically generated in the same directory as the recording file, which is also the software working path. The file type is a text document (. log). The recording file will record the name of the file recorded on that day, the start and stop recording times, the description information and remarks information during recording, and the recording file name is the date of the day.
- For easier viewing of the content in the file, you can drag the field record file into an Excel spreadsheet to view it.

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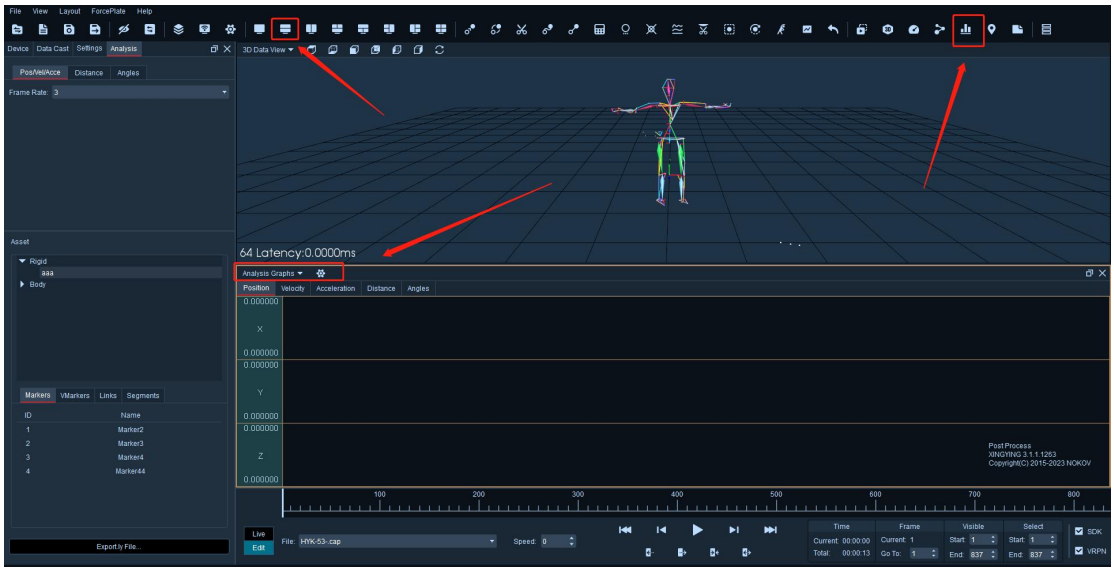
XI. Data Analysis

1. Analyze Graphs(point, line, angle data)

(1) Click on the "Layout -Two Panes: Top/Bottom" option at the top of the interface to split the main interface into two panes. When selecting a pane, there will be an orange border. At this time, click on "View Type" to display "3D Data View" in one window and "Analysis Graphs" in the other window (11.1.1);



11.1.1

(2) In Live mode, the maximum and minimum values of X, Y, and Z will be displayed on the left side of the analysis graphs (11.1.2).

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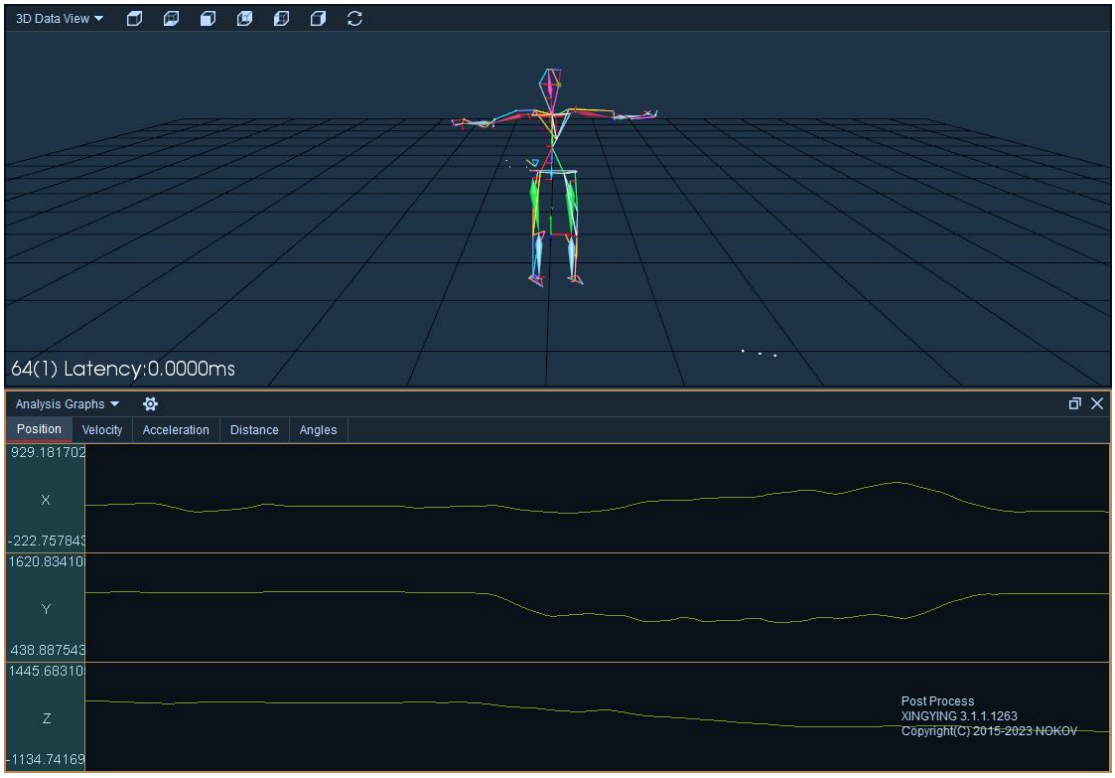
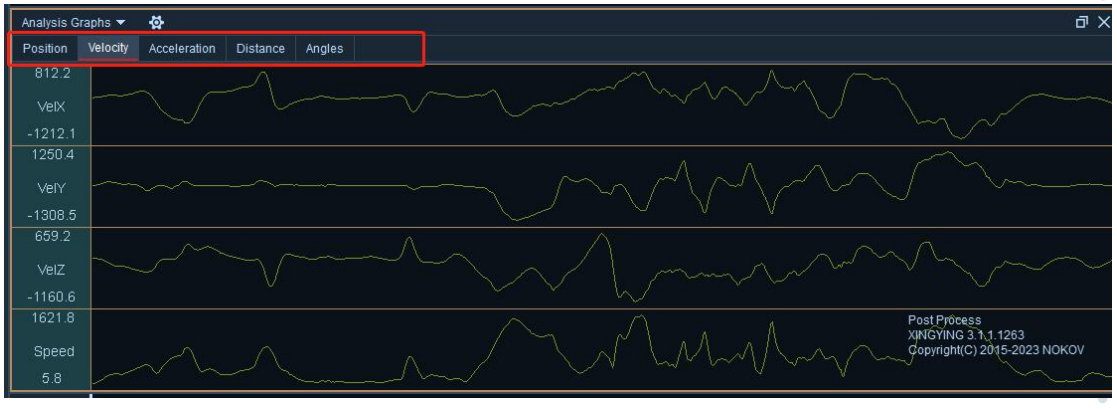


11.1.2

(3) Clicking on "Position/Velocity/Acceleration" indicates the analysis of the position (coordinate), velocity, and acceleration of the Marker point. If "Velocity" is selected, clicking on any Marker will display the velocity and waveform curve of the point in the chart (11.1.3);



11.1.3

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(4) 'Distance' represents the calculation and analysis of the linear distance between two Marker points. Select two Markers in the 3D view or asset panel list, and the analysis chart will display the spacing and curve between these two Markers (11.1.4). Be careful not to select the same point. Two points form a group, and up to ten groups of points can be selected to view distance data;

11.1.4

(5) "Angles" represent the angle between lines connected by multiple Marker points. Select four Markers to view the angle data, and the analysis chart will display the angle changes of the angles between multiple Marker points. Four Marker points are grouped together, displaying up to ten sets of data (11.1.5);

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11.1.5

(6) In the analysis chart, you can drag data left and right by holding down the left button. After selecting a Marker, you can use the shortcut keys of the up and down keys on the keyboard to select the right Marker name.

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2. Skeleton Graphs

(1) Click the button on the upper toolbar to display the skeleton chart. Select the skeleton in the MarkerSet skeleton list in the asset panel, and the data curve of this skeleton will be displayed in the skeleton chart. The "qx, qy, qz, qw" on the right represents the quaternion of skeleton rotation (11.2.1).

11.2.1

(2) In the skeleton chart, you can choose to view the "translation, rotation, velocity, and acceleration" of the skeleton. The "Frame rate" in the skeleton chart settings panel can calculate the frame interval of skeleton data, and you can choose "3, 5, 7, and 9" frames to calculate. Close the skeleton chart window, and the data curves and their quaternion values in the chart will be cleared .

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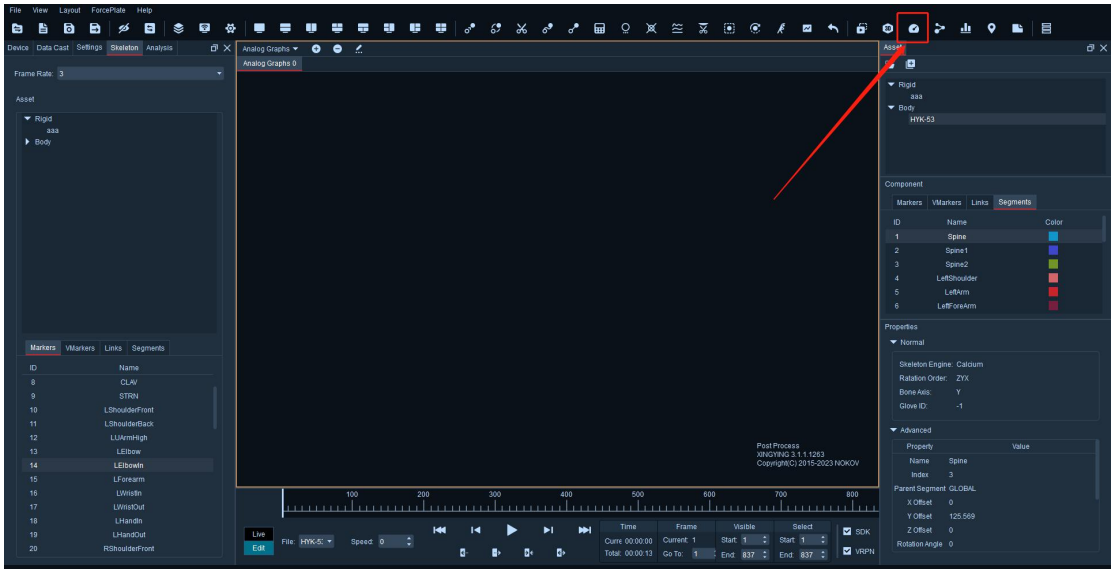
3. Analog Graphs

(1) When using simulation charts in Live mode, please first configure the force measuring platform to ensure that it can be used normally in Live mode. To use simulation charts in Edit, please load cap data containing simulation channels and turn on the enable switch of the force measurement table in the "Force Measurement Table Parameter Settings". Note: The digital force measuring platform does not support analog charts;

(2) Open "Analog Graphs" in the toolbar above the software (11.3.1).



11.3.1

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(3) Right click on the chart and select "Edit Page". All channels will be displayed in the "Channels" panel floating on the left (11.3.2).

- Click on the "Channel" button in the upper left corner of the list to select/deselect all simulation channels, and enable adaptation at the bottom of the panel. If the simulation channel is unchecked, the force and torque data of this channel will not be displayed on the simulation chart.
- The software defaults to a maximum of 6 channels to be added in the channel window. If you need to add more analog channels, please double click on "Maximum Number of Lines" and enter the total number of channels to be checked.
- Double click on 'Page Name' to modify the simulation chart name.

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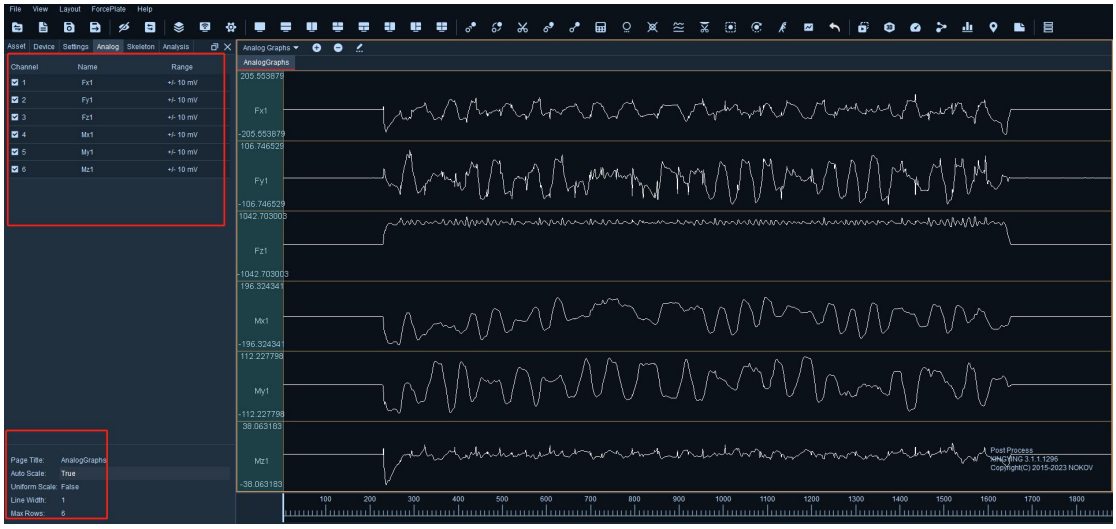
- Double click on "Line Width" and enter numerical values in the input box to increase/decrease the thickness of the lines in the simulation chart;
- Click the+button above the simulation chart to add a simulation chart, or right-click on the Add page in the simulation chart to add a simulation chart.
- If there are multiple simulation charts that need to be deleted, please select the chart above the simulation chart and right-click on the delete page to delete the simulation chart. Alternatively, click the - sign button above the simulation chart to delete the chart. At least one simulation chart must exist, that is, the last simulation chart cannot be deleted.



11.3.2

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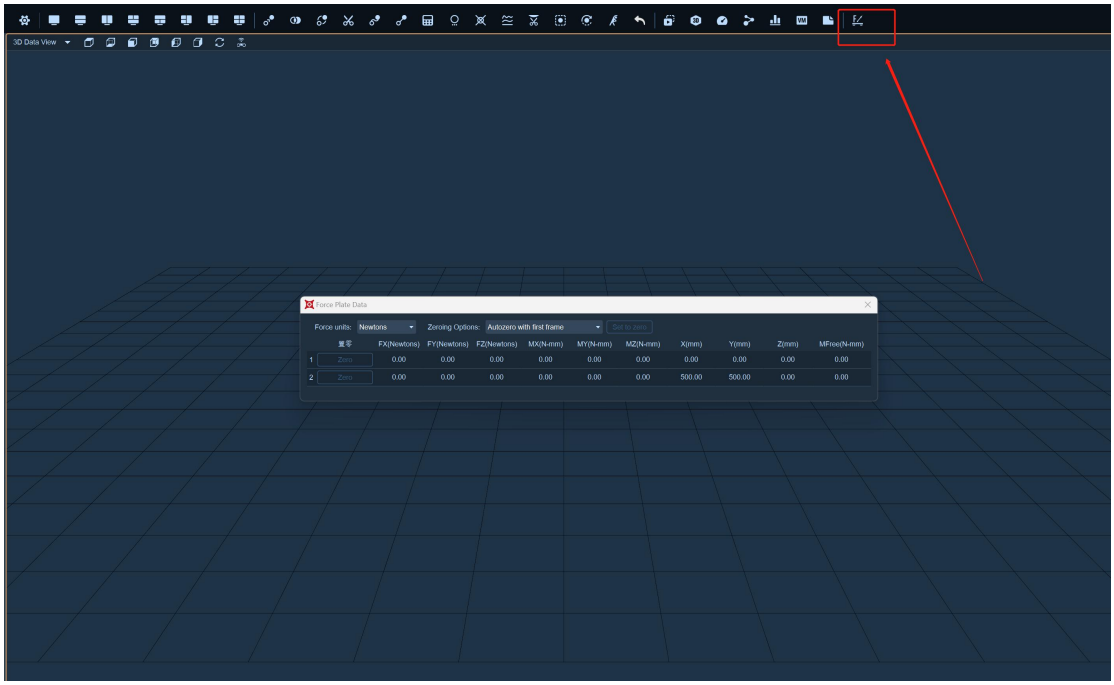
4. Force Plate Data

(1) When using or loading force plate data in live or edit mode, you can open the force plate data (11.4.1), and the "FX, FY, FZ, MX, MY, MZ, X, Y, Z, MFree" values will be displayed in the force plate data;

(2) Click the drop-down box for "Force Units" to change the unit of the data, and in "Zeroing Options," you can choose different zeroing options for the force plate. The default zeroing option is "Autozero with first frame," with the default unit being "Newtons."



11.4.1

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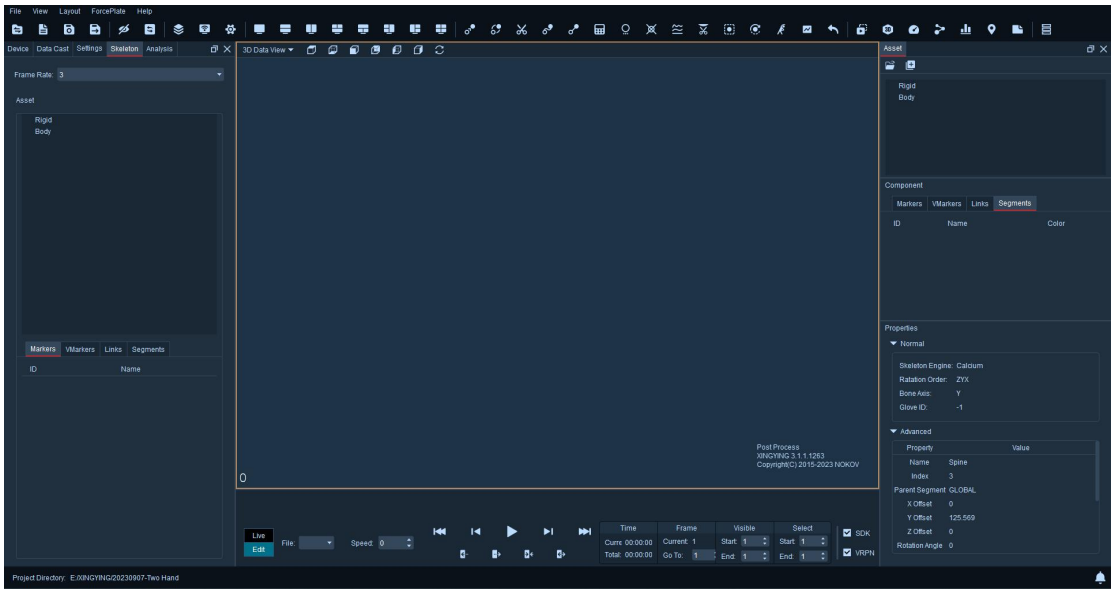
XII. Data Edit

1. Import Data

(1) Click on the "Edit" button below the XINGYING software interface to enter the Edit interface (12.1.1);



12.1.1

(2) Click "File - Load Capture File" to import the captured data file with the suffix ".cap", or directly select the cap data file (12.1.2) from the "File" drop-down menu at the bottom of the interface. When importing a. cap file, if the cap file is large, the software interface will display a progress prompt window for loading the file. When switching cap files in Edit mode, the software will release the memory of the previous loaded cap file to load the selected imported cap file. During the release process, the software will also display a progress prompt window for releasing memory;

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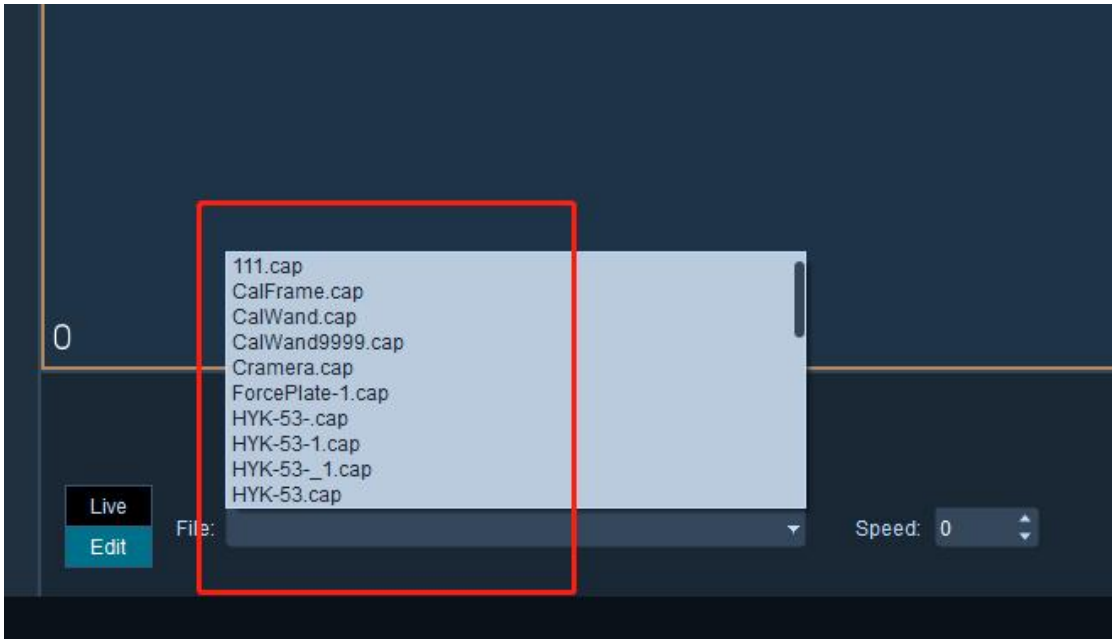
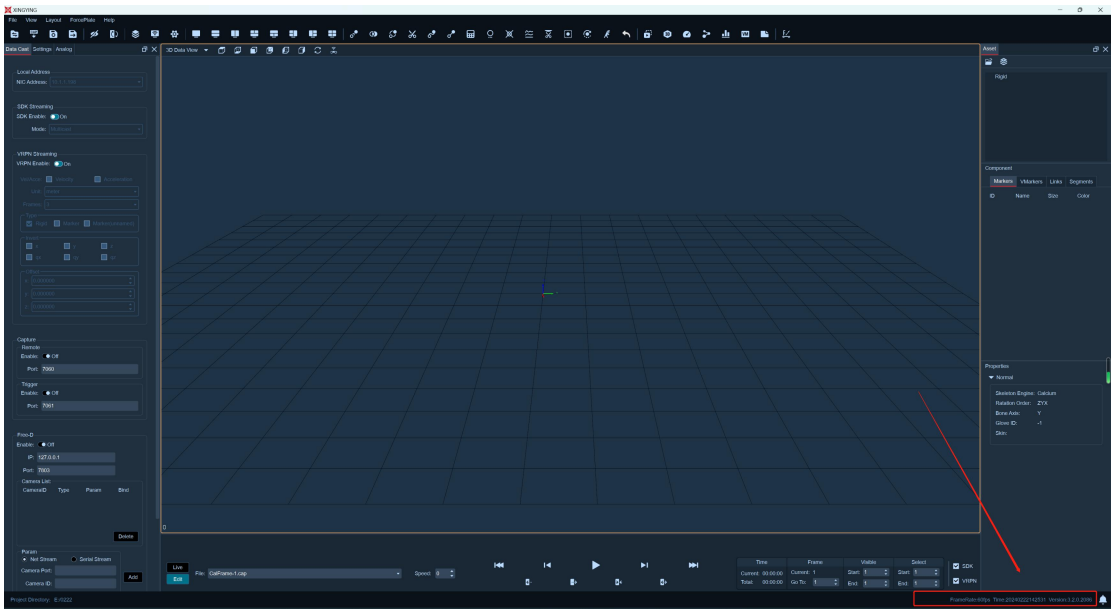


12.1.2

(3) When loading .cap data in edit mode, the software's status bar at the bottom will display the frame rate set during the recording of this data set, the time of recording, and the version number (12.1.3);



12.1.3

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(4) Quickly view the captured content of the imported data in the 3D interface by dragging the timeline (12.1.4) below the XINGYING software interface, or by clicking the operation buttons below the timeline to play, rewind, and move forward/backward frame by frame;

12.1.4

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(5) You can also use the data frame selection button to select the data to be loaded after processing (12.1.5).

- The first button from left to right at the bottom of the Edit interface is the "Select Backward Frame" button. Double-click any frame on the timeline and click "Select Backward Frame". The software will select this frame and all previous frames;
- The second button from left to right in the bottom right of Edit is the "Select Forward Frame" button. Double click any frame on the timeline and click the "Select Forward Frame" button. The software will select this frame and all subsequent frames;
- The third button from left to right at the bottom right of the Edit is the "Select Current Frame" button. If all frames are selected on the timeline, double-click any frame on the timeline and click the "Select Current Frame" button. The software will only select this frame;
- The fourth button from left to right at the bottom right of the Edit is the "Select Visible Frames" button. After clicking this button, all frames on the timeline will be selected.

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12.1.5

■ **Edit mode shortcut key**

(1) After loading cap data in Edit mode, you can use the up and down keys on the keypad to quickly switch to the lost point frame. Pressing the up key will locate the lost point frame forward of the current frame, and pressing the key will locate the lost point frame backward of the current frame.

(2) You can also open the software settings and set the shortcut key for Edit mode in the "Shortcut Key" settings page.

■ **Quickly jump to a specified frame**

(1) Enter the frame number that needs to be skipped in the "Go to" section below the Edit mode, and press the Enter key to jump to this frame.

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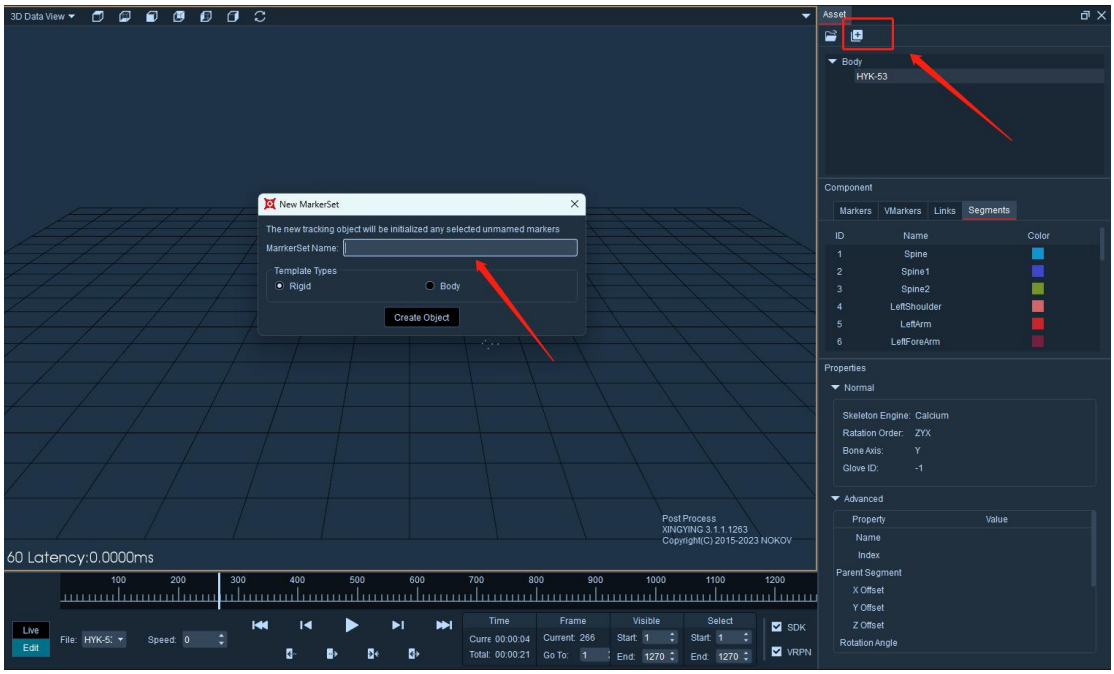
2. Create MarkerSet(Rigid)

■ Create a template

(1) Click on the "Create Asset" button below the asset, enter the MarkerSet name in the pop-up window, and click "Create Object" (12.2.1) to close the window;



12.2.1

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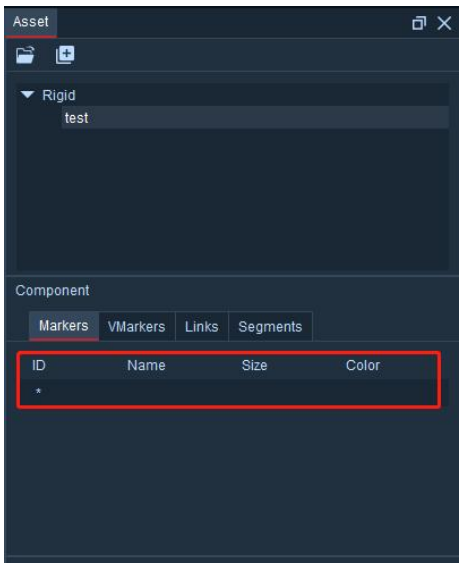
■ **Create unnamed markers**

(1) Click on the Markers tab on the right side of the software interface, double-click on the blank section in the first line to enter the name of the reflective identification point, press Enter to confirm (12.2.2), repeat the operation, and input all the names of the reflective identification points that need to be defined. You can also quickly create Marker names in the Markers tab by pressing the Enter shortcut key. For example, if you need to create five Marker names, select the first row in the Markers tab and quickly press the Enter key five times, the default names from Marker1 to Marker5 will be automatically generated in the Markers tab;

(2) Please note that when manually entering the Markers name in the Markers tab, do not create duplicate Markers names, and do not enter duplicate names when creating Link connections and Segment skeleton names as discussed below;



12.2.2

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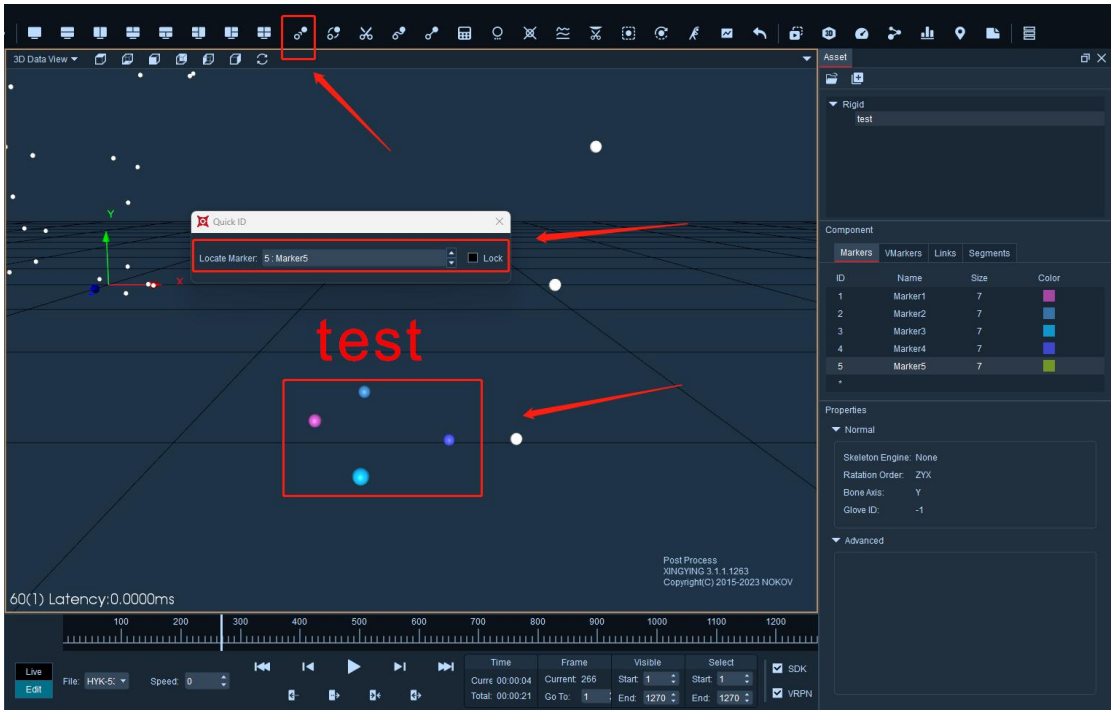
■ Name Marker

(1) By dragging the timeline, select a frame with complete data (no missing markers or error points on the captured object, usually the first frame of the data), click the "Quick ID" button on the toolbar, and a window will pop up displaying "Locate Marker". Based on the selected Marker name displayed in "Locate Marker", click the corresponding point in the 3D view to match (12.2.3), and the matching points will be automatically assigned colors;



12.2.3

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(2) If there is a marker pointing at the wrong position during the matching process, you can click the arrow in the "Quick ID" window, select the wrong marker name, and rematch. After completing the matching of the last marker, the "Quick ID" window will automatically close;

(3) Tick the "Lock" function, and after turning it on, the quick id value will be locked without automatically increasing (12.2.4);

12.2.4

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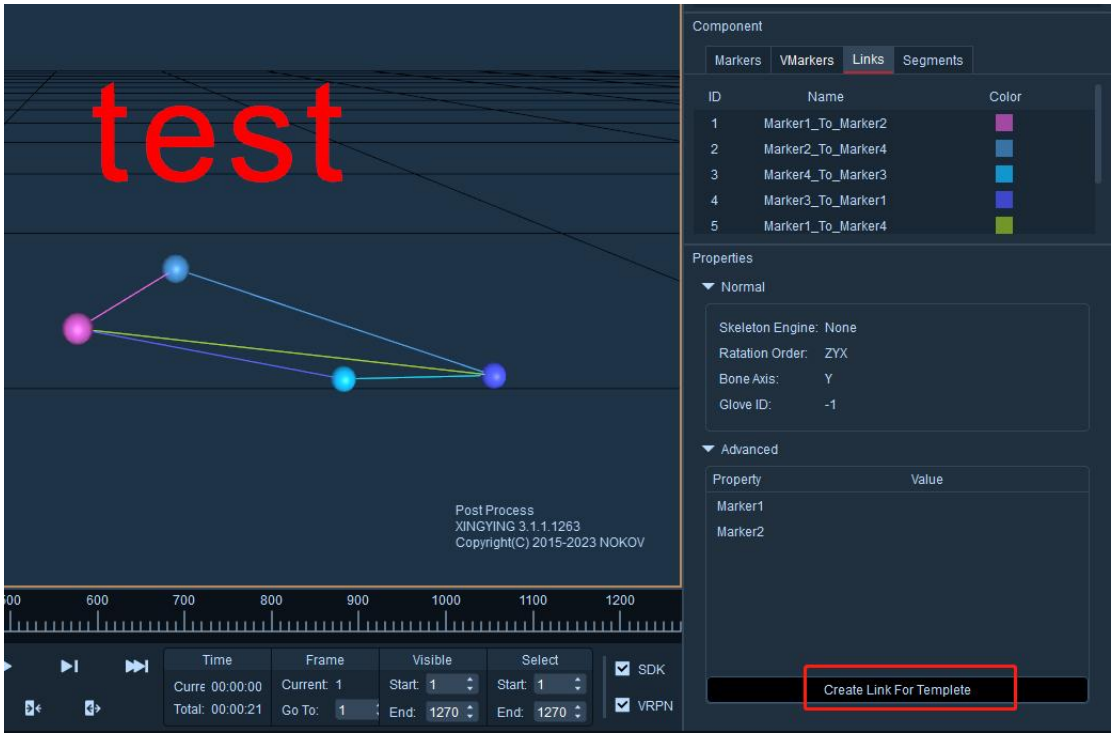
(4) During the matching process, the angle position of the 3D view can be changed by holding down the keyboard Alt/Ctrl/Shift+mouse left/right/scroll keys to confirm the actual position of each point;

■ **Create Link**

(1) After completing all Marker matching, click "Create Link for Template" in the "Links" tab of the component, select a point with the left mouse button in the 3D view, drag to the next point, and the Link Connection creation is completed. The name of this Link Connection will also be automatically generated in the Links tab（12.2.5）;



12.2.5

(2) After creating and setting all Link connections, the points and connections can be seen in the 3D view（12.2.6）;

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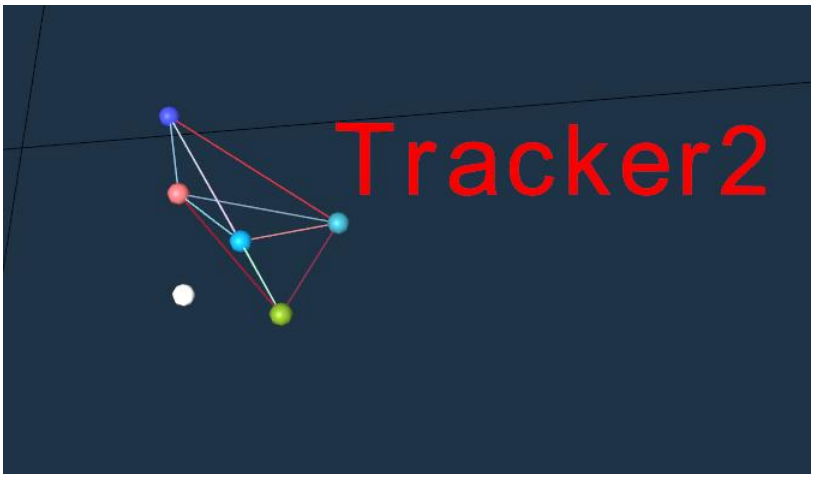
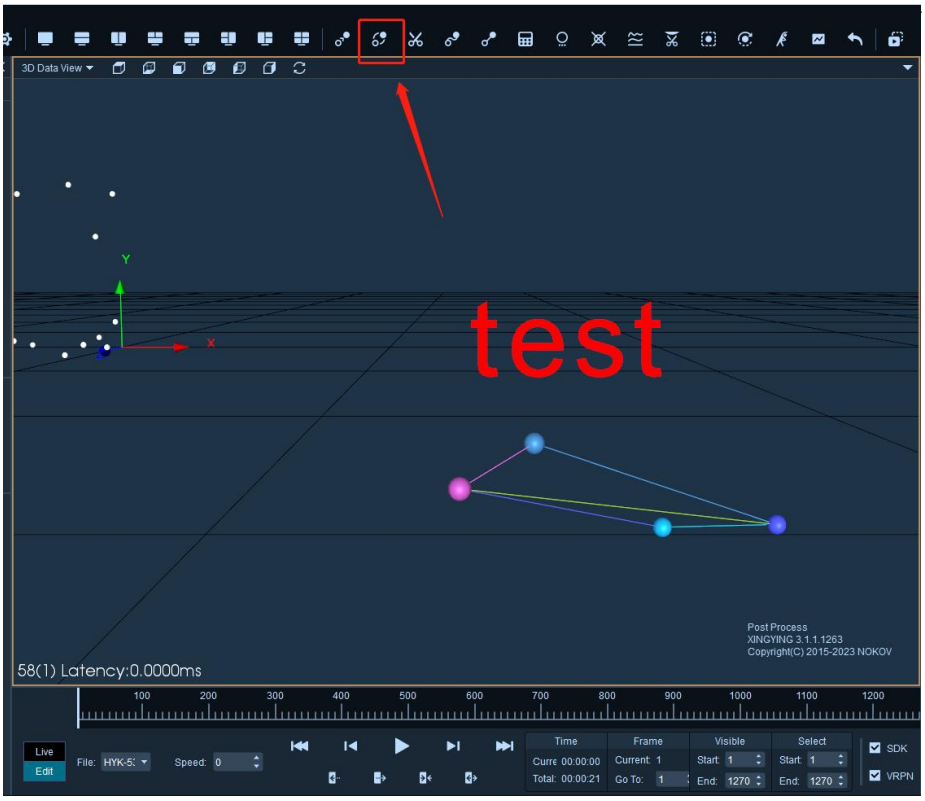


12.2.6

■ **Track and recognize all frames**

(1) Ensure that the data is currently in the first frame, click the "Track recognise" button (12.2.7), apply the definition of points and lines to all frames, and then play the data to see the effect. At this point, the MarkerSet has been created;



12.2.7

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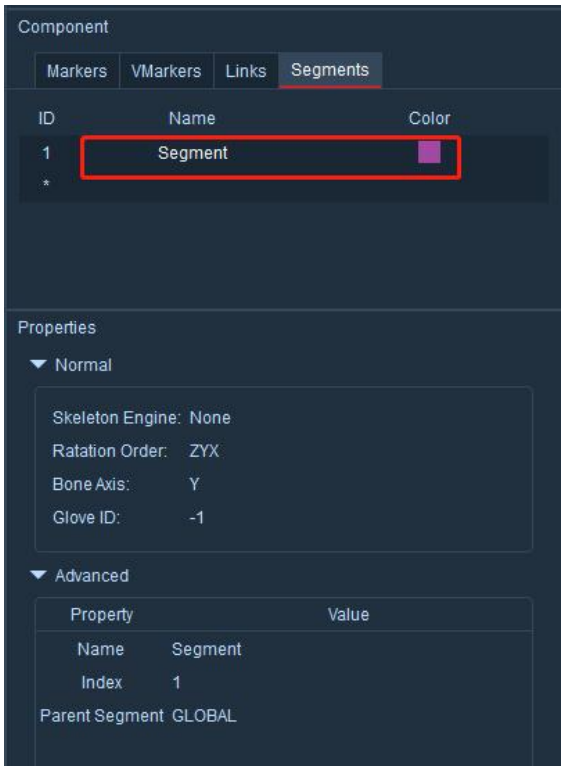
■ Create Skeleton（SKB)

(1) For data that has already established a MarkerSet and completed repairs, skeleton can be established; SKB type skeleton need to be defined by three Marker points in the Markerset, which are used to define the origin (starting point), major axis point (ending point), and flat point of the rigid body. After creating the skeleton, Euler angle data of the rigid body can be obtained, which is commonly used in application scenarios such as drones and robotic arms;

(2) In the Asset Panel - Components - Segments, double-click on the blank section to enter the Segments(skeleton) name (12.2.8);



12.2.8

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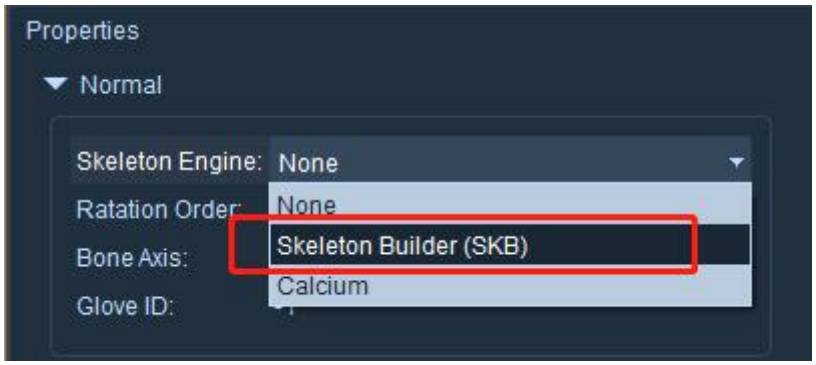
(3) Double click on "Skeleton Engine" in the normal attributes below and select "SKB" from the drop-down menu（12.2.9）；



12.2.9

(4) Select the name of the created skeleton, define the various parameters of the skeleton in the advanced attributes below, define a Marker in the origin, major axis point, and plane point, and input the rotation values of the X, Y, and Z axes to generate the skeleton in the 3D view.

■ **Create Skeleton（Calcium)**

(1) After creating the name of the skeleton, double-click " Skeleton Engine" in the normal attributes below and select "Calcium" from the drop-down menu. The default Euler angle rotation for Calcium type skeleton is ZYX, and the orientation of the skeleton is consistent with that of the calibration file.

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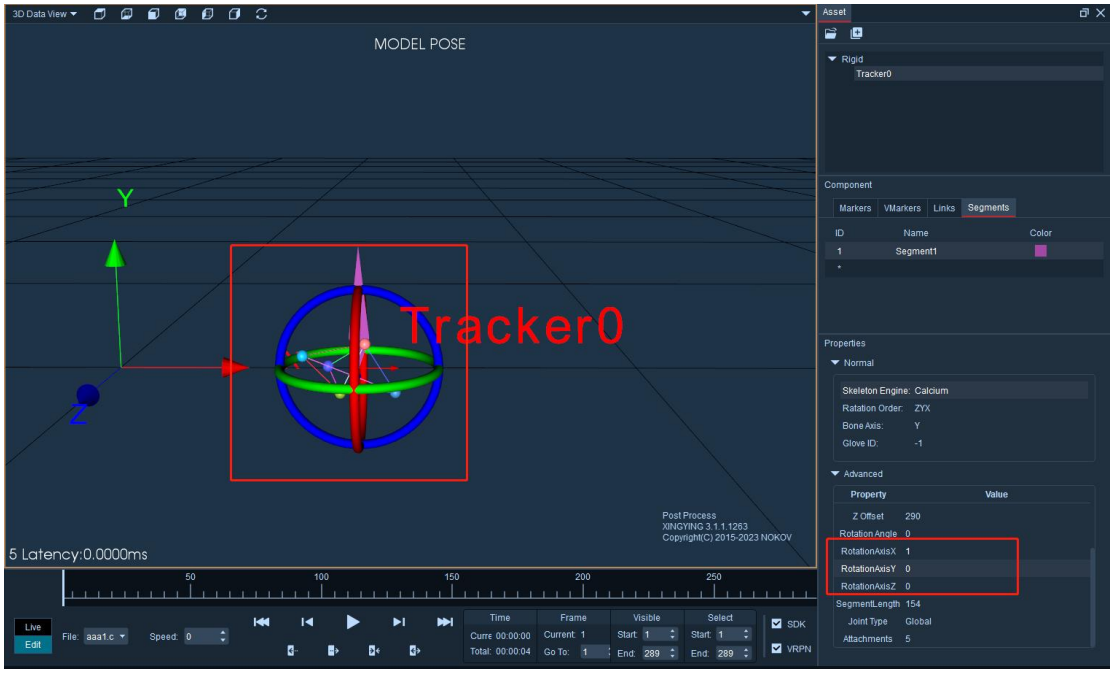
(2) Select the name of the created skeleton and define the various parameters of the skeleton in the advanced attributes below. Right click on "Model Pose" in the 3D view and enter Model Pose mode to adjust the displacement and rotation of the skeleton. Click on "X, Y, and Z axis offset" in the advanced properties. The skeleton will display a cross in the 3D view. Select an axis of the cross and drag to achieve the displacement of the skeleton. Click on "Rotation Axis X, Y, Z", and a three-dimensional circular ring will be displayed on the skeleton in the 3D view. Selecting one axis of the circular ring to rotate can achieve the rotation of the skeleton (12.2.10).



12.2.10

(3) Double click on "SegmentLength" in the advanced attributes and enter a length value. The skeleton length in the 3D view will change.

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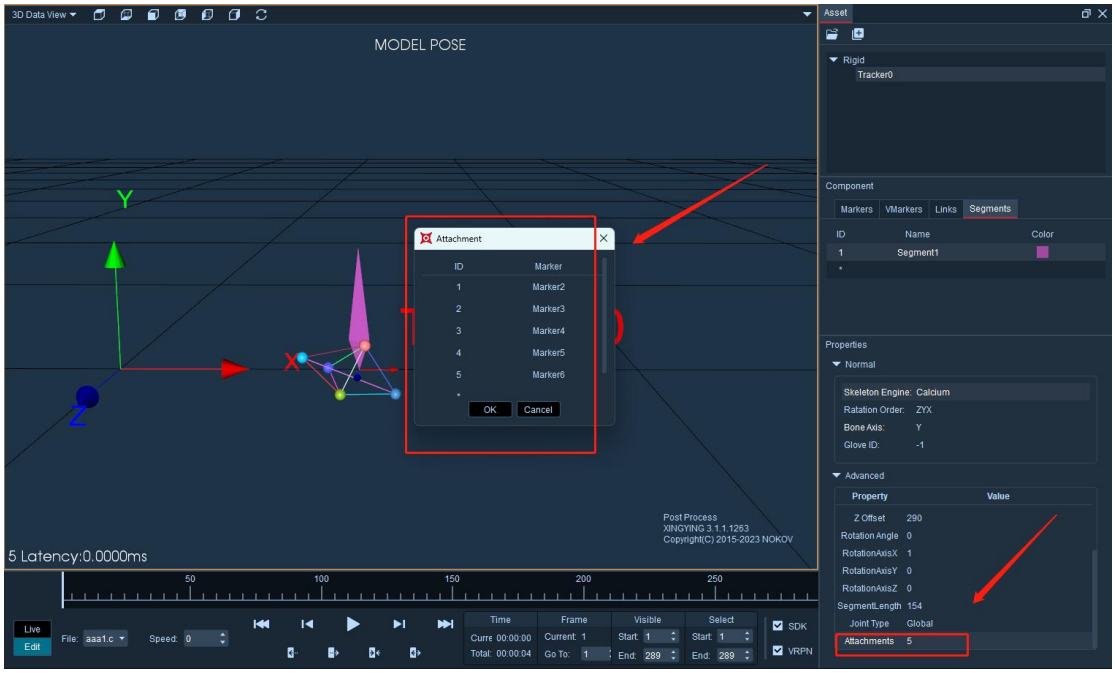
(4) Bind Points: Click on "Attachments" at the bottom of the advanced attributes, select the skeleton's association point from the Asset Component Tag list, and then click on "Confirm" to close the window (12.2.11). The selected Marker point will be bound to the skeleton.



12.2.11

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(5) If the user has created multiple skeleton in a Market, please select one skeleton as the parent skeleton, and the remaining skeleton also need to be set as parent skeleton. Double click on "Parent Segment" in the advanced properties to set the parent segment.

(6) After setting the attributes of the skeleton, right-click on "Model Pose" in the 3D view to exit. The skeleton attributes edited in Model Pose will not take effect immediately, and the data needs to be redirected to the first frame. Click the "Calculate" button on the toolbar above the software. After the solution is completed, the set attributes will take effect.

(7) Click on 'File Save MarkerSet' to save the MarkerSet.

(8) If you need to save the created template in the capture data, please click on "File Save Capture File". If the MarkerSet has not been saved, directly switching to Live mode will prompt the user whether to save the cap file. Click "Yes", and the software will save the newly created MarkerSet template along with the modified cap file;

(9) If there are multiple captured objects in a set of data, multiple Marketers can be created and the above steps can be repeated;

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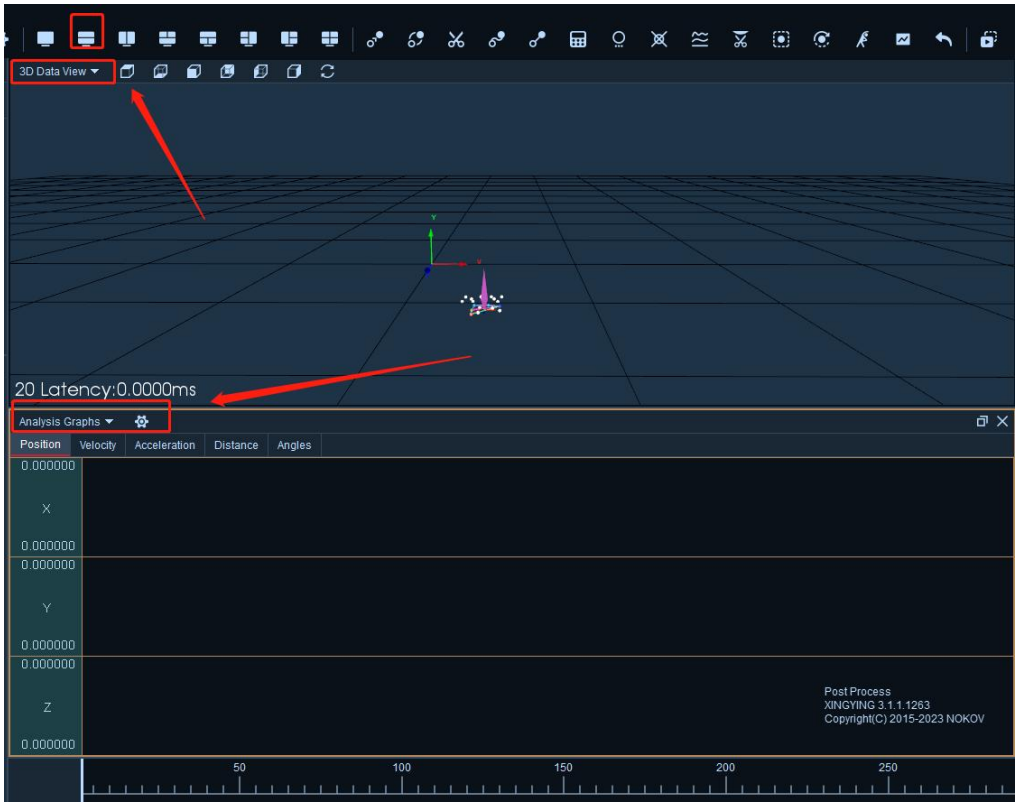
3. Use Created MarkerSet

(1) If there is a MarkerSet file that matches the Marker definition in the capture file and has already been established, you can load it by clicking on "File Load MarkerSet" or clicking on the "Load Asset" button in the asset panel and checking the corresponding MarkerSet file;

4. Data Repair

(1) Click the "Two Views (Top/Bottom)" button on the upper toolbar to split the main interface into two windows. When selecting a window, there will be a yellow border. At this time, in the drop-down menu at the top left of the window, one window will display "3D View" and the other window will select "Analysis Graphs" (12.4.1);



12.4.1

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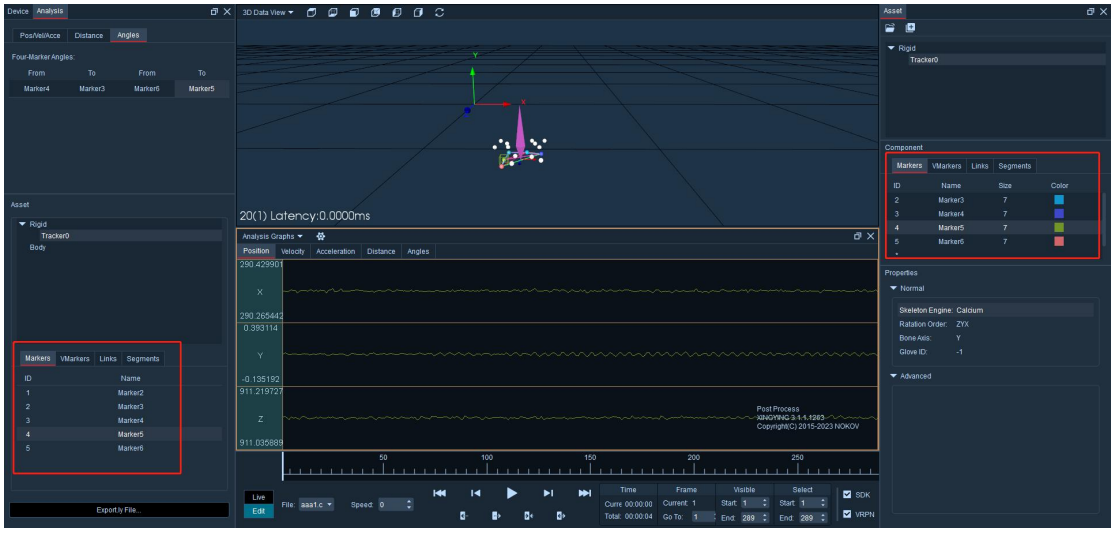
(2) Select the Marker point in the asset panel or the left analysis chart asset panel to see the XYZ coordinate curve of the reflective marker point in the window (12.4.2);

(3) You can use keyboard shortcuts to select the Marker name in the asset panel; If you want to select all the "Marker names" at once, you can use the combination keys of "Ctrl+A" to select all the marker names;

(4) Check each Marker point in the MarkerSet to see if there is any loss of data. When there is a loss of Marker points on the data frame, the chart will display a data loss indicator (12.4.3), which can help us quickly locate the lost point frame. After the data is lost, press the middle mouse button and drag on the timeline to include the missing data. Click the "Cubic join" button in the toolbar to repair it, Note that when the lost data fluctuates significantly and there are five consecutive frames lost, we do not recommend using a cubic connection for repair;



12.4.2

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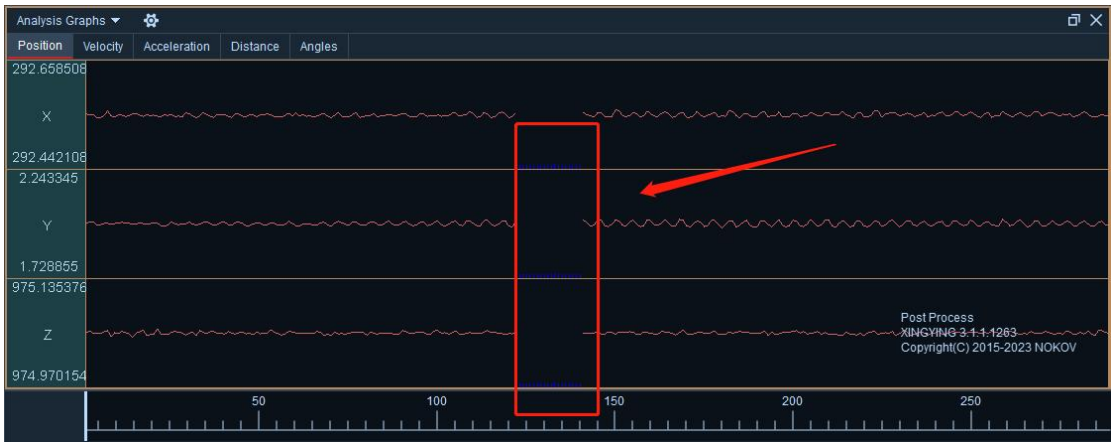

12.4.3

(5) After the data repair is completed, click on "File Save Capture File".

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5. Create Template

(1) After creating a body in Live mode, the model may encounter situations such as unrecognized or incorrectly identified human marker points in the 3D view, disordered and lost human skeleton, or loss of marker points during movement, which can affect the human body effect. If the above situation occurs, please refer to our "Calibration Operation" video and imitate the actions in the video to perform the calibration operation and record it. Then load the recorded data in Edit mode and follow the steps below to create a template. After completing the training, save the template, switch to Live mode, and load the MarkerSet created by the template to make Live human model recognition more accurate.

(2) Before starting the template establishment, it is necessary to first process the motion capture data and repair the missing data frames. For specific repair steps, please refer to "12. Data Processing → (6) Data Repair" above. If there are large areas of missing points or a large number of frames of missing points in the data, it is not recommended to repair them. Only a few missing frames of data need to be repaired.

(3) After repairing the lost data, the next step is to process the Marker points that were not recognized on the human body in the data. Firstly, in the first frame of the data, click the "Exercise" button above the software, select the frame range as "All", click "OK", and then click "Track Recognise". At this time, the Link connections between the points of all frames in the calibration operation data will be recalculated, and all frames will be tracked and recognized once.

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(4) Slowly drag the data progress bar while the software is paused to observe whether there are unrecognized Marker points on the human body in the 3D view. If there are unrecognized Marker points, click "Next Frame" button to play the data frame by frame, determine which frame the point is dropped from, and determine the name of the point (you can skip to the correct frame to identify the Marker name in the asset panel).

(5) Click the quick id button to pop up a dialog box. After selecting the name of an unrecognized point in the asset panel, the name of the point in the quick id dialog box will also change to the name of the selected point in the attribute bar (12.5.1). Click on the unrecognized Marker point in the 3D view, and the Marker point will be recognized correctly. The Link connection between the Marker points will also be automatically completed.

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(6) If the Marker point is not recognized on multiple frames, when using the quick ID for recognition, the quick ID locking function can be used to lock the quick ID value, so that the quick ID value will not automatically increase after rapid recognition.

12.5.1

(7) What just fixed is that the unrecognized point in the current frame has been identified. Next, click on the "Template Track" or "Track Recognise" to identify this point and the Link connection in all frames. Click the "Exercise" button, select all frames for template creation and update Link connections.

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(8) Repeat the above operation to repair other unrecognized Marker points until all data repairs are completed. After confirming that all unrecognized points in this set of data have been repaired, skip to the first frame of the data, click the “Exercise” button, select "All", and check the "Include current frame as the Model Pose" option. Click OK, click the tracking recognition button, click the "File" button, and select "Save MarkerSet", Click to save the capture file.

(9) Switch to Live mode, load the saved template in the asset panel, the model enters the motion capture venue, and connect the camera to play.

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6. Template identify and tracking

(1) The template identify button at the top of the Edit interface will recognize a single frame in the data as a whole after clicking on the template recognition button. Application scenario: When a certain frame shows that some points of the human body are not recognized, stay at the current frame and click "Select Current Frame" below the software. At this time, only the frame with the missing point is selected. Clicking on the template identify will successfully recognize the unrecognized points on this frame;

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(2) Template track function application scenario: If some points are not recognized in a certain frame or all points on the human body are not recognized in consecutive frames, determine the starting and ending frames to be repaired, which is the range of data to be repaired. If some points on the human body are not recognized in the 1000th frame or all points on the human body are not recognized in consecutive frames starting from the 1000th frame, then the starting frame will remain in the first few frames of the 1000th frame, And ensure that all the points of the human body in the consecutive frames before the 1000th frame are correctly recognized. If they are not correctly recognized, please use Quick ID for quick recognition. Next, middle click on the data axis to select the starting frame (i.e. the frames that were correctly recognized before 1000 frames) and ending frame for data repair. Click on the template tracking, and the number of frames that were not recognized within the selected range will be correctly recognized. It is possible that very few points on the frame number are still not recognized or recognized incorrectly. In this case, it is necessary to use Quick ID again to correctly recognize the points;

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7. Rectify

(1) Caution: When selecting a range of frames on the data axis for correction, please ensure that there are no dropped frames in the selected frame range. If there are dropped frames within the selected range, you should set the end frame of the chosen range to the frame before the drop occurs before proceeding with the correction.

(2) At the first frame of the data, select all frames or a continuous range of frames that need to be corrected, and click the correction button. All points across the frames will be properly identified. In rare cases, after using the correction feature, points on some frames may not be identified or correctly identified. If this occurs, select the partial frames where points have not been correctly identified and repeat the above data repair steps.

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8. Use MarkerSet in Live

(1) The software supports Live display of MarkerSet in Live mode, which refers to the defined names of Markers and connections, usually used in conjunction with the SDK;

(2) It is necessary to have a Market file established in Edit mode, or to create a Market in Live through the "freeze frame" function;

(3) In Live mode, ensure that the calibration configuration file has been loaded and connect the camera;

(4) Place the software in a paused playback state, click the "Asset" button at the top of the software interface, check the saved Market file in the pop-up window, and close the small window;

(5) If a Market file is loaded before switching to Live mode and processing mode, there is no need to manually load the Market file when switching to Edit mode and then switching to Live mode. XINGYING software will automatically load the Market file that was loaded in the previous Live mode. After closing the XINGYING software and restarting it, the software will also automatically load the Market file that was loaded in Live before the last shutdown;

(6) Click the play button to see the MarkerSet on the recognition in Live 3D view; In this state, data can also be collected and processed for analysis.

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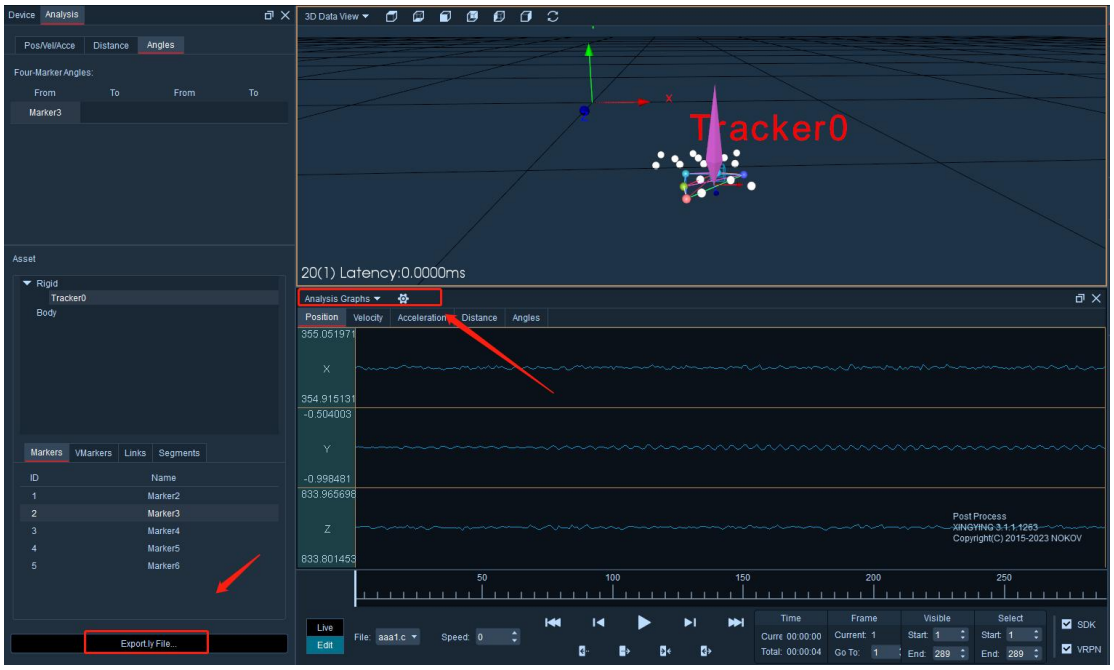
XIII. Data Export

1. Ly File

(1) Switch to the "Edit" mode, load the capture file, spilt the window according to the previous instructions (split views Top and Bottom), and select "Analysis Graphs" in the second window. Click the Analysis Graphs Settings button, select the position, velocity, acceleration, distance, and angle of the marker to be exported as needed, click "Export. ly File" (13.1.1), and a dialog box will pop up. Select the path and name of the file, and click "Save".



13.1.1

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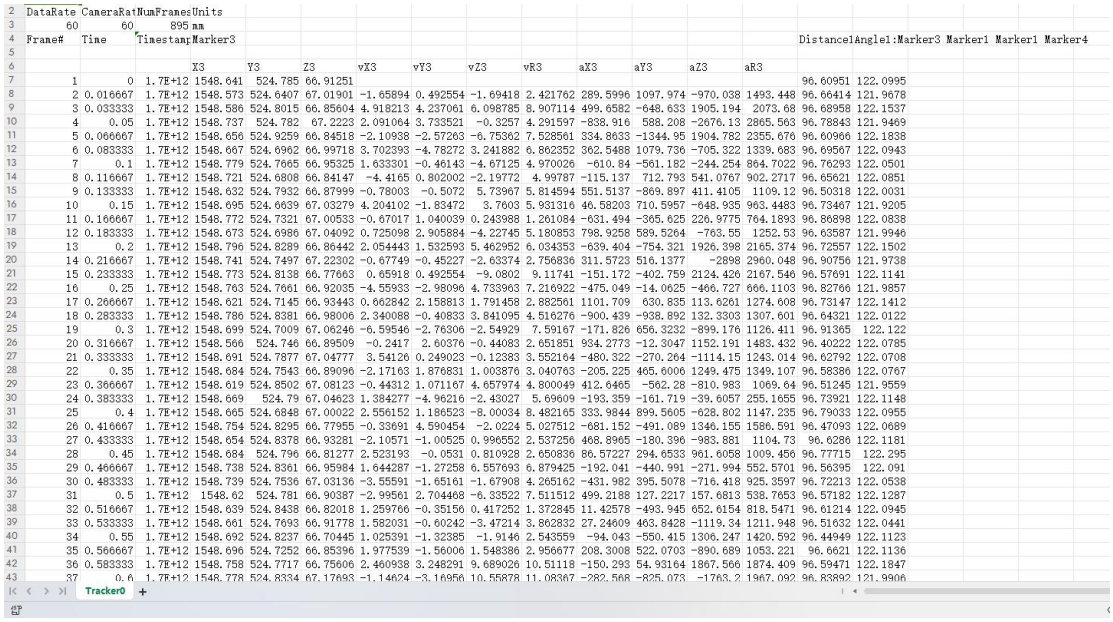
(2) The ly file supports opening in Excel format, with data formats such as "frame, time, timestamp, xyz coordinates, xyz velocity and sum velocity, xyz acceleration and sum acceleration, spacing, and angle" (13.1.2);



DataRate	CameraRat	NumFrames	Units													
60	60	895	mm													
Frame#	Time	Timestamp	Marker3												Distance	Angle1:Marker3 Marker1 Marker1 Marker4
			X3	Y3	Z3	vX3	vY3	vZ3	vR3	aX3	aY3	aZ3	aR3			
1	0	1.7E+12	1548.641	524.785	66.91251										96.60951	122.0995
2	0.016667	1.7E+12	1548.573	524.6407	67.01901	-1.65894	0.492554	-1.69418	2.421762	289.5996	1097.974	-970.038	1493.448		96.66414	121.9678
3	0.033333	1.7E+12	1548.586	524.8015	66.85604	4.918213	4.237061	6.098785	8.907114	499.6582	-648.633	1905.194	2073.68		96.68958	122.1537
4	0.05	1.7E+12	1548.737	524.782	67.2223	2.091064	3.733521	-0.3257	4.291597	-838.916	588.208	-2676.13	2865.563		96.78843	121.9469
5	0.066667	1.7E+12	1548.656	524.9259	66.84518	-2.10938	-2.57263	-6.75362	7.528561	334.8633	-1344.95	1904.782	2355.676		96.60966	122.1838
6	0.083333	1.7E+12	1548.667	524.6962	66.99718	3.702393	-4.78272	3.241882	6.862352	362.5488	1079.736	-705.322	1339.683		96.69567	122.0943
7	0.1	1.7E+12	1548.779	524.7665	66.95325	1.633301	-0.46143	-4.67125	4.970026	-610.84	-561.182	-244.254	864.7022		96.76293	122.0501
8	0.116667	1.7E+12	1548.721	524.6808	66.84147	-4.4165	0.802002	-2.19772	4.99787	-115.137	712.793	541.0767	902.2717		96.65621	122.0851
9	0.133333	1.7E+12	1548.632	524.7932	66.87999	-0.78003	-0.5072	5.73967	5.814594	551.5137	-869.897	411.4105	1109.12		96.50318	122.0031
10	0.15	1.7E+12	1548.695	524.6639	67.03279	4.204102	-1.83472	3.7603	5.931316	46.58203	710.5957	-648.935	963.4483		96.73467	121.9205
11	0.166667	1.7E+12	1548.772	524.7321	67.00533	-0.67017	1.040039	0.243988	1.261084	-631.494	-365.625	226.9775	764.1893		96.86898	122.0838
12	0.183333	1.7E+12	1548.673	524.6986	67.04092	0.725098	2.905884	-4.22745	5.180853	798.9258	589.5264	-763.55	1252.53		96.63587	121.9946
13	0.2	1.7E+12	1548.796	524.8289	66.86442	2.054443	1.532593	5.462952	6.034353	-639.404	-754.321	1926.398	2165.374		96.72557	122.1502
14	0.216667	1.7E+12	1548.741	524.7497	67.22302	-0.67749	-0.45227	-2.63374	2.756836	311.5723	516.1377	-2898	2960.048		96.90756	121.9738
15	0.233333	1.7E+12	1548.773	524.8138	66.77663	0.65918	0.492554	-9.0802	9.11741	-151.172	-402.759	2124.426	2167.546		96.57691	122.1141
16	0.25	1.7E+12	1548.763	524.7661	66.92035	-4.55933	-2.98096	4.733963	7.216922	-475.049	-14.0625	-466.727	666.1103		96.82766	121.9857
17	0.266667	1.7E+12	1548.621	524.7145	66.93443	0.662842	2.158813	1.791458	2.882561	1101.709	630.835	113.6261	1274.608		96.73147	122.1412
18	0.283333	1.7E+12	1548.786	524.8381	66.98006	2.340088	-0.40833	3.841095	4.516276	-900.439	-938.892	132.3303	1307.601		96.64321	122.0122
19	0.3	1.7E+12	1548.699	524.7009	67.06246	-6.59546	-2.76306	-2.54929	7.59167	-171.826	656.3232	-899.176	1126.411		96.91365	122.122
20	0.316667	1.7E+12	1548.566	524.746	66.89509	-0.2417	2.60376	-0.44083	2.651851	934.2773	-12.3047	1152.191	1483.432		96.40222	122.0785
21	0.333333	1.7E+12	1548.691	524.7877	67.04777	3.54126	0.249023	-0.12383	3.552164	-480.322	-270.264	-1114.15	1243.014		96.62792	122.0708
22	0.35	1.7E+12	1548.684	524.7543	66.89096	-2.17163	1.876831	1.003876	3.040763	-205.225	465.6006	1249.475	1349.107		96.58386	122.0767
23	0.366667	1.7E+12	1548.619	524.8502	67.08123	-0.44312	1.071167	4.657974	4.800049	412.6465	-562.28	-810.983	1069.64		96.51245	121.9559
24	0.383333	1.7E+12	1548.669	524.79	67.04623	1.384277	-4.96216	-2.43027	5.69609	-193.359	-161.719	-39.6057	255.1655		96.73921	122.1148
25	0.4	1.7E+12	1548.665	524.6848	67.00022	2.556152	1.186523	-8.00034	8.482165	333.9844	899.5605	-628.802	1147.235		96.79033	122.0955
26	0.416667	1.7E+12	1548.754	524.8295	66.77955	-0.33691	4.590454	-2.0224	5.027512	-681.152	-491.089	1346.155	1586.591		96.47093	122.0689
27	0.433333	1.7E+12	1548.654	524.8378	66.93281	-2.10571	-1.00525	0.996552	2.537256	468.8965	-180.396	-983.881	1104.73		96.6286	122.1181
28	0.45	1.7E+12	1548.684	524.796	66.81277	2.523193	-0.0531	0.810928	2.650836	86.57227	294.6533	961.6058	1009.456		96.77715	122.295
29	0.466667	1.7E+12	1548.738	524.8361	66.95984	1.644287	-1.27258	6.557693	6.879425	-192.041	-440.991	-271.994	552.5701		96.56395	122.091
30	0.483333	1.7E+12	1548.739	524.7536	67.03136	-3.55591	-1.65161	-1.67908	4.265162	-431.982	395.5078	-716.418	925.3597		96.72213	122.0538
31	0.5	1.7E+12	1548.62	524.781	66.90387	-2.99561	2.704468	-6.33522	7.511512	499.2188	127.2217	157.6813	538.7653		96.57182	122.1287
32	0.516667	1.7E+12	1548.639	524.8438	66.82018	1.259766	-0.35156	0.417252	1.372845	11.42578	-493.945	652.6154	818.5471		96.61214	122.0945
33	0.533333	1.7E+12	1548.661	524.7693	66.91778	1.582031	-0.60242	-3.47214	3.862832	27.24609	463.8428	-1119.34	1211.948		96.51632	122.0441
34	0.55	1.7E+12	1548.692	524.8237	66.70445	1.025391	-1.32385	-1.9146	2.543559	-94.043	-550.415	1306.247	1420.592		96.44949	122.1123
35	0.566667	1.7E+12	1548.696	524.7252	66.85396	1.977539	-1.56006	1.548386	2.956677	208.3008	522.0703	-890.689	1053.221		96.6621	122.1136
36	0.583333	1.7E+12	1548.758	524.7717	66.75606	2.460938	3.248291	9.689026	10.51118	-150.293	54.93164	1867.566	1874.409		96.59471	122.1847
37	0.6	1.7E+12	1548.778	524.8334	67.17693	-1.14624	-3.16956	10.55878	11.08367	-282.568	-825.073	-1763.2	1967.092		96.83892	121.9906

Tracker0

13.1.2

2. XRS File

(1) For cap files containing Rigid, you can export xrs files to view the motion data of Rigid;

(2) In Edit mode, after loading the dynamic capture data, click "File" and select "Export XRS File". The system prompts that the XRS file has been successfully exported, and then click OK (13.2.1). The system saves XRS files to the working path by default, with naming rules: cap file name+'-'+MarkerSet name+'. xrs';

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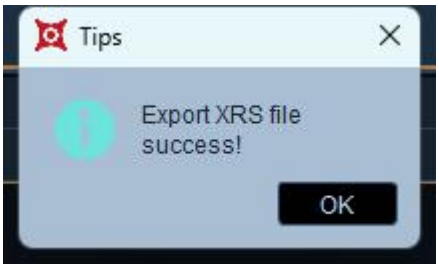

13.2.1

(3) XRS files support opening in Excel format, with data formats such as frames, timestamps, xyz coordinates, quaternions qx, qy, qz, qw, and rigid body length (as shown in Figure 13.2.2);

# Hierarchical Translation and Rotation (.xrs) file									
[Head]									
NumFrames	NumSegmer	DataFrame	EulerRots	BoneAxis	TranslationUnits				
895		1		60	ZYX		Y		mm
[SegmentNames&Hierarchy]									
Segment					Parent				
Segment1					Global				
[SegmentData]									
Frame#		Segment1							
	Timestamp	XToGlobal	YToGlobal	ZToGlobal	QxToGlobal	QyToGlobal	QzToGlobal	QwToGlobal	Segmentlength1
1	1.7E+12	1490.249	544.0136	8.174683	0.002075	-0.00052	0.000237	0.999998	194
2	1.7E+12	1490.246	543.9562	8.143104	0.002956	-0.00093	0.000698	0.999995	194
3	1.7E+12	1490.136	543.9835	8.138408	0.002085	-0.00052	0.00053	0.999998	194
4	1.7E+12	1490.259	544.0038	8.244776	0.001802	-0.0009	0.000374	0.999998	194
5	1.7E+12	1490.223	544.0699	8.205189	0.002188	-0.00024	0.000686	0.999997	194
6	1.7E+12	1490.221	543.9562	8.244285	0.003073	-0.00041	0.000732	0.999995	194
7	1.7E+12	1490.277	544.041	8.160295	0.002101	-0.00026	0.000456	0.999998	194
8	1.7E+12	1490.294	544.0179	8.156736	0.002973	-0.00017	0.000399	0.999995	194
9	1.7E+12	1490.301	544.0061	8.11209	0.001816	-0.00053	0.000273	0.999998	194
10	1.7E+12	1490.265	544.0183	8.154387	0.002508	-0.00039	0.000064	0.999997	194
11	1.7E+12	1490.217	544.0249	8.202109	0.002449	-0.00027	0.00054	0.999997	194
12	1.7E+12	1490.256	544.0138	8.256482	0.002323	-0.00034	0.000086	0.999997	194
13	1.7E+12	1490.243	544.0116	8.157231	0.002164	-0.00022	0.000679	0.999997	194
14	1.7E+12	1490.244	544.0078	8.250343	0.001828	-0.00067	0.000196	0.999998	194
15	1.7E+12	1490.285	544.0427	8.131745	0.002264	0.000003	0.000413	0.999997	194
16	1.7E+12	1490.293	544.0844	8.066724	0.002185	-0.00044	0.000669	0.999997	194
17	1.7E+12	1490.235	544.0022	8.190016	0.00201	-0.00056	0.000233	0.999998	194
18	1.7E+12	1490.28	544.0496	8.209882	0.001768	-0.00015	0.000319	0.999998	194
19	1.7E+12	1490.165	543.9669	8.200442	0.002143	-0.00083	0.000432	0.999997	194
20	1.7E+12	1490.22	543.939	8.25822	0.002292	-0.00023	0.000254	0.999997	194
21	1.7E+12	1490.274	544.0223	8.291356	0.001876	-0.00052	0.000045	0.999998	194
22	1.7E+12	1490.257	543.9904	8.174574	0.002549	-0.00059	0.000796	0.999996	194
23	1.7E+12	1490.291	544.0111	8.245888	0.001673	-0.00054	0.000296	0.999998	194
24	1.7E+12	1490.253	543.9969	8.267346	0.001083	-0.00054	-5.4E-05	0.999999	194
25	1.7E+12	1490.236	543.9835	8.185547	0.002633	-0.00086	0.000728	0.999996	194

13.2.2

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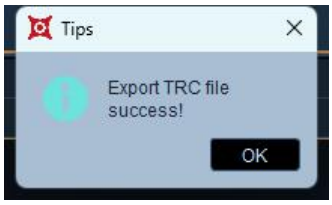
3. TRC File

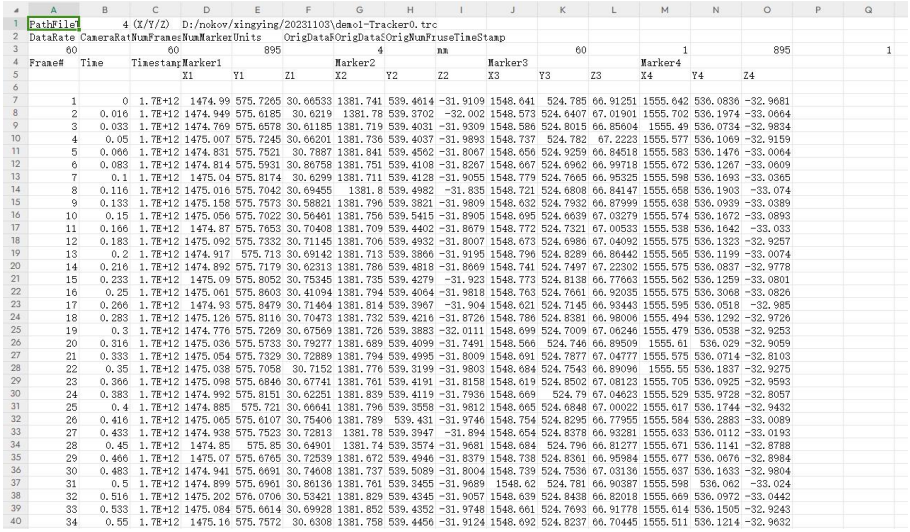
(1) The TRC file is a coordinate data file for points, which outputs the data coordinates of named and unnamed points contained in the cap file into a file;

(2) In Edit mode, after loading the capture data, click "File" and select "Export TRC File". The system prompts that the export of TRC file was successful, and then click "Confirm" (13.3.1). The system saves the TRC file to the working path by default. The naming convention is cap file name+'-'+MarkerSet name+'. xrs', and the coordinate data of unnamed points is also exported by default. The naming convention is cap file name+' - '+unnamed+'. xrs';



13.3.1

(3) Trc files support opening in Excel format, with data format of "frame, time, timestamp, xyz coordinates" (13.3.2);



PathFile	4 (X/Y/Z)	D:/nokov/xingying/20231103\demo1-Tracker0.trc														
DataRate	CameraRat	NumFrames	NumMarker	Units	OrigDataS	OrigDataR	OrigNumFr	useTimeStamp								
60		60	895		4		mm			60		1		895		1
Frame#	Time	Timestamp	Marker1			Marker2			Marker3			Marker4				
			X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3	X4	Y4	Z4		
1	0	1.7E+12	1474.99	575.7265	30.66533	1381.741	539.4614	-31.9109	1548.641	524.785	66.91251	1555.642	536.0836	-32.9681		
2	0.016	1.7E+12	1474.949	575.6185	30.6219	1381.78	539.3702	-32.002	1548.573	524.6407	67.01901	1555.702	536.1974	-33.0664		
3	0.033	1.7E+12	1474.769	575.6578	30.61185	1381.719	539.4031	-31.9309	1548.586	524.8015	66.85604	1555.49	536.0734	-32.9834		
4	0.05	1.7E+12	1475.007	575.7245	30.66201	1381.736	539.4037	-31.9893	1548.737	524.782	67.2223	1555.577	536.1069	-32.9159		
5	0.066	1.7E+12	1474.831	575.7521	30.7887	1381.841	539.4562	-31.8067	1548.656	524.9259	66.84518	1555.583	536.1476	-33.0064		
6	0.083	1.7E+12	1474.814	575.5931	30.86758	1381.751	539.4108	-31.8267	1548.667	524.6962	66.99718	1555.672	536.1267	-33.0609		
7	0.1	1.7E+12	1475.04	575.8174	30.6299	1381.711	539.4128	-31.9055	1548.779	524.7665	66.95325	1555.598	536.1693	-33.0365		
8	0.116	1.7E+12	1475.016	575.7042	30.69455	1381.8	539.4982	-31.835	1548.721	524.6808	66.84147	1555.658	536.1903	-33.074		
9	0.133	1.7E+12	1475.158	575.7573	30.58821	1381.796	539.3821	-31.9809	1548.632	524.7932	66.87999	1555.638	536.0939	-33.0389		
10	0.15	1.7E+12	1475.056	575.7022	30.56461	1381.756	539.5415	-31.8905	1548.695	524.6639	67.03279	1555.574	536.1672	-33.0893		
11	0.166	1.7E+12	1474.87	575.7653	30.70408	1381.709	539.4402	-31.8679	1548.772	524.7321	67.00533	1555.538	536.1642	-33.033		
12	0.183	1.7E+12	1475.092	575.7332	30.71145	1381.706	539.4932	-31.8007	1548.673	524.6986	67.04092	1555.575	536.1323	-32.9257		
13	0.2	1.7E+12	1474.917	575.713	30.69142	1381.713	539.3866	-31.9195	1548.796	524.8289	66.86442	1555.565	536.1199	-33.0074		
14	0.216	1.7E+12	1474.892	575.7179	30.62313	1381.786	539.4818	-31.8669	1548.741	524.7497	67.22302	1555.575	536.0837	-32.9778		
15	0.233	1.7E+12	1475.09	575.8052	30.75345	1381.735	539.4279	-31.923	1548.773	524.8138	66.77663	1555.562	536.1259	-33.0801		
16	0.25	1.7E+12	1475.061	575.8603	30.41094	1381.794	539.4064	-31.9818	1548.763	524.7661	66.92035	1555.575	536.3068	-33.0826		
17	0.266	1.7E+12	1474.93	575.8479	30.71464	1381.814	539.3967	-31.904	1548.621	524.7145	66.93443	1555.595	536.0518	-32.985		
18	0.283	1.7E+12	1475.126	575.8116	30.70473	1381.732	539.4216	-31.8726	1548.786	524.8381	66.98006	1555.494	536.1292	-32.9726		
19	0.3	1.7E+12	1474.776	575.7269	30.67569	1381.726	539.3883	-32.0111	1548.699	524.7009	67.06246	1555.479	536.0538	-32.9253		
20	0.316	1.7E+12	1475.036	575.5733	30.79277	1381.689	539.4099	-31.7491	1548.566	524.746	66.89509	1555.61	536.029	-32.9059		
21	0.333	1.7E+12	1475.054	575.7329	30.72889	1381.794	539.4995	-31.8009	1548.691	524.7877	67.04777	1555.575	536.0714	-32.8103		
22	0.35	1.7E+12	1475.038	575.7058	30.7152	1381.776	539.3199	-31.9803	1548.684	524.7543	66.89096	1555.55	536.1837	-32.9275		
23	0.366	1.7E+12	1475.098	575.6846	30.67741	1381.761	539.4191	-31.8158	1548.619	524.8502	67.08123	1555.705	536.0925	-32.9593		
24	0.383	1.7E+12	1474.992	575.8151	30.62251	1381.839	539.4119	-31.7936	1548.669	524.79	67.04623	1555.529	535.9728	-32.8057		
25	0.4	1.7E+12	1474.885	575.721	30.66641	1381.796	539.3558	-31.9812	1548.665	524.6848	67.00022	1555.617	536.1744	-32.9432		
26	0.416	1.7E+12	1475.065	575.6107	30.75406	1381.789	539.431	-31.9746	1548.754	524.8295	66.77955	1555.584	536.2883	-33.0089		
27	0.433	1.7E+12	1474.938	575.7523	30.72813	1381.78	539.3947	-31.894	1548.654	524.8378	66.93281	1555.633	536.0112	-33.0193		
28	0.45	1.7E+12	1474.85	575.85	30.64901	1381.74	539.3574	-31.9681	1548.684	524.796	66.81277	1555.671	536.1141	-32.8788		
29	0.466	1.7E+12	1475.07	575.6765	30.72539	1381.672	539.4946	-31.8379	1548.738	524.8361	66.95984	1555.677	536.0676	-32.8984		
30	0.483	1.7E+12	1474.941	575.6691	30.74608	1381.737	539.5089	-31.8004	1548.739	524.7536	67.03136	1555.637	536.1633	-32.9804		
31	0.5	1.7E+12	1474.899	575.6961	30.86136	1381.761	539.3455	-31.9689	1548.62	524.781	66.90387	1555.598	536.062	-33.024		
32	0.516	1.7E+12	1475.202	576.0706	30.53421	1381.829	539.4345	-31.9057	1548.639	524.8438	66.82018	1555.669	536.0972	-33.0442		
33	0.533	1.7E+12	1475.084	575.6614	30.69928	1381.852	539.4352	-31.9748	1548.661	524.7693	66.91778	1555.614	536.1505	-32.9243		
34	0.55	1.7E+12	1475.16	575.7572	30.6308	1381.758	539.4456	-31.9124	1548.692	524.8237	66.70445	1555.511	536.1214	-32.9632		

13.3.2

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4. BVH File

(1) BVH files record data related to the human body, including cap data. You can export BVH files to view the data of the first frame of the human skeleton and each frame of the cap file;

(2) Load a set of human body data in Edit mode, click File, select Export BVH File, and the system prompts that the export of the BVH file was successful. Click OK, and the system will save the BVH file to the current working path by default. The BVH naming rule is "cap file name - selected human body template name. bvh". BVH files support opening in Excel mode;

5. HTR File

(1) The HTR file records data related to the human body and rigid body. In Edit mode, load a set of human body or rigid body data, click on the file, select Export HTR File, and in the Export HTR File window, the Euler rotation angle defaults to ZYX and cannot be changed. Users can choose the HTR file data to export according to their own needs in the basic frame options.

(2) If you are a biomechanical user, you can choose the first option of "exporting uncalibrated frames" to export an HTR file. If you are an animation user, you can choose the second and third options according to your own needs. The second option is "exporting skeleton model frames", and the third option is "exporting current frames" ".

(3) File Naming Rules:

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- Select the first export option, and the naming convention for HTR files is: cap file name - selected template name - nobase.htr;
- Select the second export option, and the naming convention for HTR files is: cap file name - selected template name - modelpose.htr;
- Select the third export option, and the naming convention for HTR files is: cap file name - selected template name - currentframe.htr;

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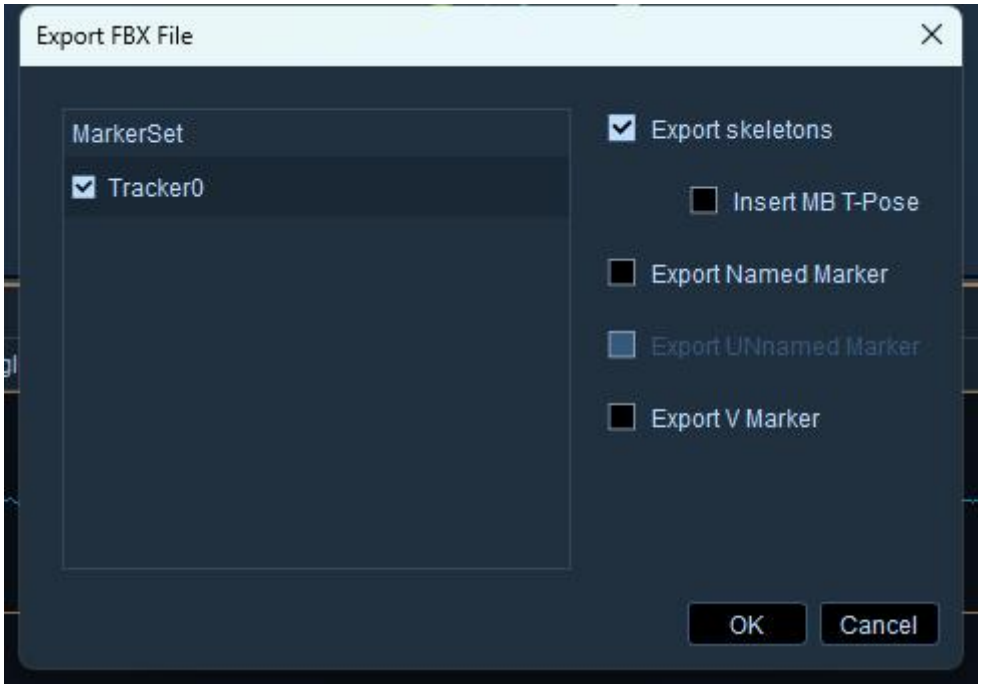
6. FBX File

(1) Both rigid body and human body data can be exported to FBX in Edit mode, and the exported FBX can be imported into animation software such as Motionbuilder and UE.

(2) Load motion capture data with MarkerSet in the Edit, click File - Export FBX File. In the Export FBX File window, you can specify the MarkerSet name to export (13.6.1). On the right side of the window, you can select "Export Skeletons, Insert MB T-Pose, Export Named Points, Export VMarker" to export the FBX file.

(3) Select 'Insert MB T-Pose, Export skeleton' to export the FBX file. The exported FBX file will be inserted with one frame of standard T-Pose. Choosing to insert MB T-Pose will insert a frame of Motionbuilder's standard T-Pose into the exported FBX file.



13.6.1

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7. Dynamics File

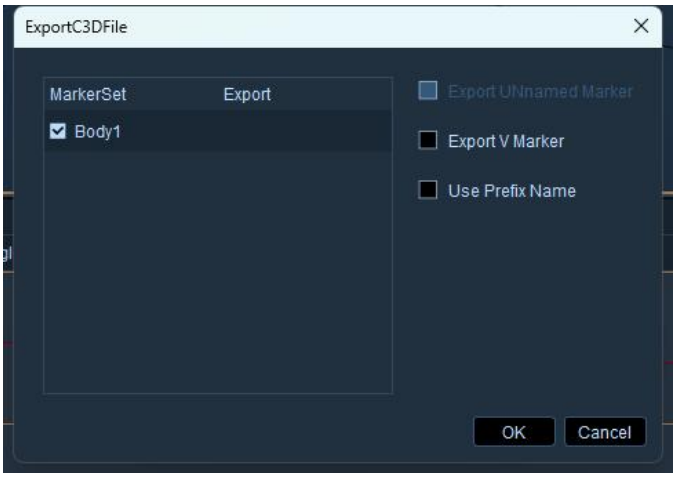
(1) In Edit mode, load 29 points of full body Helen Hayes human body data. You can click File - Export Dynamics File to export dynamics file. The dynamics file records the center of mass of the human body and the rotation data of each skeleton in the Helen Hayes model. The dynamics file can be imported into an Excel spreadsheet for viewing.

8. C3D File

■ **Export c3d file**

(1) In Edit mode, load data containing MarkerSet or force measuring platform, and click on File - Export c3d File (13.8.1).

(2) In the Export C3D File window, you can specify a certain Market for export, or you can export all Markets. The exported c3d file will contain the named points of the Market. If there is a force station in the dynamic capture data, the data of the force station and simulation channel will also be exported when exporting the c3d file.



13.8.1

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■ Import c3d file

(1) Click on File - Import c3d file, select a file with a suffix of. c3d to import, and all named points and force measurement table data recorded in this c3d file will be displayed in the 3D view after import.

(2) You can also import the c3d files exported from XINGYING into software such as Visual 3D for use.

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9. ANC File

(1) After processing and loading the data of the force measuring platform, click File - Export ANC File to generate a file with the suffix. inc in the current working path. The generated ANC file can be opened in Notepad or Excel spreadsheet. After opening, you can see the original data of the force measuring platform recorded in the ANC file. If the force measuring platform in the dynamic capture data is an analog force measuring platform, then the ANC records the voltage. If the force measuring platform in the dynamic capture data is a digital force measuring platform, So ANC records the "FX, FY, FZ, X, Y, Z" values of the force measuring platform.

10. Forces File

(1) Click on File - Export Forces file. The exported Forces file is based on the force and torque of the dynamic capture coordinate system. The data in the Forces file is the "FX, FY, FZ, X, Y, Z, Mfree" data of the force measuring platform.

(2) You can import the exported Forces file into an Excel spreadsheet for viewing.

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XIV. Body Template

1. 53 Markers and Skeleton Descriptions

- **53 Markers descriptions**

Item Number	Marker Name	Description
1	HeadTop	Top of the head
2	LHeadFront	Left front side of the head
3	LHeadBack	Left back side of the head
4	RHeadFront	Right front side of the head
5	RHeadBack	Right back side of the head
6	C7	Base of the neck at the back
7	T10	Symmetrical point on the back of the sternum
8	CLAV	Collarskeleton
9	STRN	Sternum (midpoint of the centerline of the upper body)
10	LShoulderFront	Left shoulder front
11	LShoulderBack	Left shoulder back
12	LUArmHight	Left upper arm
13	LElbow	Left elbow
14	LElbowIn	Left elbow (symmetrical side)

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15	LFoream	Left forearm, outer side
16	LWristIn	Inside of left wrist (side of the thumb)
17	LWristOut	Outside of left wrist
18	LHandIn	Root of the index finger joint of the left hand
19	LHandOut	2cm below the root of the little finger joint of the left hand (space for one marker)
20	RShoulderFront	Front of right shoulder
21	RShoulderBack	Back of right shoulder
22	RUArmHight	Right upper arm
23	RElbow	Right elbow
24	RElbowIn	Right elbow (symmetrical side)
25	RFoream	Outer side of right forearm
26	RWristIn	Inside of right wrist (thumb side)
27	RWristOut	Outside of right wrist
28	RHandIn	Root of the index finger joint of the right hand
29	RHandOut	2cm below the root of the little finger joint of the right hand

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		(space for one marker)
30	WaistLFront	Front of left hip
31	WaistLSide	Side of left hip (middle position from front to back)
32	WaistLBack	Back of left hip
33	WaistRFront	Front of right hip
34	WaistRSide	Side of right hip (middle position from front to back)
35	WaistRBack	Back of right hip
36	LThight	Left thigh
37	LKness	Outside of left knee
38	LknessIn	Inside of left knee
39	LShin	Left calf
40	LAnkleOut	Left ankle
41	LHeel	Back of left foot
42	LMT5	Outside of front of left foot
43	LMT1	Inside of front of left foot
44	LToe	Front part of the sole of the left foot
45	RThight	Right thigh
46	RKness	Outside of right knee

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47	RKnessIn	Inside of right knee
48	RShin	Right calf
49	RAnkleOut	Right ankle
50	RHeel	Back of right foot
51	RMT5	Outside of front of right foot
52	RMT1	Inside of front of right foot
53	RToe	Front part of the sole of the right foot

Item Number	skeleton Names	Associated Point	Parent Segment skeleton
1	Hips	WaistLFront、WaistLSide、WaistLBack、WaistRFront、WaistRSide、WaistRBack	GLOBAL
2	Spine	T10、STRN、WaistLBack、WaistRBack	Hips
3	Spine1	T10、STRN	Spine
4	Spine2	C7、T10、CLAV、STRN	Spine1

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5	LeftShoulder	C7、CLAV、LShoulderFront、LShoulderBack	Spine2
6	LeftArm	LShoulderFront、LUArmHigh、LElbow、LElbowIn	LeftShoulder
7	LeftForeArm	LForearm、LWristIn、LWristOut	LeftArm
8	LeftHand	LHandIn、LHandOut	LeftForeArm
9	RightShoulder	C7、CLAV、RShoulderFront、RShoulderBack	Spine2
10	RightArm	RShoulderFront、RUArmHigh、RElbow、RElbowIn	RightShoulder
11	RightForeArm	RForearm、RWristIn、RWristOut	RightArm
12	RightHand	RHandIn、RHandOut	RightForeArm
13	Neck	HeadTop、LHeadFront、RHeadBack、RHeadFront、RHeadBack	Spine2
14	Head	HeadTop、LHeadFront、LHeadBack、RHeadFront、	Neck

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		RHeadBack	
15	LeftUpLeg	LThigh、LKnee、LKneeIn	Hips
16	LeftLeg	LKnee、LKneeIn、LShin、LAnkleOut	LeftUpLeg
17	LeftFoot	LHeel、LMT5、LMT1	LeftLeg
18	LeftToeBase	LToe、LMT5、LMT1	LeftFoot
19	RightUpLeg	RThigh、RKnee、RKneeIn	Hips
20	RightLeg	RKnee、RKneeIn、RShin、RAnkleOut	RightUpLeg
21	RightFoot	RHeel、RMT5、RMT1	RightLeg
22	RightToeBase	RToe、RMT5、RMT1	RightFoot

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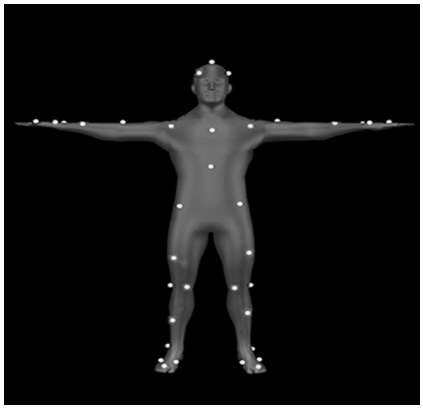
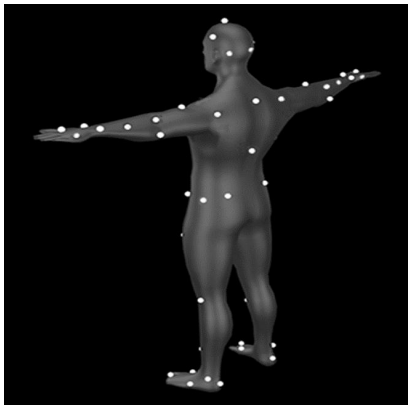
■ **53 point schematic diagram of human body sticking points**





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■ Schematic diagram of real sticking points

Front full body view

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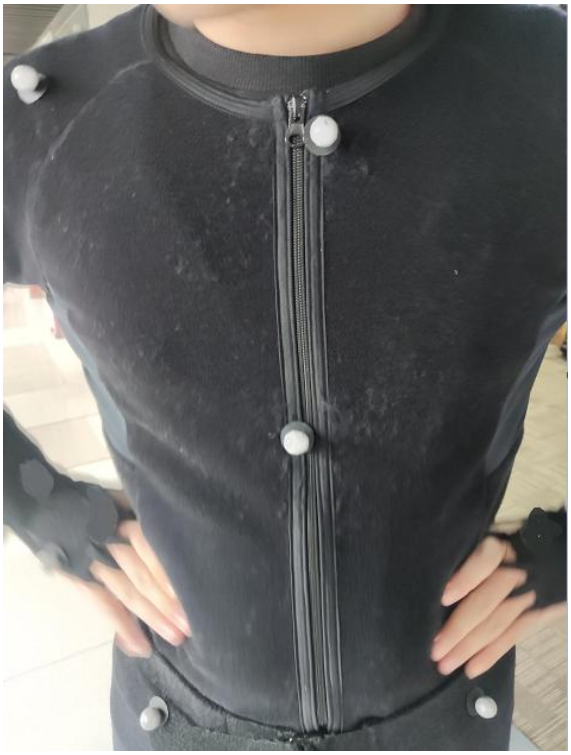
Front Head Top View



Upper body view

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Front view of legs

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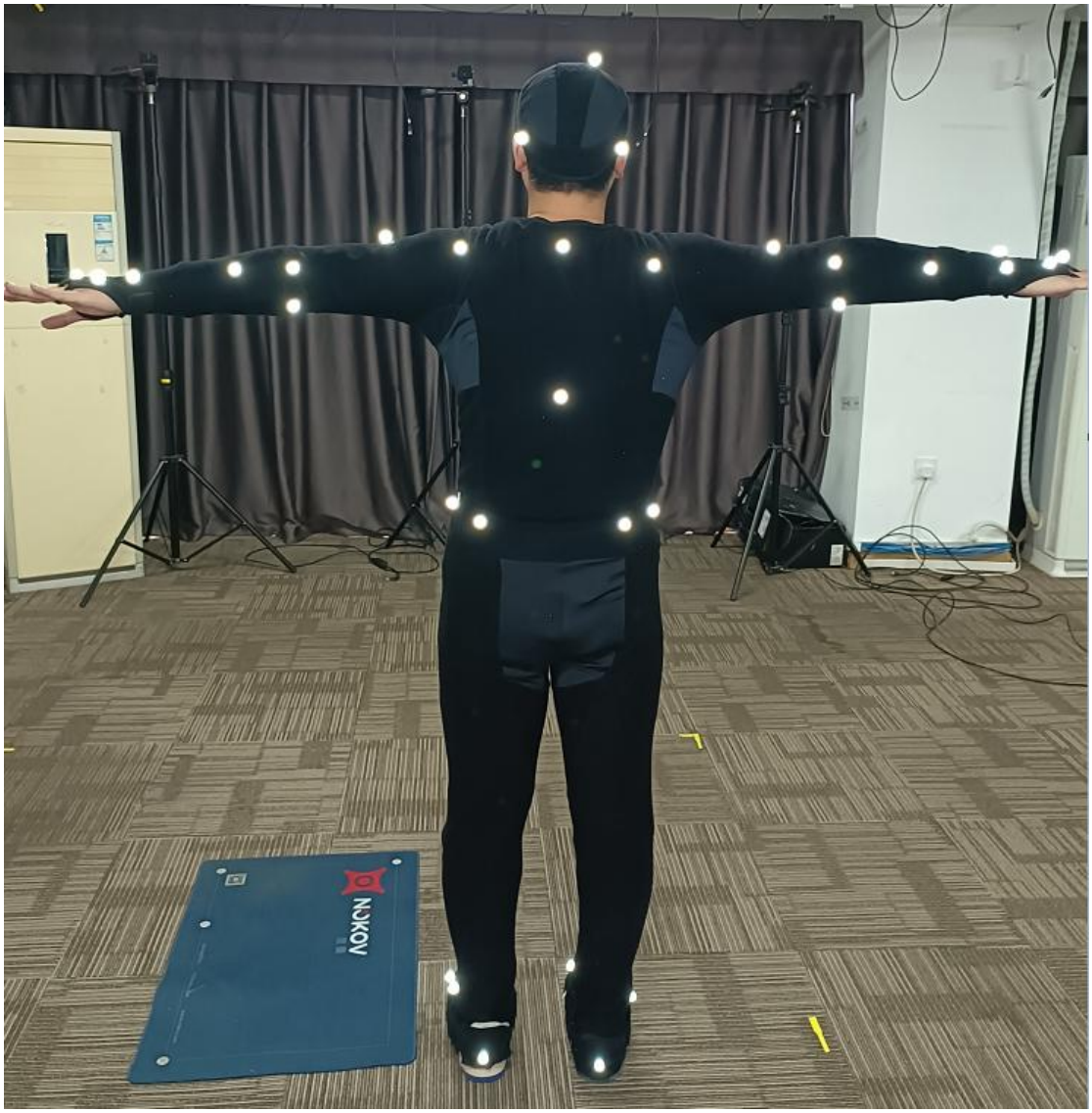

Back body view

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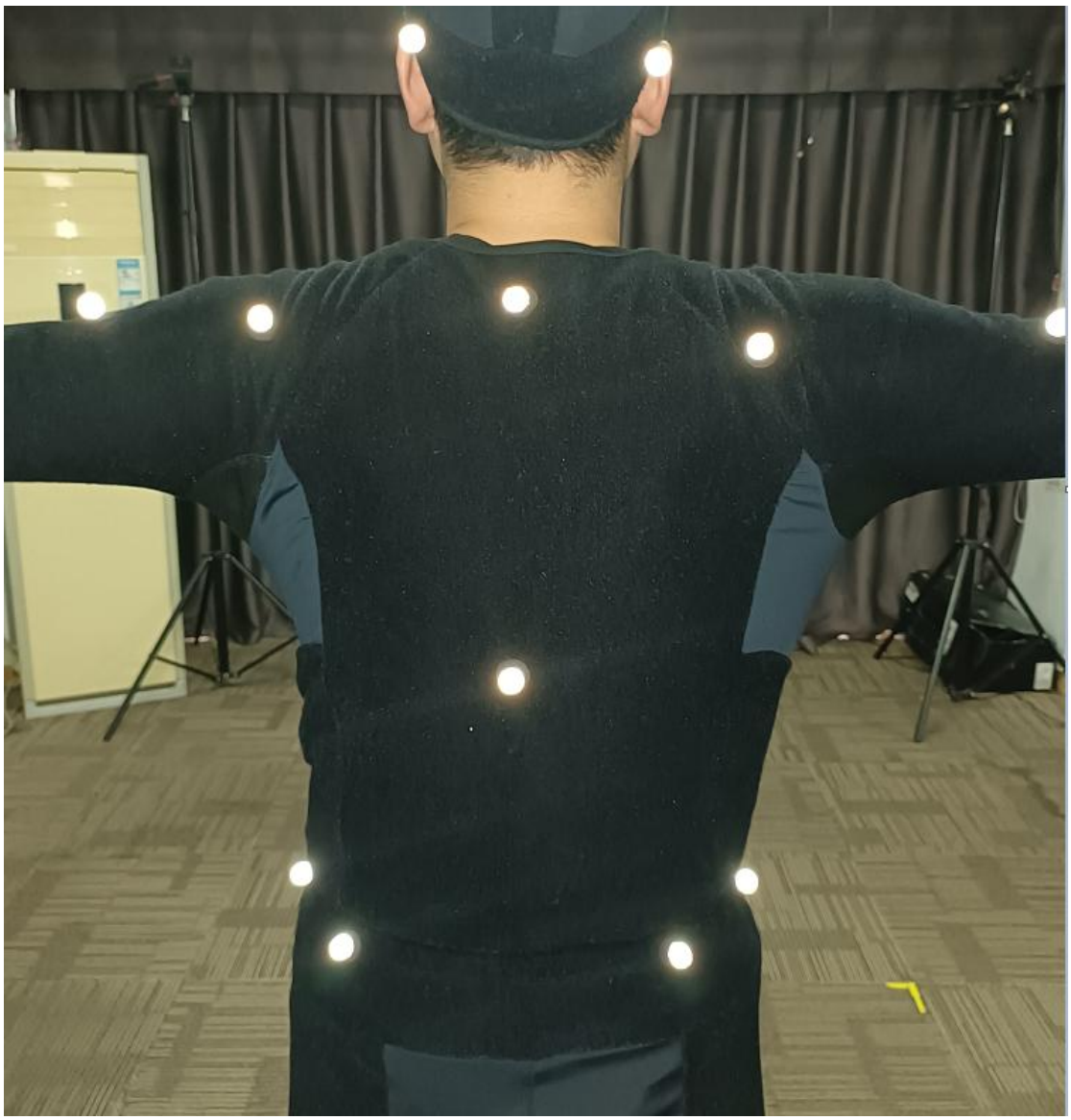

Back view

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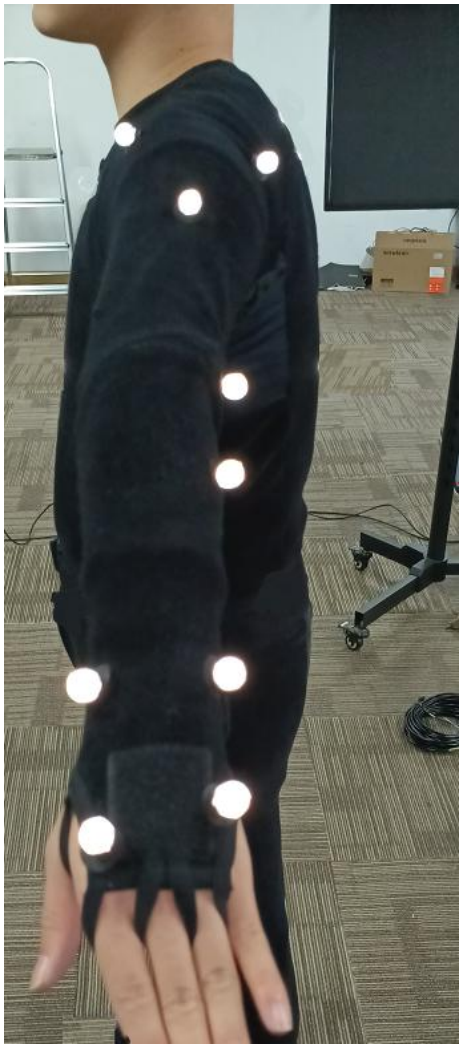

Left arm view

Right arm view

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Left arm bending view

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Right arm bending view

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Hand detail drawing

Hand bending details

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■ 53 points and precautions for human body

(1) There are 5 points on the head, one at the highest point on the top of the head, and the other 4 points are marked with 1 point in front, back, left, and right respectively. The points on the front, back, left, and right should not be completely symmetrical, and the point on the top of the head should be offset to make it different from the other 4 points.

(2) 8 points on the upper torso, 1 point at the collar (clavicle position), 1 point at the midpoint of the front centerline (sternum), 1 point at the intersection of the spine and shoulder line (neck end), 1 point at the midpoint of the back centerline, and at the same level as the center of the front centerline, 1 point at the front and back of the left and right shoulders respectively.

(3) 8 points on the upper body, 1 point on the collar (clavicle position), 1 point at the midpoint of the front centerline (sternum), 1 point at the intersection of the spine and shoulder line (neck end), 1 point at each midpoint of the back centerline, in the same horizontal plane as the center of the front centerline, and 1 point at the front and back of the left and right shoulders.

(4) 6 at the waist, 2 at the front of the hips, 2 symmetrically at the back and front, with the rear point slightly higher than the front point, 1 on each side, asymmetrical, one can be slightly forward and one can be slightly backward.

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(5) There are eight points on the legs, 1 on the middle and outer sides of the thighs, with the point on the left thigh pointing upwards in the middle and the point on the right thigh pointing downwards in the middle, which is asymmetrical with the right thigh. There are 2 knee joints, and the points on the inner side of the knee need to be placed slightly forward to prevent obstruction. The points on the left calf should be placed above the middle and on the outer side, and the points on the right calf should be placed below the middle and on the outer side.

(6) 10 feet. One in front of the front foot, two at the bending joint of the front foot, ensuring that the inner marker is farther forward than the outer marker, one at the ankle, one at the heel, and the two markers on both sides of the front foot are on the same plane. Try to maintain the same height of the attachment points on both sides of the left and right ankles and front soles as much as possible.

(7) If there is an issue with the occlusion of the elbow joint marker, place the intra elbow joint marker behind the arm slightly above the elbow joint, rather than inside the elbow joint.

(8) If you encounter issues with knee markers blocking, please place the inner knee marker slightly forward rather than on the inner knee.

(9) Try to keep the height of the attachment points on the left and right waists, knees, and ankles as consistent as possible.

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(10) When flipping the wrist and forearm, if there is a situation where recognition is not possible, please check and adjust the attachment points of the forearm. Each point on the left and right forearms is asymmetrical, with 1 point in the middle of the left forearm and 1 point in the middle of the right forearm, both of which are located on the outside. Do not stick them in the middle. When sticking points in this area, the actor can bend their arms upwards and place them on their shoulders to adjust the attachment points of the forearm, The distance between the attachment point on the forearm and the inner attachment point on the wrist (WristIn) is greater than the distance between the attachment point on the forearm and the outer attachment point on the wrist (WristOut).

(11) Secure easily loose and wrinkled areas with straps, such as the waist, upper arms, wrists, palms, etc.

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2. Helen Hayes

■ Helenhayes Sticking instructions

describe	MarkerName	Helenhayes FullBodyWithHead(29 Static)	Helenhayes FullBody(26 Static)	Helenhayes LowerBody(19 Static)	drop location
top	Top.Head	√			At the center and top of the head
In front of the head Behind the head	Front.Head Rear.Head	√			At the front and rear of the head
Left shoulder Right shoulder	L.Shoulder R.Shoulder	√	√		The tip of the shoulder crest protrusion
Left elbow Right elbow	L.Elbow R.Elbow	√	√		Lateral Epicondyle
Left wrist Right wrist	L.Wrist R.Wrist	√	√		Between the radial styloid process and the ulnar styloid process
sacrum	R.Offset	√	√		The upper surface at the sacral interface
Left front waist Right front waist	L.ASIS R.ASIS	√	√	√	On the protruding skeleton on the left and right sides of the front of the pelvis
Upper left thigh Upper right thigh	L.Thigh R.Thigh	√	√	√	Middle thigh up 1cm

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Left lateral knee Right lateral knee	L.Knee R.Knee	√	√	√	Place the mark on the lateral protrusion of the knee joint axis
Left medial knee Right medial knee	L.Knee.Medial R.Knee.Medial	√	√	√	The medial protrusion of the knee joint axis
Left lateral ankle joint Right lateral ankle joint	L.Ankle R.Ankle	√	√	√	On the side of the ankle axis, at the lateral protrusion of the inner ankle skeleton
Left medial ankle joint Right medial ankle joint	L.Ankle.Medial R.Ankle.Medial	√	√	√	The medial side of the ankle axis; The medial protrusion of the inner malleolus
Left toe Right toe	L.Toe R.Toe	√	√	√	The center of the foot, between the second and third metatarsals
Left heel Right heel	L.Heel R.Heel	√	√	√	Center of heel skeleton

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■ Helenhayes Skeleton Description

skeleton Name	Origin Marker	Long Axis	Plane Axis	Parent skeleton
Pelvis	V_Pelvis_Origin	V_Mid_Hip	V.Sacral	GLOBAL
R.Thigh	V_R.Hip_JC	V_R.Knee_JC	R.Knee	Pelvis
L.Thigh	V_L.Hip_JC	V_L.Knee_JC	L.Knee	Pelvis
R.Shank	V_R.Knee_JC	V_R.Ankle_JC	R.Ankle	R.Thigh
L.Shank	V_L.Knee_JC	V_L.Ankle_JC	L.Ankle	L.Thigh
R.Foot	V_R.Ankle_JC	R.Toe	R.Ankle	R.Shank
L.Foot	V_L.Ankle_JC	L.Toe	L.Ankle	L.Shank
Trunk	V_Pelvis_Origin	V_Mid_Shoulder	R.Shoulder	Pelvis
Head/Neck	V_Mid_Shoulder	Top.Head	Front.Head	Trunk
R.UpperArm	R.Shoulder	R.Elbow	L.Shoulder	Trunk
L.UpperArm	L.Shoulder	L.Elbow	R.Shoulder	Trunk
R.Forearm	R.Elbow	R.Wrist	L.Elbow	R.UpperArm
L.Forearm	L.Elbow	L.Wrist	R.Elbow	L.UpperArm
R.Hand	R.Wrist	V_R.Hand	L.Wrist	R.Forearm
L.Hand	L.Wrist	V_L.Hand	R.Wrist	L.Forearm
PelvisWRTLab	V_Mid_Hip	V_Pelvis_Origin	V.Sacral	GLOBAL
TrunkWRTLab	V_Pelvis_Origin	V_Mid_Shoulder	R.Shoulder	GLOBAL

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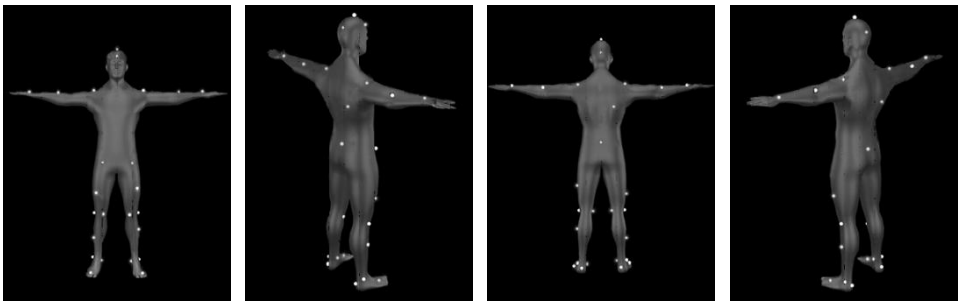
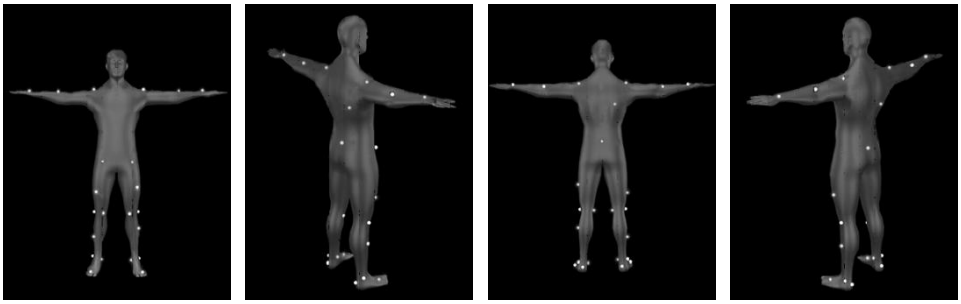
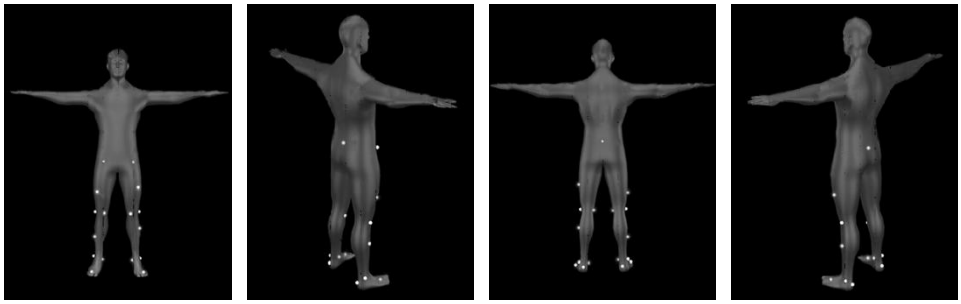
■ Helen Hayes human body patch diagram



Helenhayes FullBodyWithHead(29 Static)



Helenhayes FullBody(26 Static)



Helenhayes LowerBody(19 Static)

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3. Wearing Gloves At 53 Markers On The Human Body

■ **Sticking instructions**

(1) The application points of gloves on the human body at 53 points are consistent with the application points and precautions for the human body at 53 points mentioned above

(2) For the connection and precautions of 2 gloves, please refer to "IX. Create MarkerSet Baseline+Toe+Hand，Headband(53)”.

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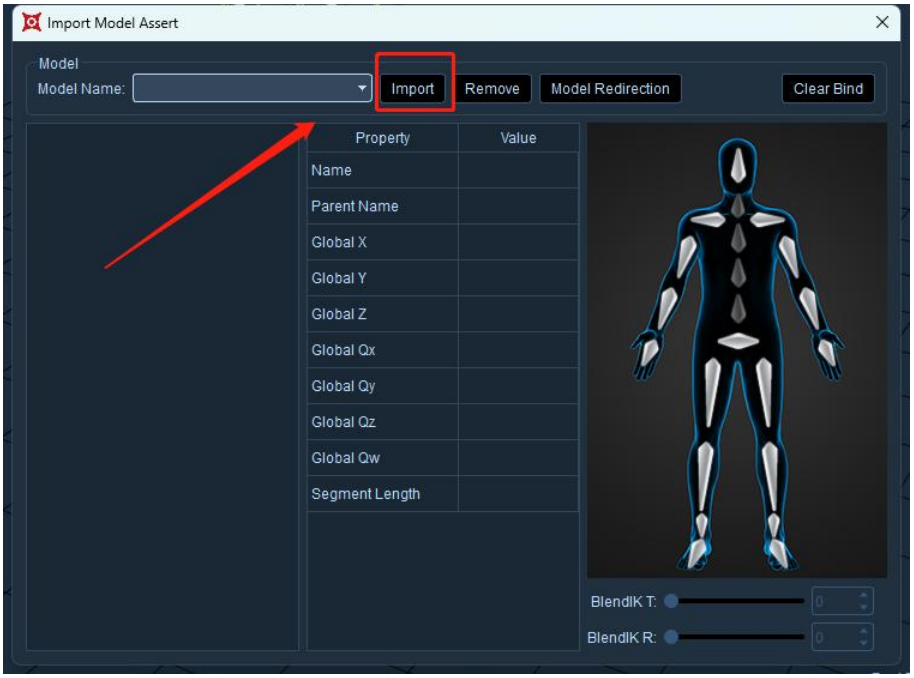
XV. Data Redirection

1. Model Asset Import

(1) The model asset import function supports redirecting human data by importing FBX and HTR files in Live and Edit modes.

■ **Live mode**

(1) In Live mode, after creating a fifty-three point human model, click the "File" button in the upper left corner of the software, click "Import Model Asset". The software will pop up the Model Asset Import window. In the Model Asset Import window, click "Import", select the FBX model file or HTR model file that needs to be imported, then click "Open" to import the model file (15.1.1);



15.1.1

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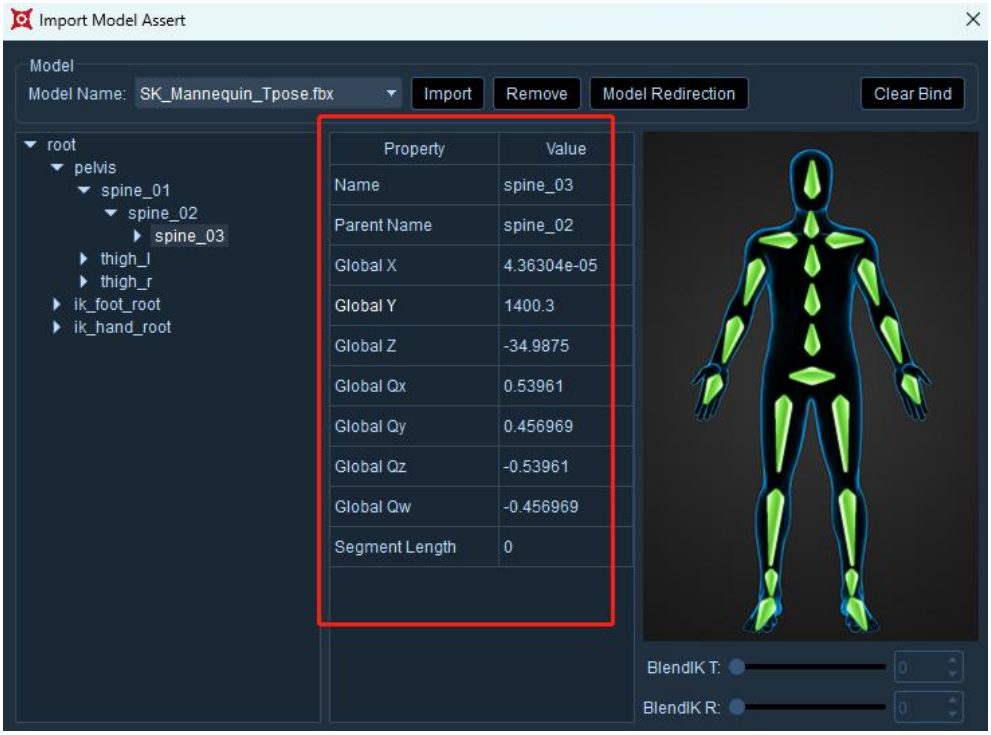
(2) After successfully importing the model file, the "Model Name" option box will display the name of the currently imported model file. If multiple model files have been imported, you can select the model file that needs to be bound through the drop-down box on the left. When importing multiple model files, the focus will be on the newly imported model file;

(3) After successfully importing the model, the left side of the window will display the skeleton and skeleton names of the imported model. Click on the skeleton name to expand and show the sub-skeleton, click "-" to fold. After importing the model file, select a segment of skeleton, the global displacement and rotation information of the selected skeleton, the parent segment name, and the skeleton length information will be displayed in the middle area of the window (15.1.2);



15.1.2

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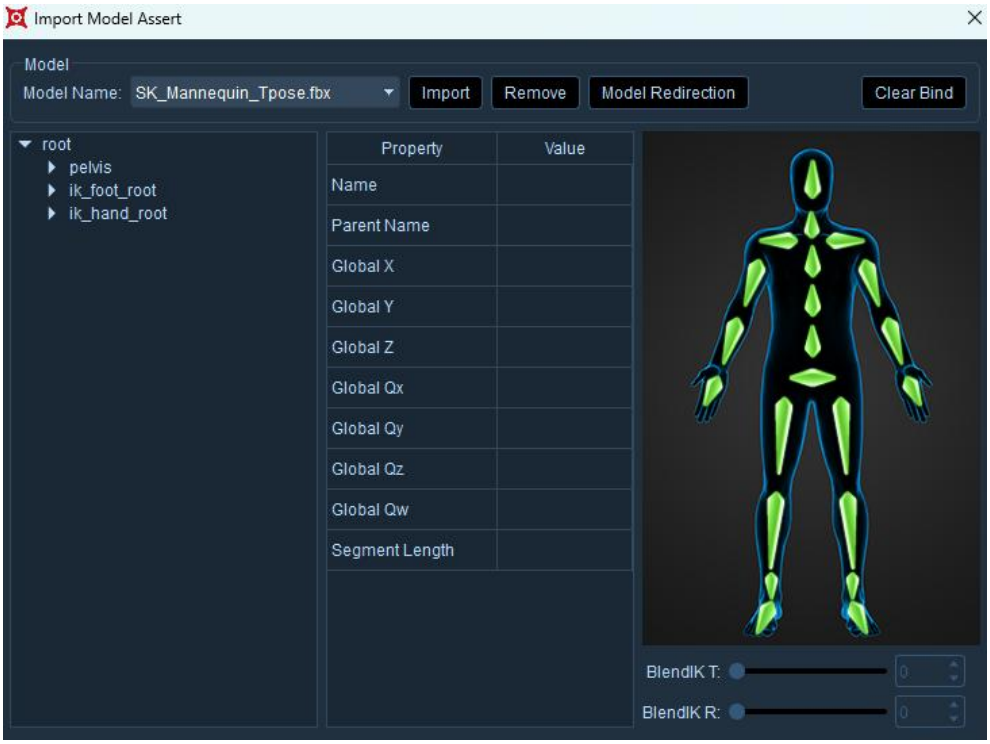
(4) If UE, MotionBuilder models are imported, the model import window will automatically match the model skeleton and automatically bind it, no manual binding is needed;

(5) Hover the mouse over the skeleton position on the human skeleton diagram on the far right, it will display the name of the skeleton that needs to be bound at this skeleton position. Select the corresponding skeleton in the skeleton tree diagram on the left, and select the corresponding skeleton on the human diagram on the right (15.1.3), click again to deselect this segment of skeleton (the selected skeleton will be highlighted). After the model is bound, hover the mouse over the bound skeleton, and the interface will display the name of the model skeleton corresponding to the bound skeleton;



15.1.3

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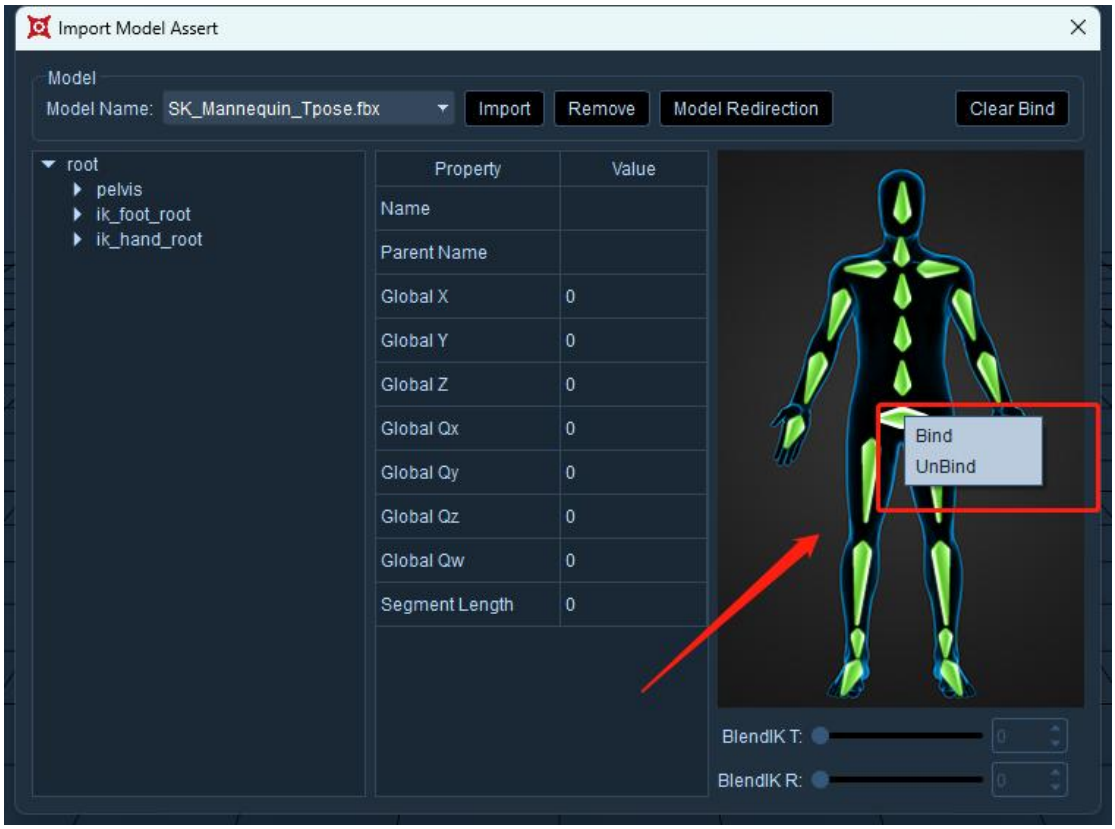
(6) After selecting the skeleton, right-click and click Bind. If the skeleton is bound incorrectly, you can right-click to select the incorrectly bound skeleton and click Unbind (15.1.4). Correctly bind the human skeleton one by one. The correctly bound skeleton will turn green. After all are bound, click "Model Redirection" at the top. The software will pop up a prompt saying "Binding successful". Click "OK" (15.1.5). At this point, the FBX model has been successfully bound to the human MarkerSet. Close the Model Asset Import window;



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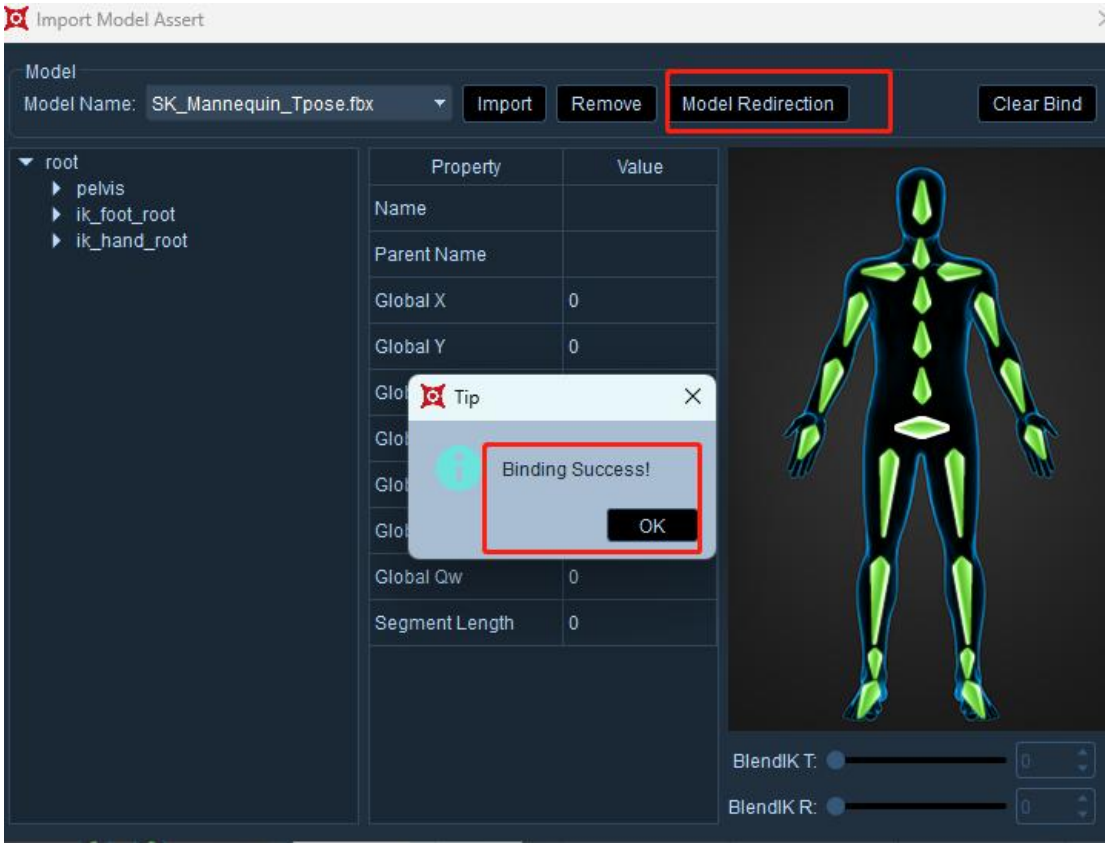

15.1.5

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(7) Click the "Clear Bind" button in the upper right corner of the Model Asset Import window. The software will pop up a prompt. Click OK, and all bound skeleton will be cleared with one click;

(8) After clicking the "Clear Bind" button at the top of the Model Asset Import window, the currently used model file will be removed. After the model is removed, the model file in the "Model Name" option box will also be removed. After removal, click on Model Import from the lower right corner of the software again, select to import the model file that was just removed, there is no need to re-bind the skeleton again, the software will automatically load the skeleton bound last time and perform model binding;

■ **Enable redirected data**

(1) If you need to use the SDK to get redirected human data, open setting panel,select other settings, turn on "Redirected Data" (15.1.6), and turn on "SDK" at the lower right corner of the software. At this time, the redirected human data will be broadcasted and sent out. You can receive the redirected human data in UE. If "Redirected Data" is not checked, the original human data will be sent out by the SDK;

(2) Note: When using the SDK plugin to get redirected hybrid human data, if the "Redirected Data" button is unchecked, you need to reconnect the SDK plugin, otherwise it will cause the motion capture data obtained by the client to be original human data;

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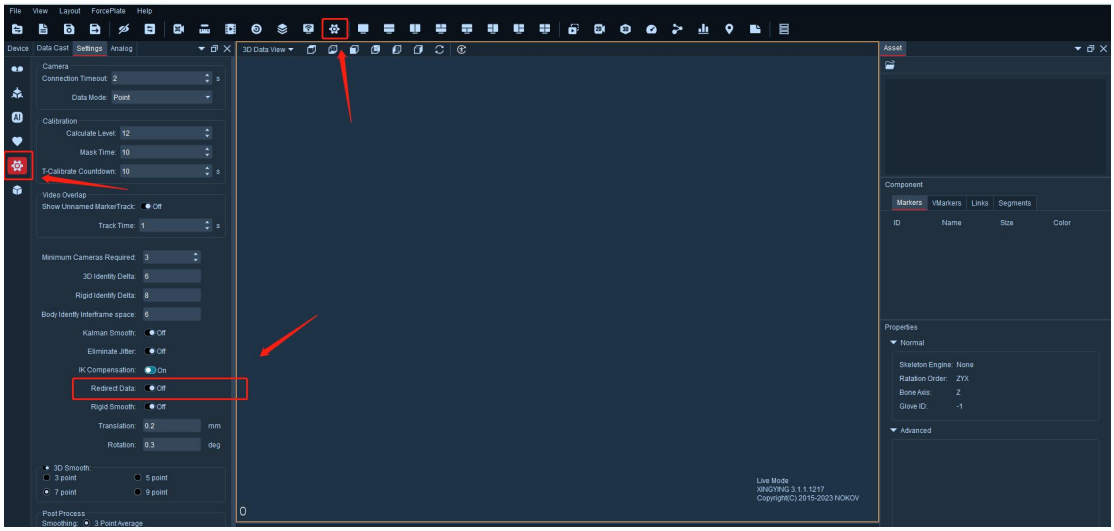
■ Edit mode

(1) For Edit mode, import the model for skeleton redirection. You need to enable "Enable Redirected Data" and "SDK" in the settings, then click the "Calculate" button in the Edit menu bar to re-calculate the human skeleton. This allows you to use the SDK plugin to obtain redirected human data. This is the difference between Live mode and Edit mode.



15.1.6

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XVI. Third-Party Adaptation

1. Force Plate

■ **Note**

- AD analog force platforms and electromyography cannot be used together with USB digital force platforms;
- AD analog force platforms and electromyography cannot be used together with network digital force platforms;
- AD analog force platforms and electromyography cannot be used together with digital electromyography;

■ **Connecting Bertec Force Platform in AD Analog Mode**

(1) XINGYING software supports the integration of Bertec force platform via NI6218/6225.

(2) The AD access force platform scheme needs to use the camera's trigger synchronization, and the digital force platform does not use AD synchronization.

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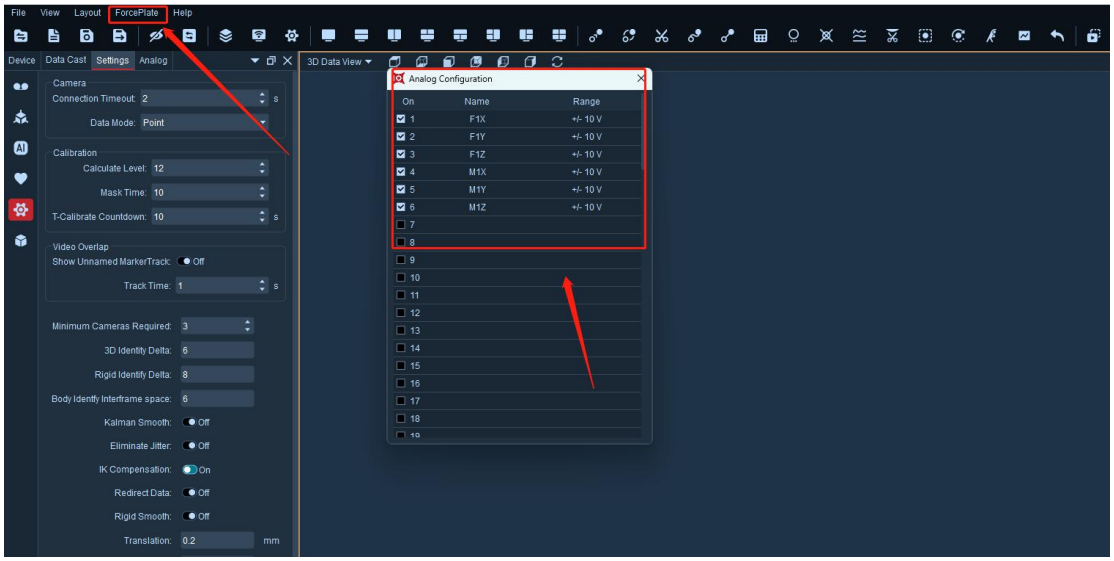
(3) After the force platform is connected to the computer, the NI driver needs to be installed. After the driver installation is completed, open XINGYING, click on the force platform in the menu bar at the top of the software, select "Analog Configuration", and configure the analog channel of Bertec in the Analog Configuration window. Right-click in the list to select "Bertec--FP1", and you can configure the range of each channel according to the output range of the test platform you are connected to. Select a channel, and you can choose +/-10mV, +/-10V, etc. in the "Range" drop-down box of each analog channel. Click the "Select" button at the top left of the window to select all analog channels (16.1.1).



16.1.1

(4) Click on the "ForcePlate" in the menu bar at the top of the software, select the "Force Platform Configuration" option, and click the "+" button in the Force Platform Configuration window to add a Bertec Force Platform (16.1.2);

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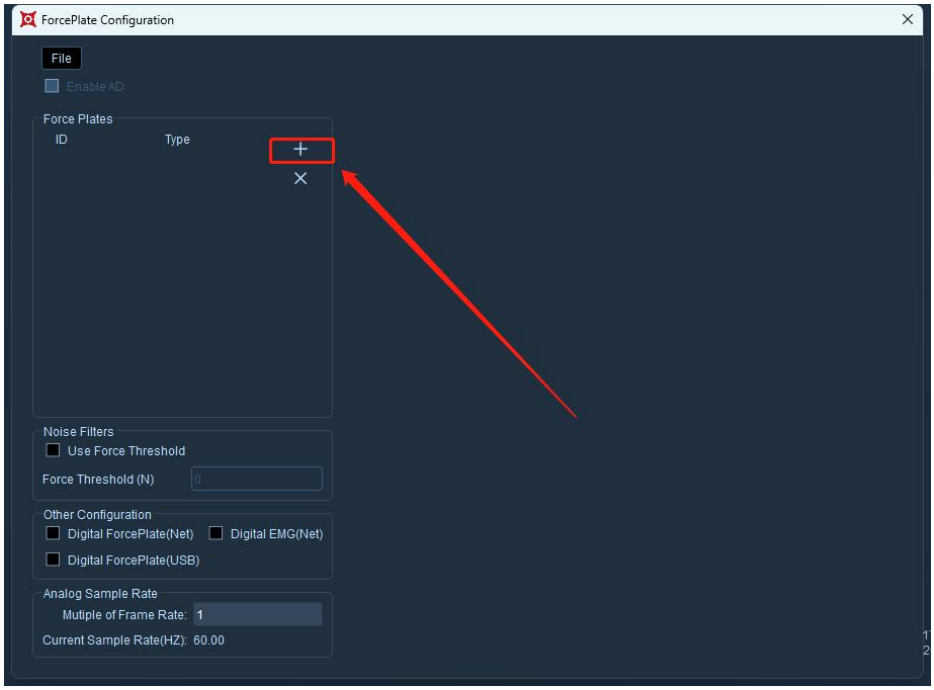
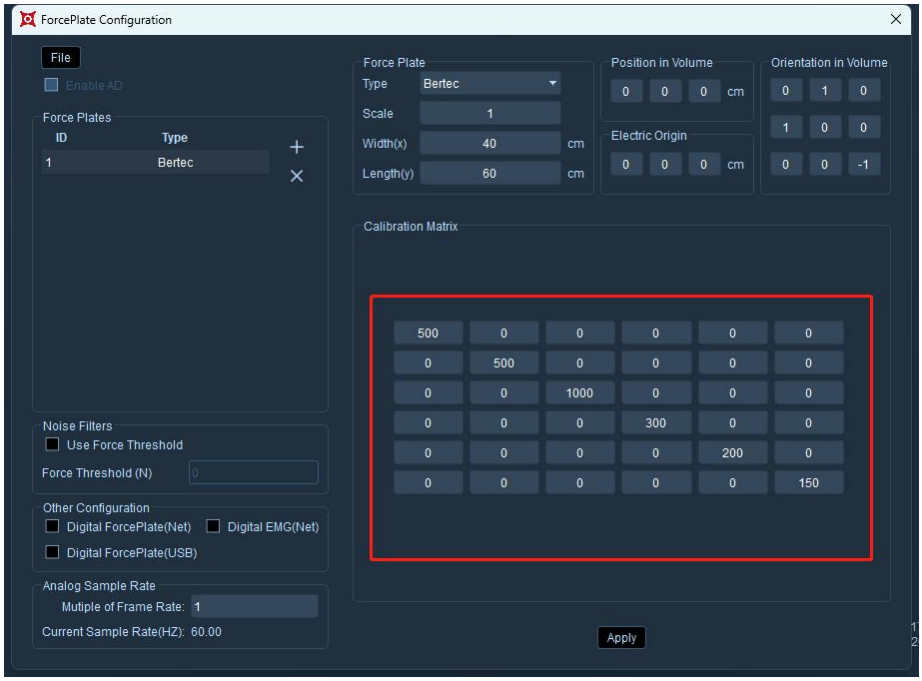


16.1.2

(5) Select the force platform name, and set the parameters of the Bertec force platform on the right: force platform specifications, position in space, direction and calibration matrix, then click "Apply" (16.1.3);



16.1.3

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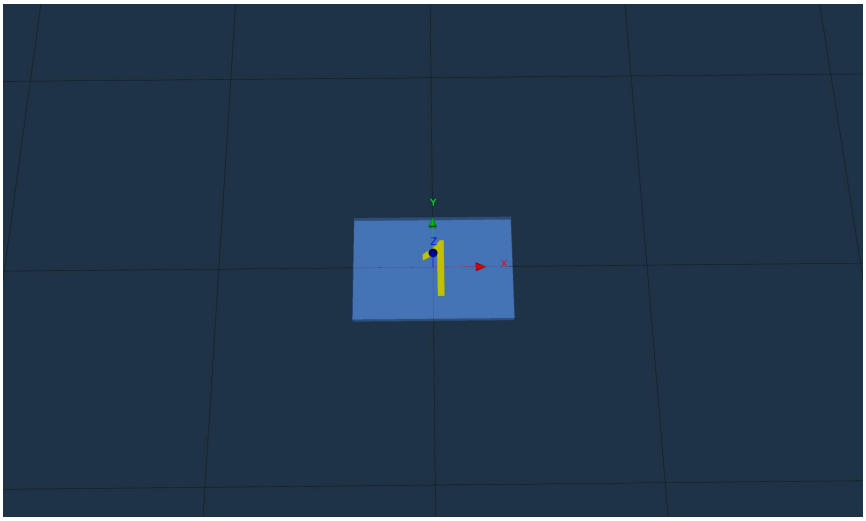
(6) After configuring the analog channels, the AD analog force platform needs to manually check the "Enable AD" option (16.1.4). When using the AD analog force platform, if the "Enable AD" is checked without adding channels, the software will pop up a prompt saying "The number of analog channels and force platforms does not match". At this point, you need to first configure the analog channels and then check the "Enable AD" option;

16.1.4

(7) Close the settings window, connect the camera, and click the play button in the 3D view under real-time mode, we can see the AD-simulated Bertec force plate has been added to the coordinate system (16.1.5), and the test stand's serial number will be displayed on the force plate.



16.1.5

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■ USB Access to Bertec Force Platform

(1) Power on the force platform, the indicator light on the amplifier lights up, press the Zero button of the signal amplifier to zero the signal, and connect the analog signal line to the amplifier (16.1.6);

16.1.6

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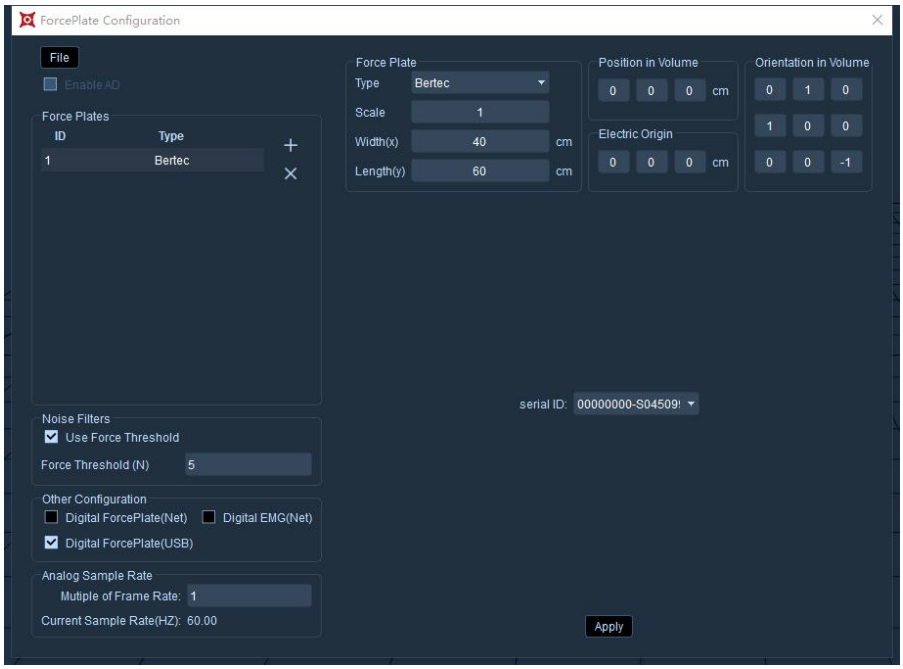
(2) Connect the USB cable from the amplifier to the computer where the XINGYING software is located;

(3) Open XINGYING software, click on the force platform menu bar, choose "Force Platform Configuration", in the "Other Configurations" at the bottom of the Force Platform Configuration window, check the "Digital ForcePlate(USB)" option (16.1.7), click "+" will automatically add a Bertec force platform. Select the force platform name, set the length and width according to the size of the force platform in the "Force Plate" on the right of the window; The parameters in "Orientation in Volume, Position in Volume" can use the system default parameters, or you can modify the parameters according to your needs. The "Serial ID" at the bottom right of the window will display the serial number of the force platform. After configuring the force platform parameters, click the "Apply" button to save this configuration;



16.1.7

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(4) Close the Force Platform Configuration window, connect the camera, click the play button in the Live 3D view mode, at this point the Bertec force plate, which has been connected via USB, has been added to the 3D view and is ready for use.

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2. Digital Force Plate (Network)

(1) The digital force plate supports domestic Kunwei digital force plates and Aili force plates; if you are using an Aili force plate, please contact our engineering staff for assistance. The following configuration instructions are only for the Kunwei force plates.

(2) Connect the power to the Kunwei force plate. Since the default IP range of the Kunwei force plate does not match the network segment of the motion capture system, you need to change the IP of the Kunwei force plate to the 10.1.1.X network segment first;

(3) For the IP setting method of the Kunwei force plate, please contact the Kunwei manufacturer. If the user chooses not to use the 10.1.1.X IP address, then please use a dual network card host and ensure the IP of the Kunwei force plate is correctly configured;

(4) After setting the force plate IP, you can enter the set IP address in the command prompt to see if it can be pinged successfully. Once communication is normal, you can configure the relevant parameters of the force plate in the motion capture software. Open XINGYING -- click on the force plate menu bar -- select "Force Platform Configuration," and in the "Other Configurations" of the Force Platform Configuration window, check "Digital ForcePlate (Net)" and click the "+" button to add a Kunwei force plate, select the added force plate, and configure various parameters of the force plate on the right side;

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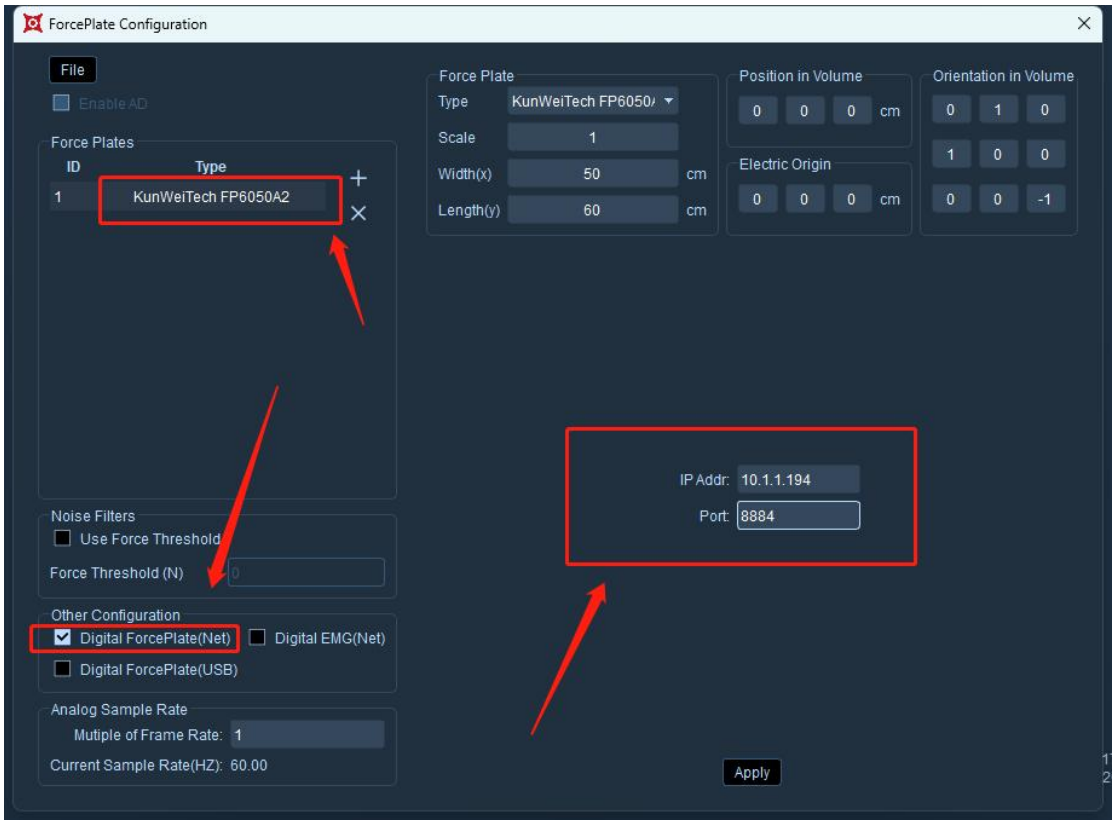
(5) In the "IP Addr" input box, please enter the IP address of your force plate, for example, if your Kunwei force plate IP address is 10.1.1.194, then fill in 10.1.1.194 in the IP address. In the Port, enter the corresponding port number, for example, if your Kunwei force plate IP address is 10.1.1.19X, then its port number is 888X;

(6) When there are multiple Kunwei force plates, please repeat steps 1 to 5 above for configuration, and also correctly set the center of the force plates based on the actual placement positions of the plates. After all parameters are configured (16.2.1), please click the "Apply" button to save your operation.



16.2.1

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3. Configuration and Use of AMTI Force Plates

■ AD Analog Access to AMTI Force Plates

(1) Accessing AMTI force plates via AD requires the use of camera trigger synchronization. Connect one end of the synchronization cable to the AUX port at the back of the camera with IP 201, and the other end to the NI AD acquisition card through an adapter and jumper cable. According to the names like Fx, Fy on the AMTI analog signal cable, correctly connect the analog signal cables to the NI AD acquisition card as per the wiring requirements of the AMTI force plate;

(2) Driver Installation:

- Ensure the signal amplifier is connected to the force plate and the amplifier is powered on.
- In the Control Panel, search for "Device Manager" and click it.
- Find "Other devices," which is marked with a yellow warning (16.3.1).

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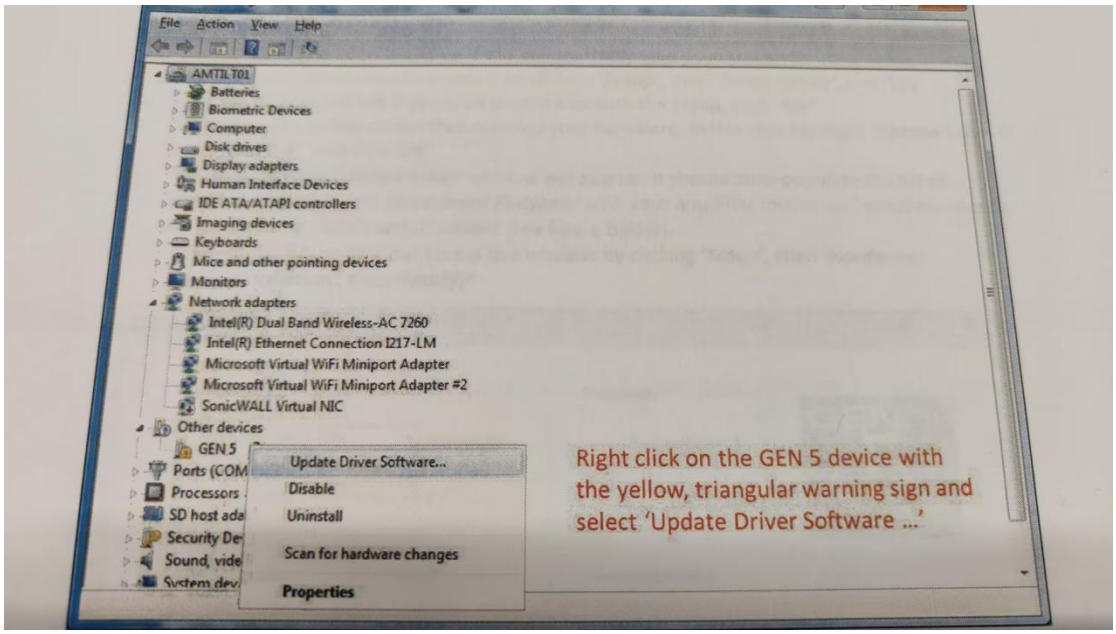
- Right-click and select "Update Driver", choose "Browse my computer for driver software". Using AMTI's USB drive, find the "64-bit Drivers Ver. 3.4.7" folder in the following path on the USB. Select this folder and click next . After the progress bar ends, "Windows has successfully updated your drivers" will be displayed, indicating that the driver installation is complete.

- If you don't have a driver folder, please contact the AMTI manufacturer to get it.



16.3.1

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(3) Install "NetForce":

- For the installation of "NetForce" software, please contact our engineering technical staff to copy or send the "NetForce Ver software installation package". Click "setup" to start the installation and follow the installation prompts to complete the software installation.

(4) Configure the matrix in "NetForce" software:

- Open the "NetForce" software, click "setup" at the top of the software, and select "Hardware Installation" (16.3.2). In the "Hardware Installation" window, select "Optima \Gen-5" from the dropdown list under "New Installation" (16.3.3), and click "Install".

- In the pop-up "AMTI System Configuration" window, select "Fully Conditioned" from the dropdown list under "Analog Outputs" (16.3.4); click the Optima button at the bottom of the window, click Continue, and click Browse. In the subsequent window (16.3.5), navigate to the path and select the "10382M.bcf" file (16.3.6), click Open and wait for the download to finish. Click Done to exit once the download is complete.

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- In the Installed Amplifier section of the AMTI System Configuration window, click the Configure button underneath. In the pop-up window, set all Excitation values of Fx/Fy/Fz/Mx/My/Mz to 10 and set all Gain values to 1000. Click the Analog Adjust button at the bottom, and record all six values in the Analog Scale Factor row (16.3.7). Divide 1000 by each value in the Analog Scale Factor to get the matrix value in the XINGYING software. Click Apply all, then OK to close the window.

- In the AMTI System Configuration window, click Apply then Save to preserve this configuration for future use, then click Done to exit. When exiting the NetForce software, you will be prompted whether to save these settings (16.3.8); click "Yes" to automatically close the software. Once the NetForce software is closed, unplug the USB cable connecting the AMTI force plate amplifier to your computer.

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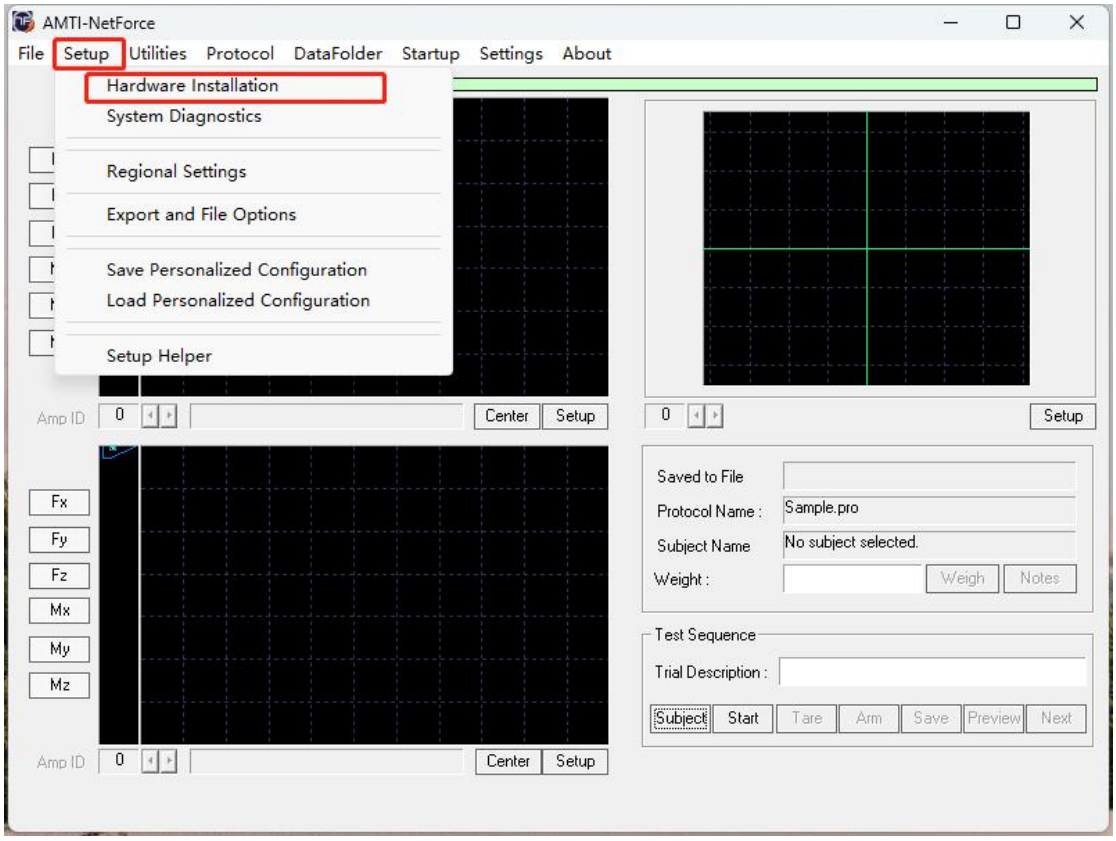
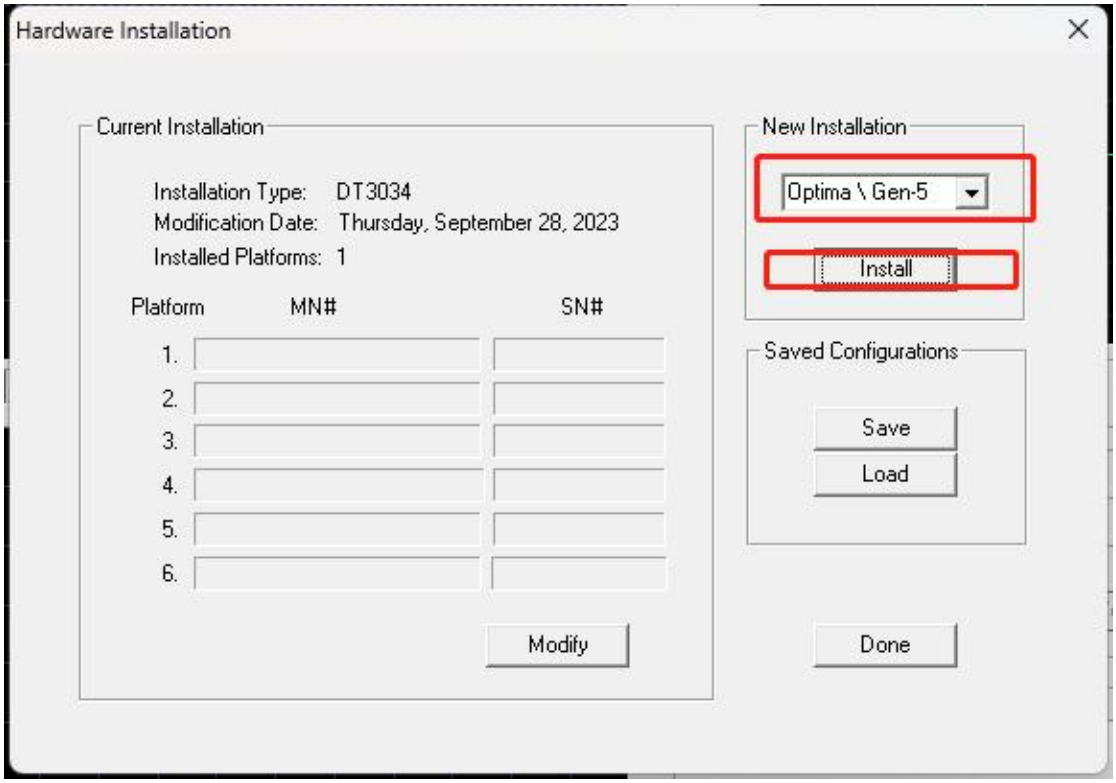


16.3.2



16.3.3

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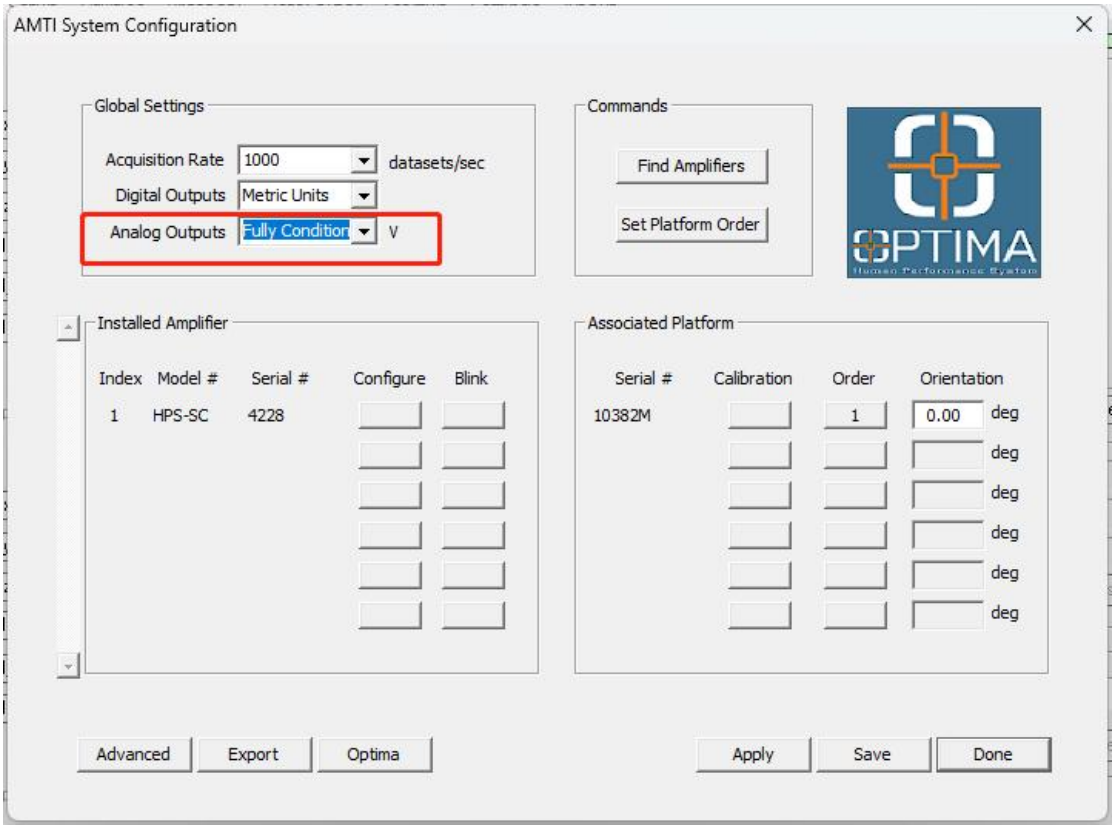
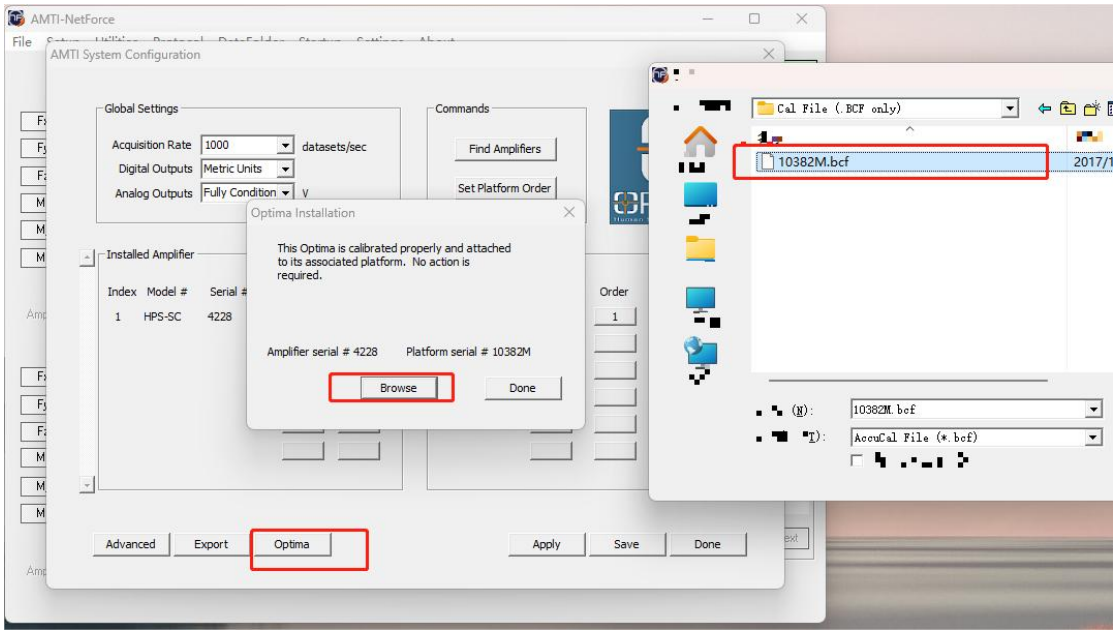


16.3.4



16.3.5

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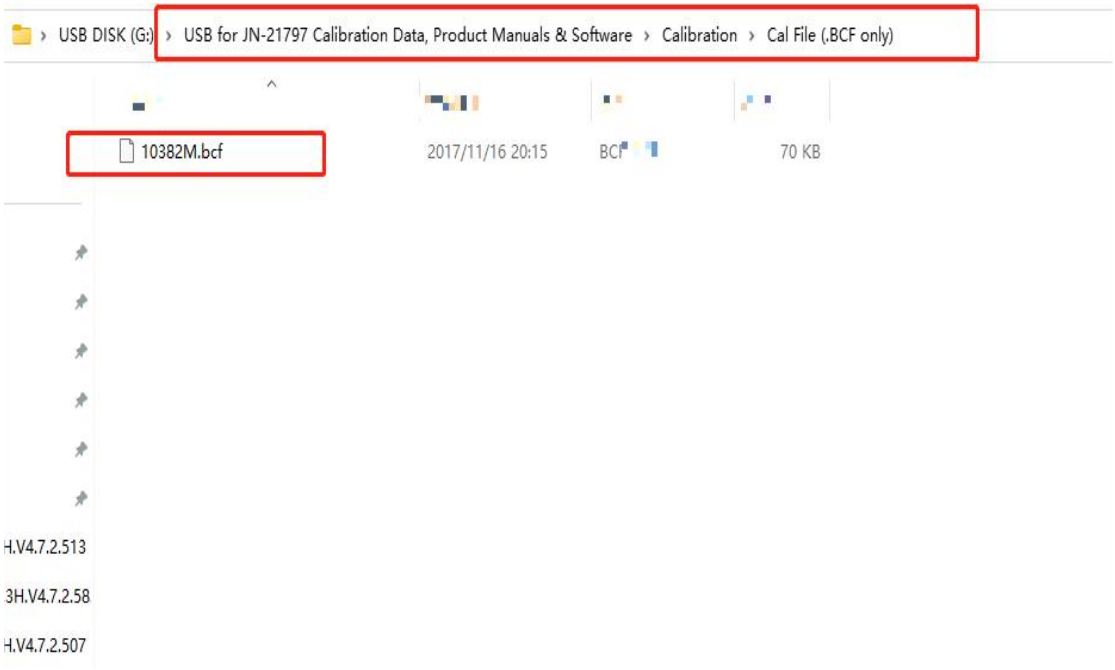
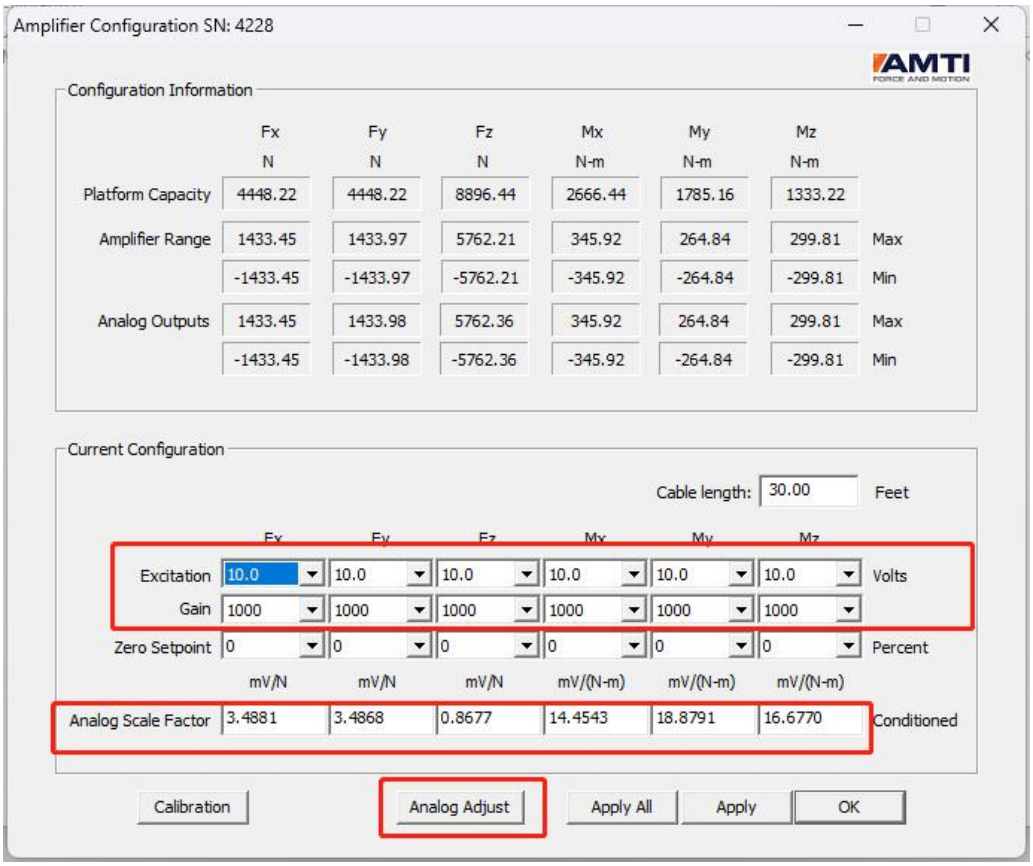


16.3.6



16.3.7

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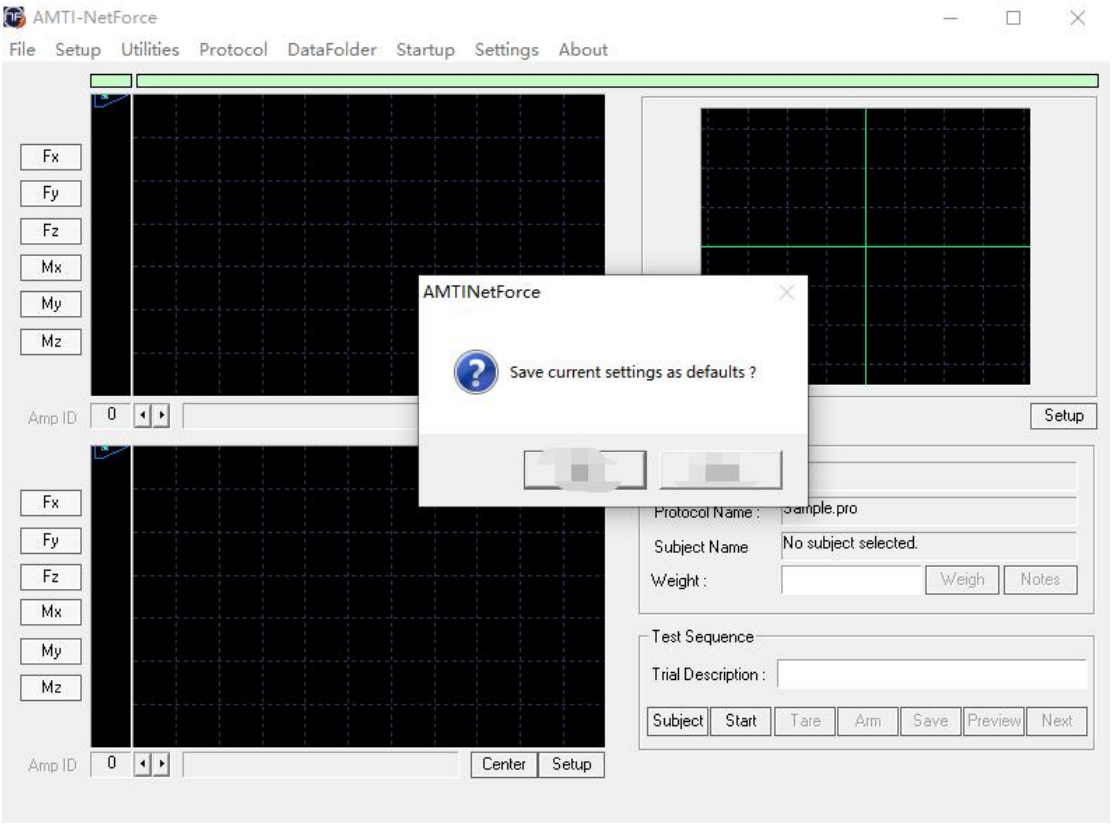

16.3.8

(5) Open XINGYINM -- click on the dynamometer menu bar -- select Force Platform Configuration, then click the "+" to add a force plate. On the right, set the parameters for the AMTI force plate. Starting from the top left to the bottom right of the calibration matrix, enter the matrix values derived from the "AMTI NetForce" software, then click apply.

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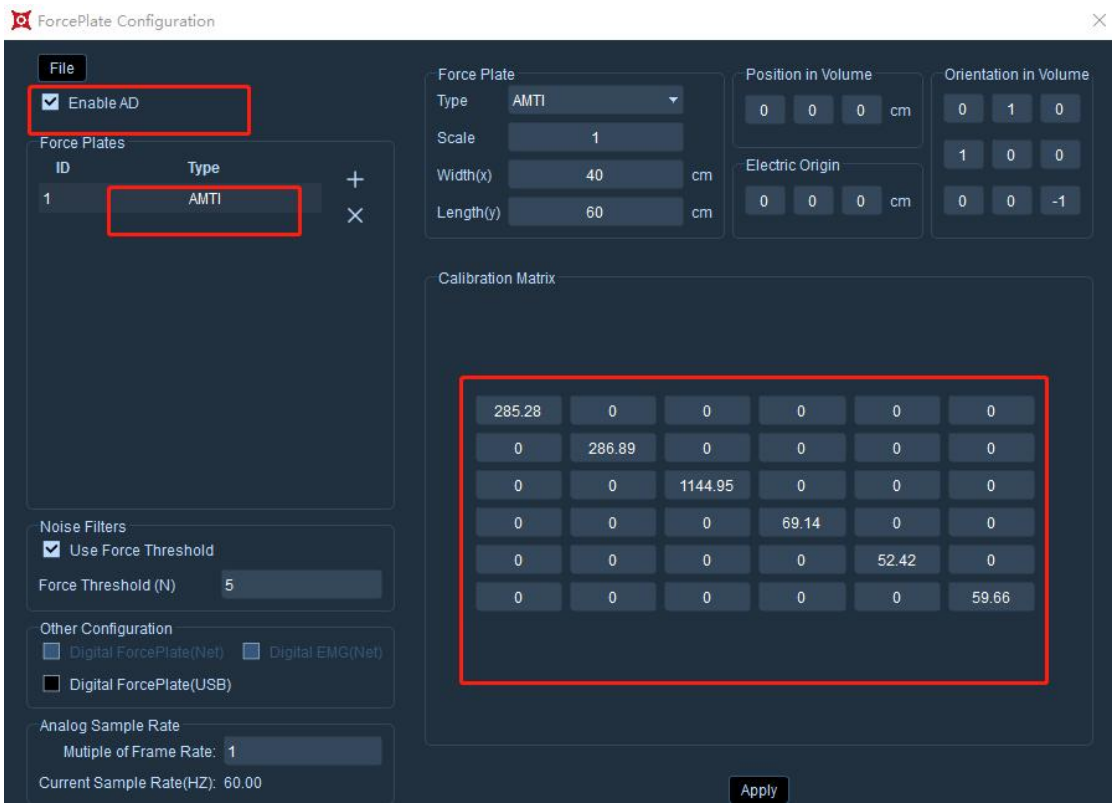
(6) Click on the dynamometer menu bar -- select Analog Configuration. In the Analog Configuration window, configure the analog channels for AMTI. Right-click in the list and select "AMTI--FP1". Configure the range for each channel according to the output range of the test platform. Each analog channel can select ranges like +/-10mV, +/-10V, etc., from the "Range" drop-down menu. Click the "Select" button at the top left of the window to select all analog channels.

(7) In the Force Platform Configuration window, check the box for Analog Access (16.3.9), connect the camera, play, and you can use the AMTI force plate in Live.



16.3.9

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■ **USB Access to AMTI Force Plates**

(1) To connect AMTI force plates via USB, first power on the amplifier, ensure the amplifier's power switch is turned on, and connect the force plate cable to the amplifier's "TRANSDUCER INPUT" port;

(2) Connect one end of the synchronization cable to the AUX port at the back of the camera with IP 201, and the other end's white synchronization cable to the "GENLOCK/TRIGGER INPUT" port on the amplifier;

(3) Insert the USB cable into the USB port on the amplifier, and connect the other end of the USB cable to the computer where the XINGYING software is installed;

(4) Open the XINGYING software, open the Force Platform Configuration. In the "Other Configurations" at the bottom of the Force Platform Configuration window, check the "Digital Force Plate (USB)" option, click "+" and it will automatically add a force plate. Select the force plate name, and in the "Force Plate Specifications" on the right side of the window, set the type to AMTI, and set the length and width according to the size of the force plate; the parameters under "Orientation in Volume, Position in Volume" can use the system's default parameters, or you can modify them according to your needs. The "Serial ID" at the bottom of the window will display the serial number of the force plate. After configuring the force plate parameters, please click the "Apply" button to save this configuration (16.3.10);

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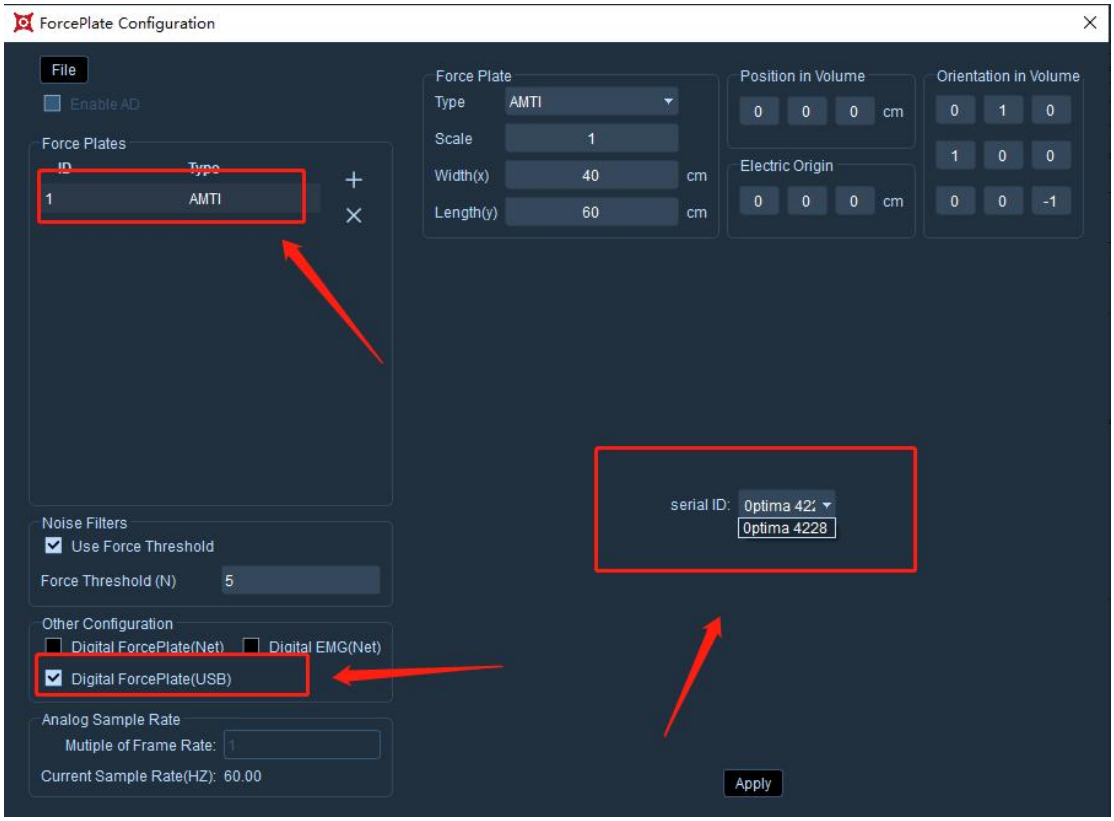
(5) Close the settings window, connect the camera, click the play button in the Live 3D view mode, at this point the AMTI force plate, which has been connected via USB, has been added to the 3D view and is ready to be used.



16.3.10

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4. Other Configurations

(1) After setting the force plate parameters, check "Use Force Threshold" in the "Noise Filters" module and set the value to "5" to filter out the noise on the force plate in the 3D view;

(2) Set the channel magnification by opening the Force Platform Configuration window, enter the frame rate multiplier at the bottom, and press Enter. The magnification setting will be successful. Sampling frequency value = frame rate multiplier × frame rate.

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5. Importing and Exporting Force Plate Configuration Files

(1) In the Force Platform Configuration window, you can import/export the force plate configuration files (16.5.1).

(2) After configuring the force plate parameters, click File, click Export Force Plate Configuration File, choose a save path, and file name to save. If you do not change the name, it will save with the software's default file name. The exported force plate file can be seen in the selected folder as a .fpl file, and the force plate's parameter configurations will be saved in the .fpl file.

(3) If you have previously saved force plate configuration files, click File, click Import Force Plate Configuration File, and open the .fpl configuration file. The parameters from that configuration file will be imported, eliminating the need for manual configuration. Click Refresh to refresh.

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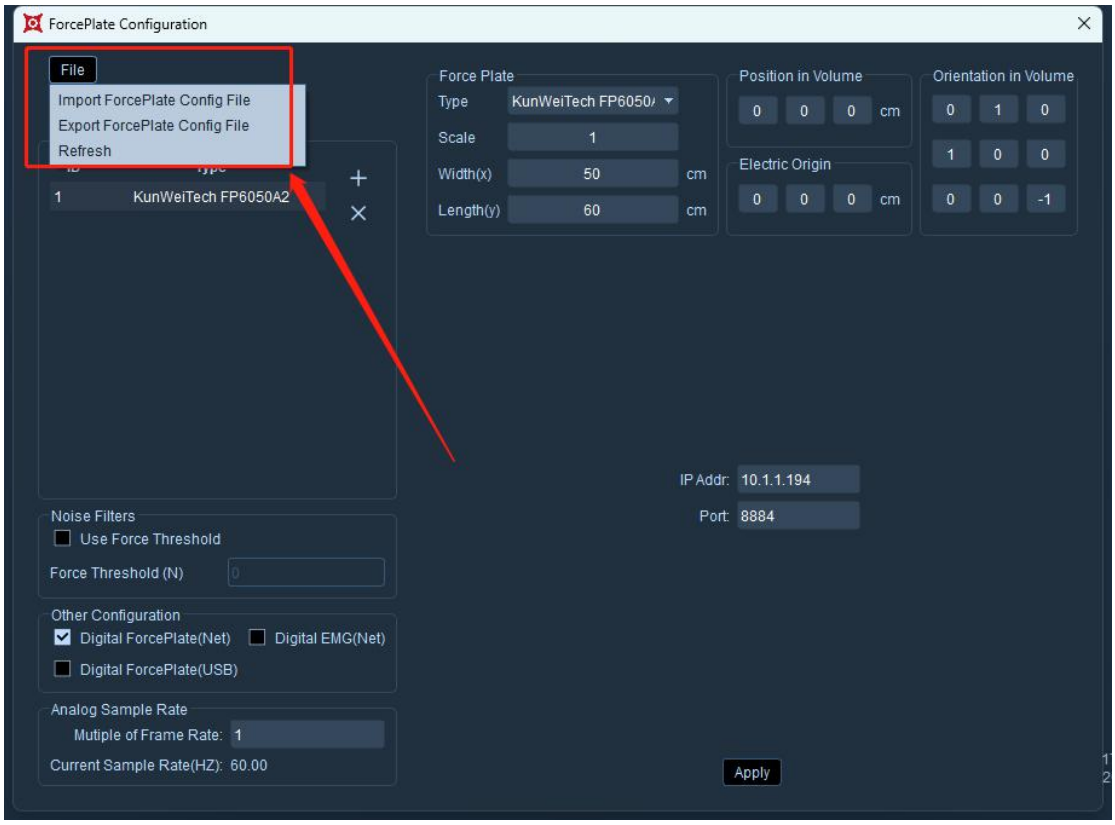

16.5.1

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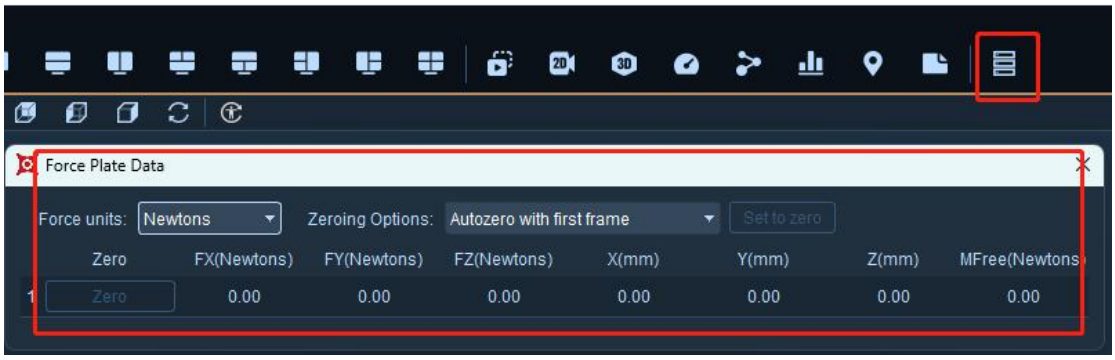
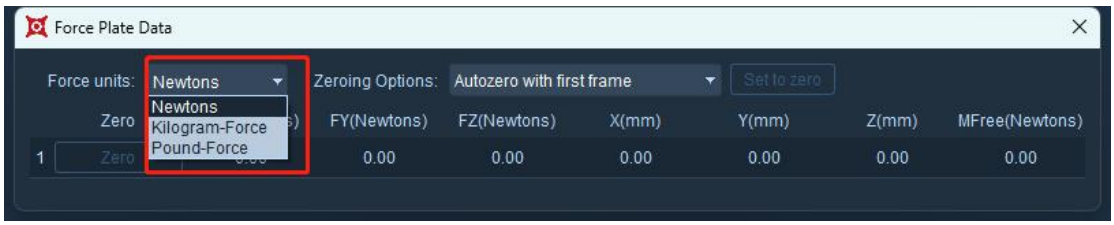
6. Force and Torque

(1) After connecting the force plate in Live mode, force and torque can be displayed in Live. Click on "Force Plate Data" in the toolbar at the top of the software, and in the "Force Plate Data" window, force and torque readings will be displayed in real time (16.6.1). Data for force and torque recorded in Live on the force plate can also be displayed in the "Force Plate Data" window during Edit.



16.6.1

(2) In the "Force Plate Data" window, the force units can be changed via the "Force Units" drop-down menu, with options like "Kilogram-Force," "Pound-Force," and "Newtons" available for switching (16.6.2). In the same window, you can toggle the "Zeroing Option" drop-down menu; the software defaults to "no zeroing" (16.6.3).



16.6.2

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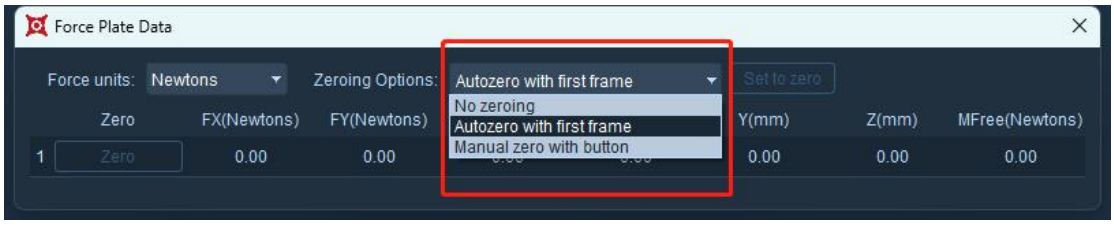


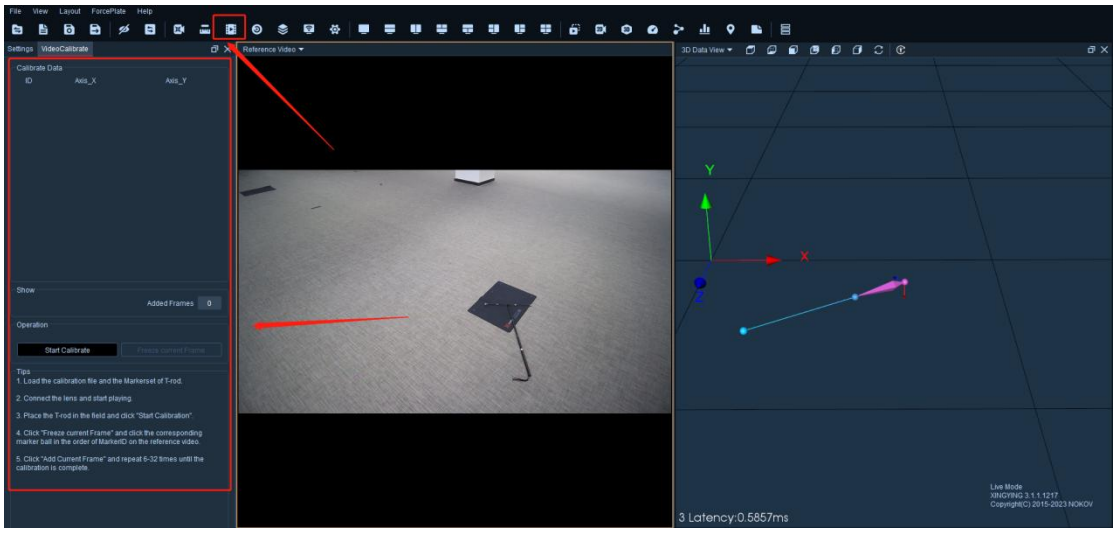
16.6.3

7. Industrial Cameras

■ Reference Video Calibration

(1) Connect the USB camera to the computer;

(2) Open the XINGYING software, connect the camera, and play. Place the T-shaped bar in the capture scene and quickly create a rigid body. Switch the layout to dual-view in the toolbar at the top of the software, opening the reference video and 3D view. Click the "Video Calibration Pane" button on the toolbar at the top of the software to pop up the video calibration panel (16.7.1);



16.7.1

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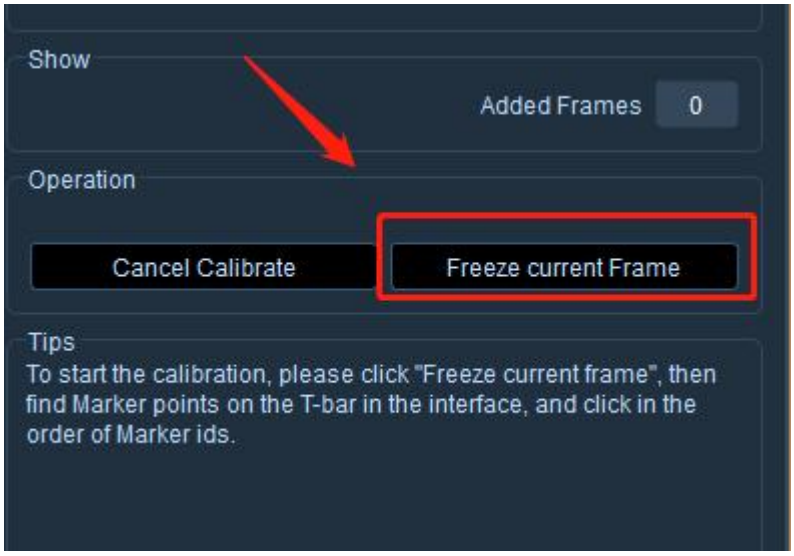
(3) Follow the calibration steps indicated at the bottom of the video calibration panel, place the T-shaped bar within the visible range of the reference video, and click "Start Calibration";

(4) Click "Freeze current Frame" (16.7.2), and following the ID names of the Markers in the assets panel, sequentially click on the corresponding marker spheres on the T-bar in the reference video; after clicking, the marker spheres will turn white (16.7.3).

(5) Click "Add Current Frame" to complete the calibration for that frame (16.7.4). The number in the "Added Frames" field of the video calibration window will automatically increment by one (16.7.5);



16.7.2

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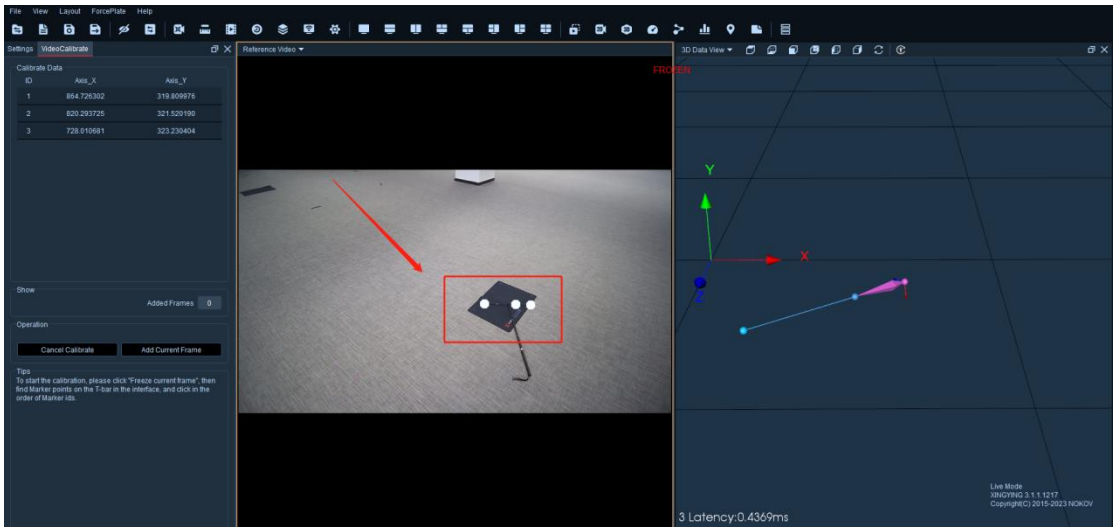
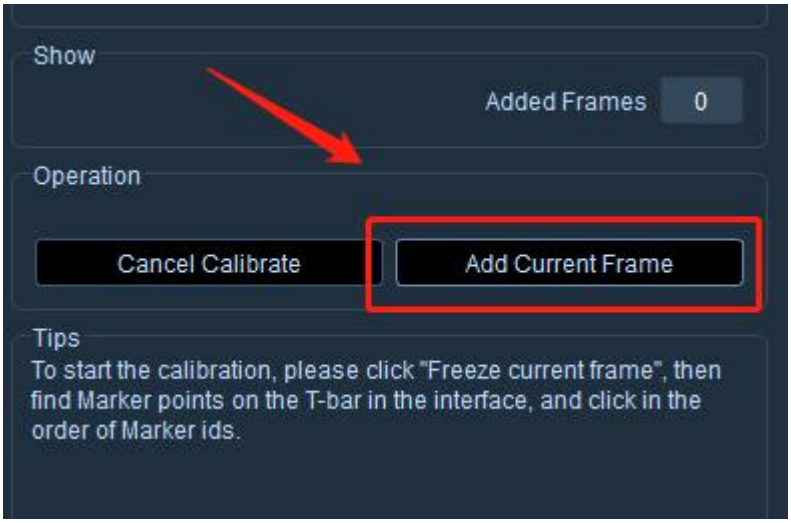
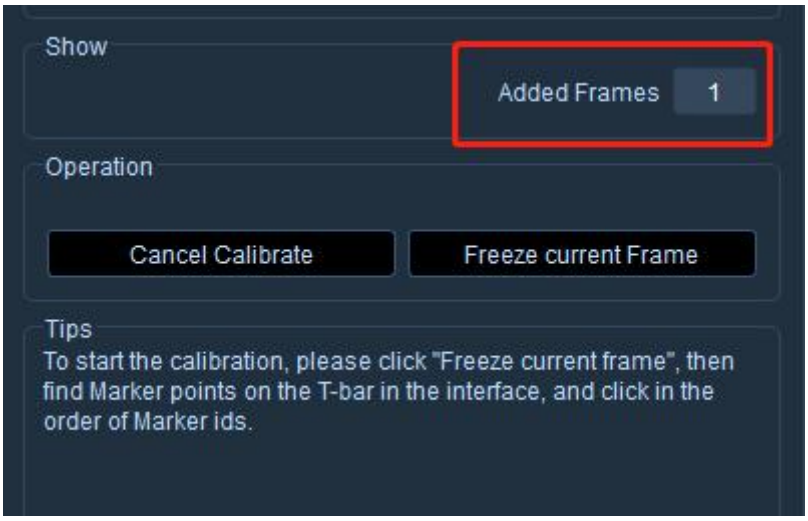


16.7.3



16.7.4



16.7.5

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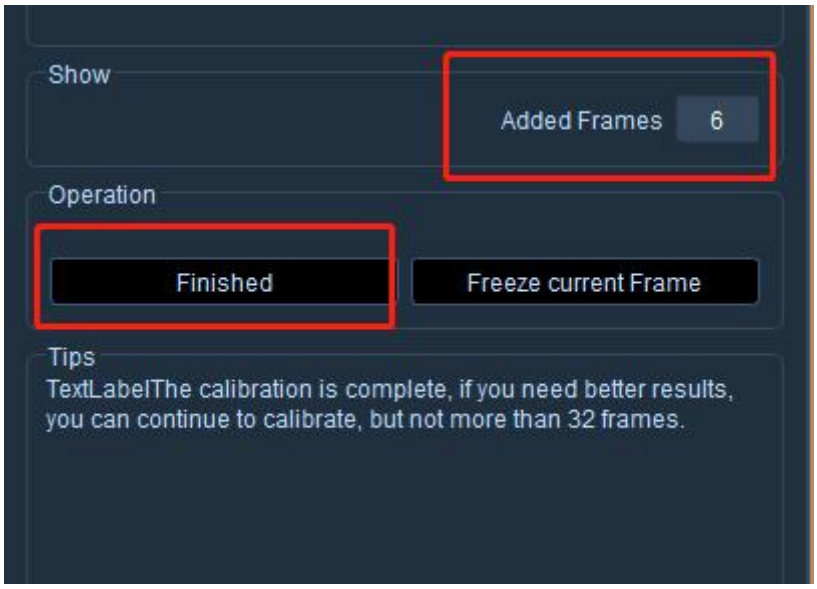
(6) Move the T-bar to a different position and repeat the actions from steps 5 and 6 (do this at least 6 times or until the "Finished" button appears). The T-bar should be placed in the central area of the field, making sure to collect data near and above the upper left, lower left, upper right, lower right corners, and the central area of the field. This ensures that the rigid body in the reference video corresponds more accurately to the actual rigid body;

(7) When the "Finished" button appears, click on "Finished" (16.7.6);



16.7.6

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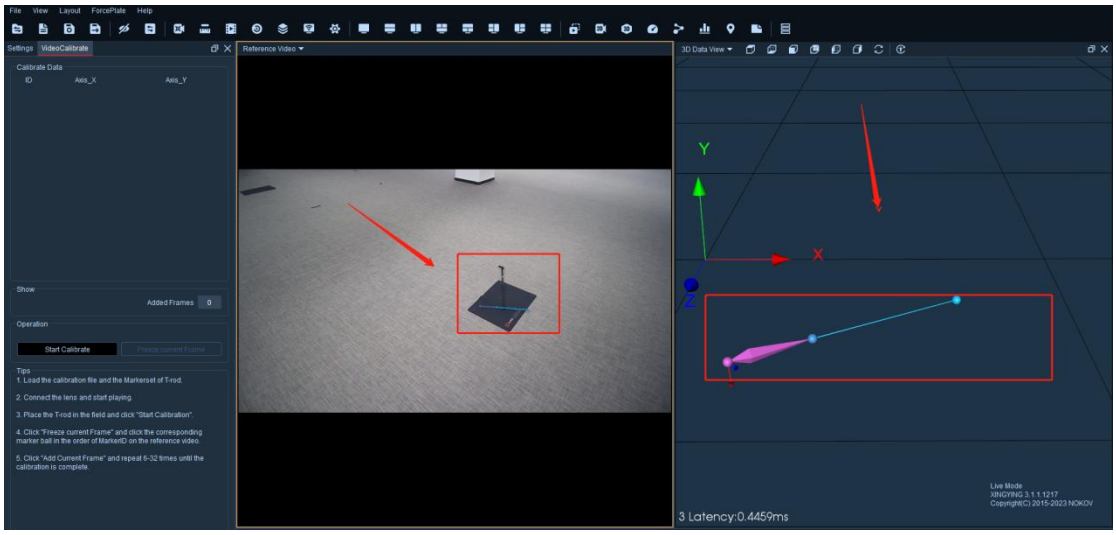
(8) Save the USB calibration file separately for easy use next time. Change the view in the software to dual view to display the 3D view; you can then see the correspondence between the T-shaped calibration pole in the reference video and the rigid body in the 3D view (16.7.7).



16.7.7

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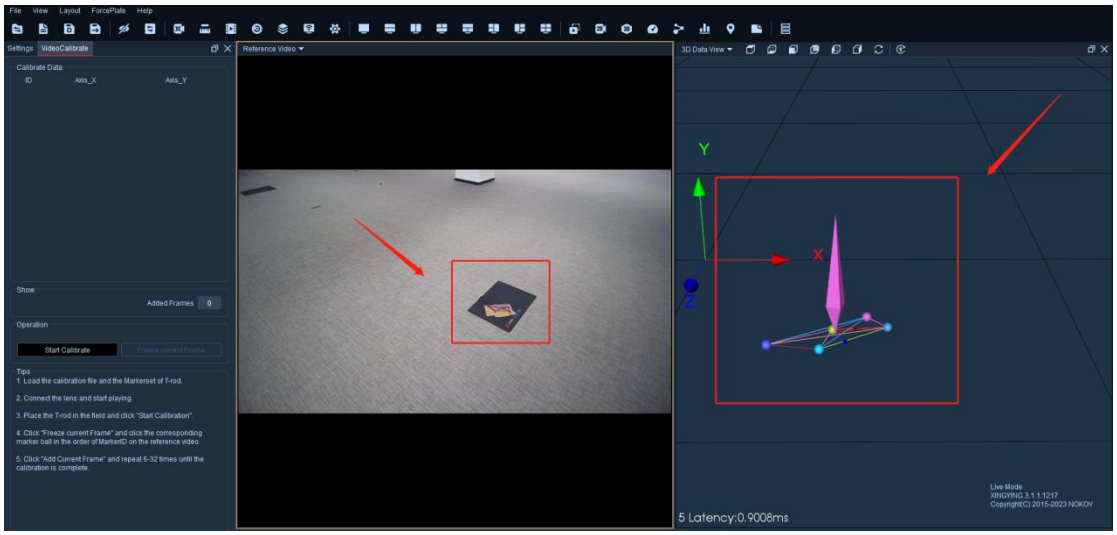
■ Synchronized Demonstration of Rigid Body and Reference Video

(1) Place the object being tested in the capture area and use one-key creation to create a rigid body. After the rigid body has been created, open the reference video. You will see that the object being tested in the reference video now also has a created rigid body and connections (16.7.8).



16.7.8

(2) Move the object being tested, and you will observe the effect of the synchronized movement of the rigid body in the reference video and the rigid body in the 3D view.

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8. High-Speed Industrial Cameras

■ **Supported Brands for High-Speed Industrial Cameras**

(1) Currently, the XINGYING software supports high-speed industrial cameras from "Daheng Industrial Camera, Gray Point Industrial Camera, and Alkeria High-Speed Industrial Camera." For specific models, please contact technical support. Different industrial cameras require the installation of the corresponding camera brand's drivers, and the use of the camera's own software for pre-setting the camera parameters.

■ **Installing Drivers for High-Speed Industrial Cameras**

(1) Here's an example with Alkeria high-speed industrial cameras: To use Alkeria high-speed industrial cameras, you need to install the camera drivers. Open the driver installation package and double-click "SDK-MaestroUSB3_Windows-v2.8.0.exe" to install the drivers (16.8.1). During the installation process, choose the default installation path, click "Next," select "I agree," and click "Install" to wait for the installation to complete.

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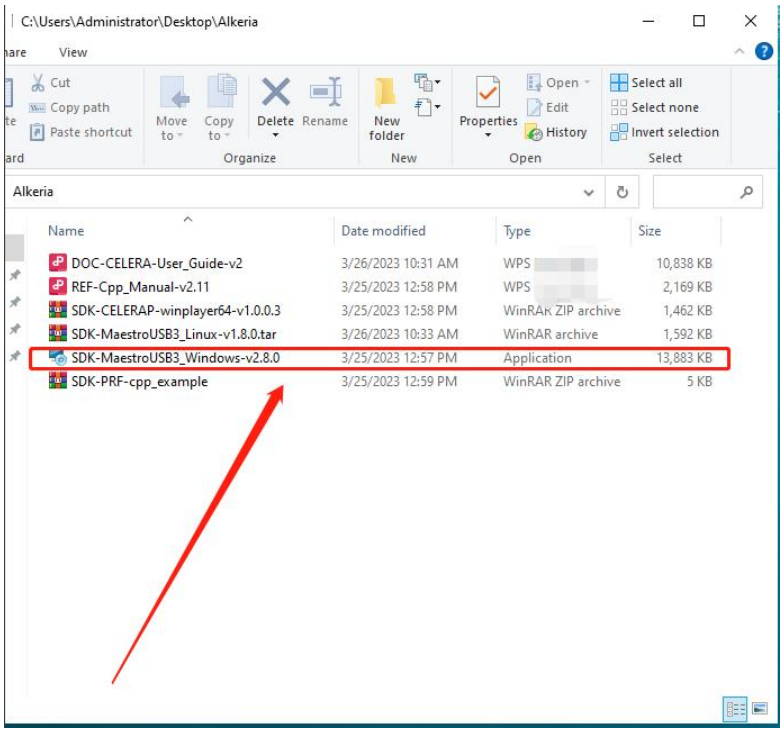

16.8.1

(2) After the drivers have been successfully installed, a "MaestroUSB3" tool will be generated on the computer desktop (16.8.2). Double-click "MaestroUSB3," enter the Bin— .NET x64 path in the pop-up folder (16.8.3), plug the high-speed industrial camera's USB cable into the computer's USB 3.0 port, and double-click "AlkeriaPlayer64.exe" to enter the camera player interface (16.8.4).

16.8.2

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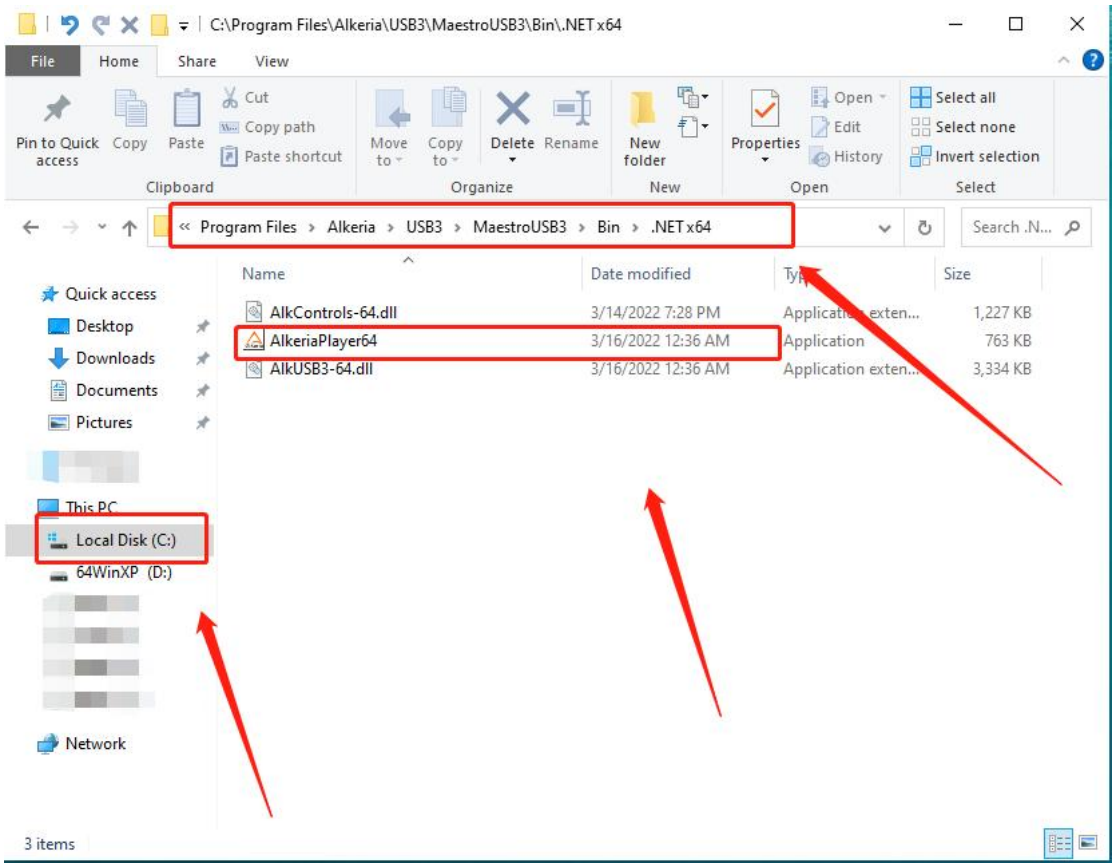
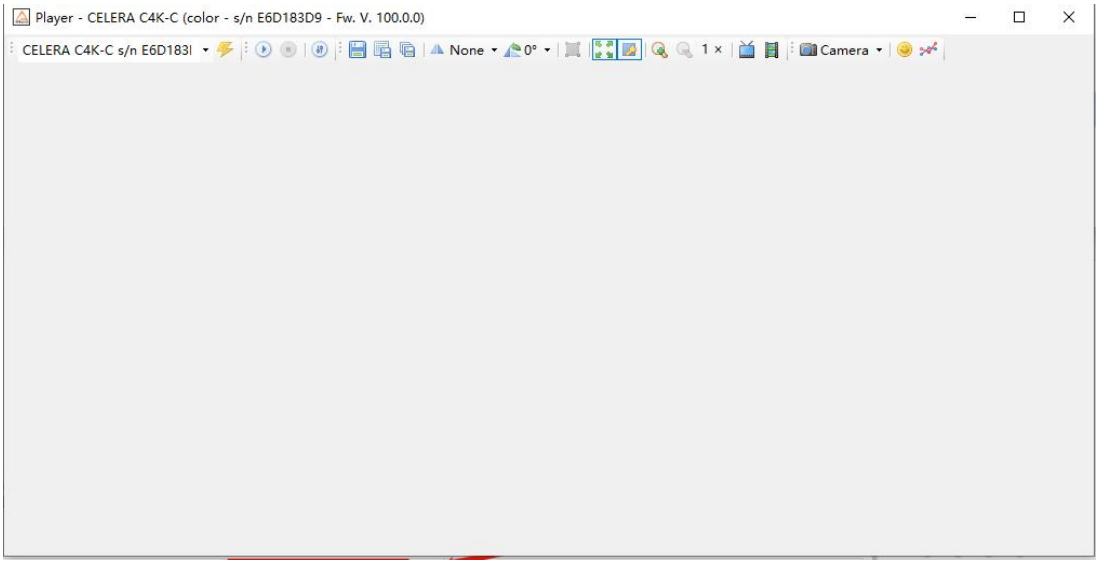


16.8.3



16.8.4

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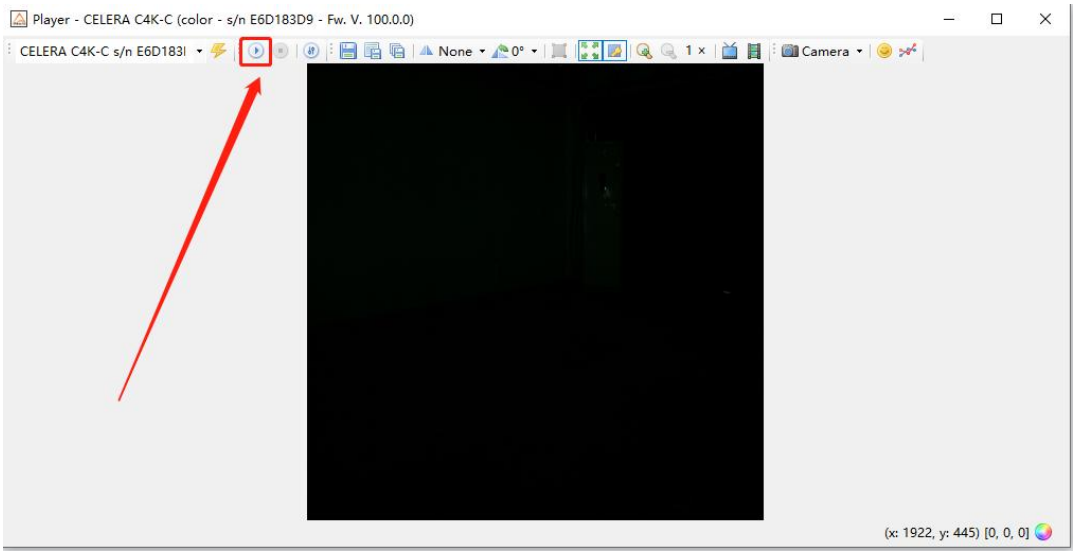
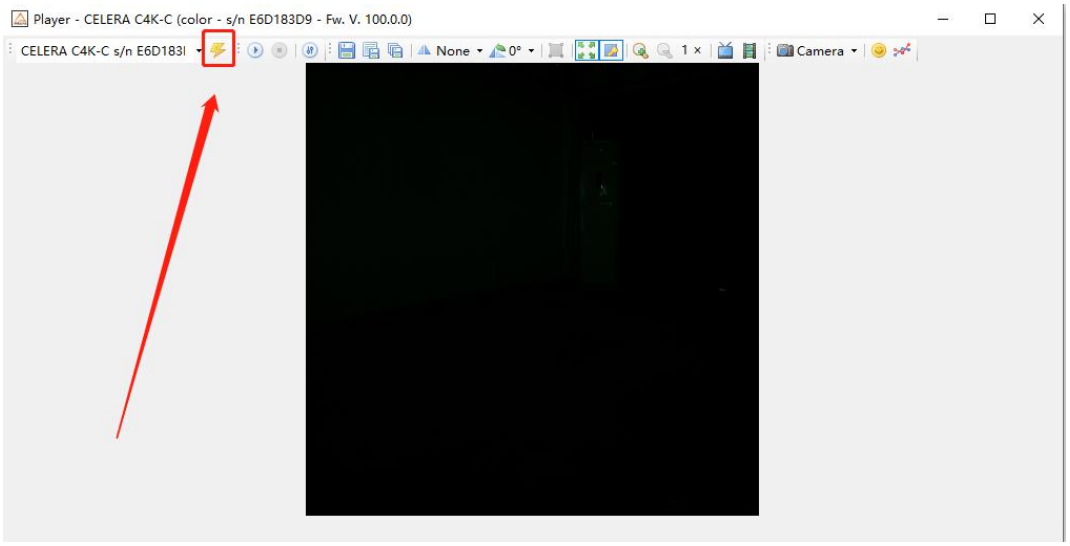
■ Connecting and Configuring High-Speed Industrial Cameras

(1) After connecting the Alkeria high-speed industrial camera to the computer, in the industrial camera player, click the play button (16.8.5), and the player window will display the camera's image. If there's an error pop-up after clicking the play button, click the "Init Camera" button to initialize the camera (16.8.6). After initialization, clicking play will display the camera's image.



16.8.5



16.8.6

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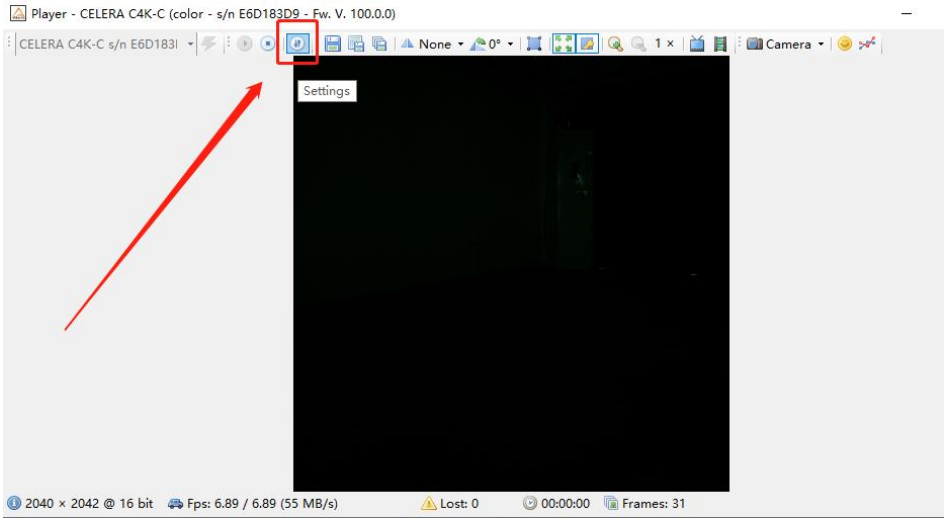
(2) After playing the image from the camera in the player, users can configure various parameters of the camera according to their needs. Click the "Settings" button to bring up the settings menu (16.8.7), where you can modify the camera's brightness, exposure, and other parameters (16.8.8) to suit your personal needs. If you have configured the camera parameters and then unplug and reinsert the USB cable of the high-speed industrial camera, the settings will be reset to default values, and you will need to reconfigure the camera parameters in "Settings".



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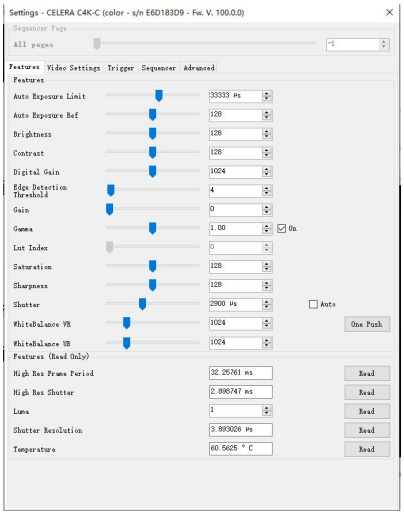

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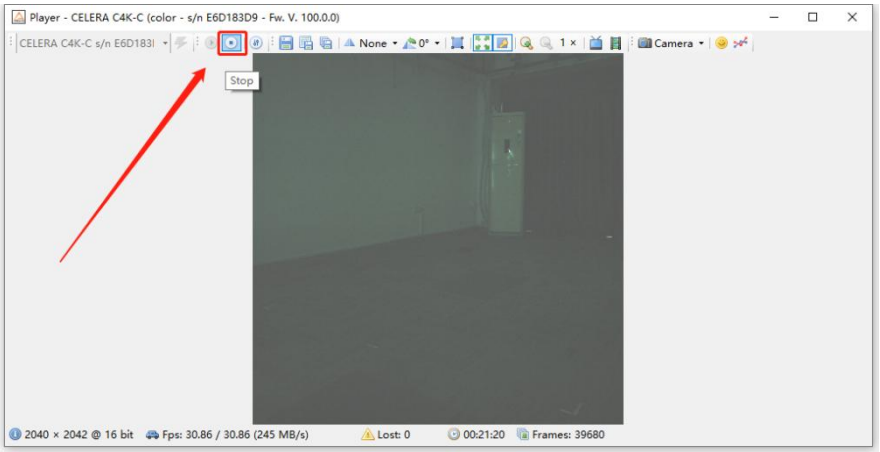
■ Synchronization of Alkeria High-Speed Industrial Camera with Motion Capture

(1) Install version 3.1.1.X of XINGYING and run XINGYING as an administrator to perform a correct calibration.

(2) After calibration, perform a reference video calibration for the Alkeria high-speed industrial camera. Once the calibration is complete, synchronization can be achieved (for detailed steps, please refer to the section "16, Third-party Adaptation (7) Industrial Cameras").

(3) Important Notes: When using the Alkeria high-speed industrial camera, the camera player and XINGYING's reference video can only play one at a time, not simultaneously. When using the reference video view in XINGYING software to play the high-speed industrial camera image, please disconnect the player from playing (16.8.9).



16.8.9

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■ Recording Reference Video

(1) After successful reference video calibration of the industrial camera, we can record data synced with the 3D view from the industrial camera. Switch the interface to the dual view of 3D and reference video, enter the recording file name, and check the "Reference Video" option, then click the record button to start recording.

(2) After recording is completed, switch the interface to the dual view of 3D and reference video in Edit mode. Load the recorded data and click play to observe the synchronized effect of the reference video and the 3D view.

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XVII. Plugins & SDK

1. Unreal Engine (UE) Plugin

■ **Software Setup and Human Model Creation**

(1) Open Data Castting Pane,Enable "SDK" in the software.

(2) After successful calibration in XINGYING software, create a human model in Live mode or load a set of data with MarkerSet human model in Edit and play it in the software.

■ **Plugin Installation and UE Settings**

(1) Depending on the version of UE used, download the corresponding NokovLiveLink plugin. The installation and usage methods are consistent. For example, if you are using the UE_4.26 engine, please unzip the "NokovLiveLink1.XXX" plugin version for the UE_4.26 engine and copy the entire plugin folder and paste it into the UE_4.26 engine path. The specific path is "Epic games\UE_4.26\Engine\Plugins", and it will depend on the software in your computer (17.1.1).

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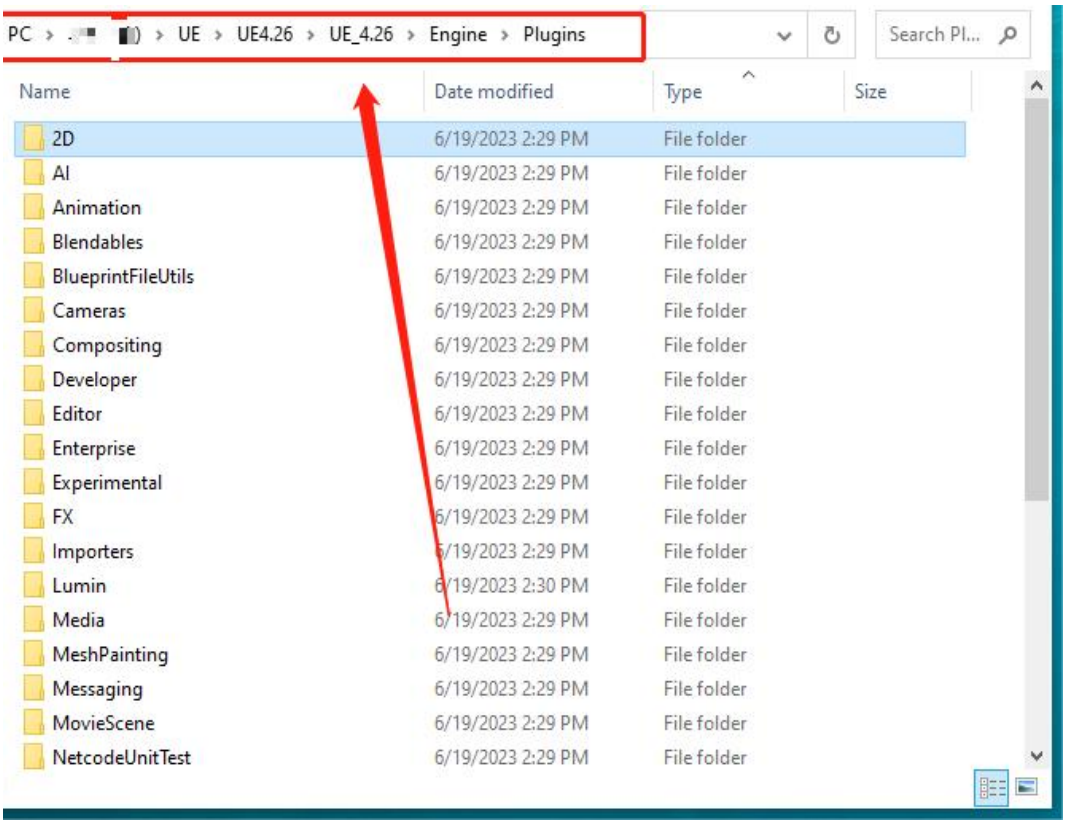

17.1.1

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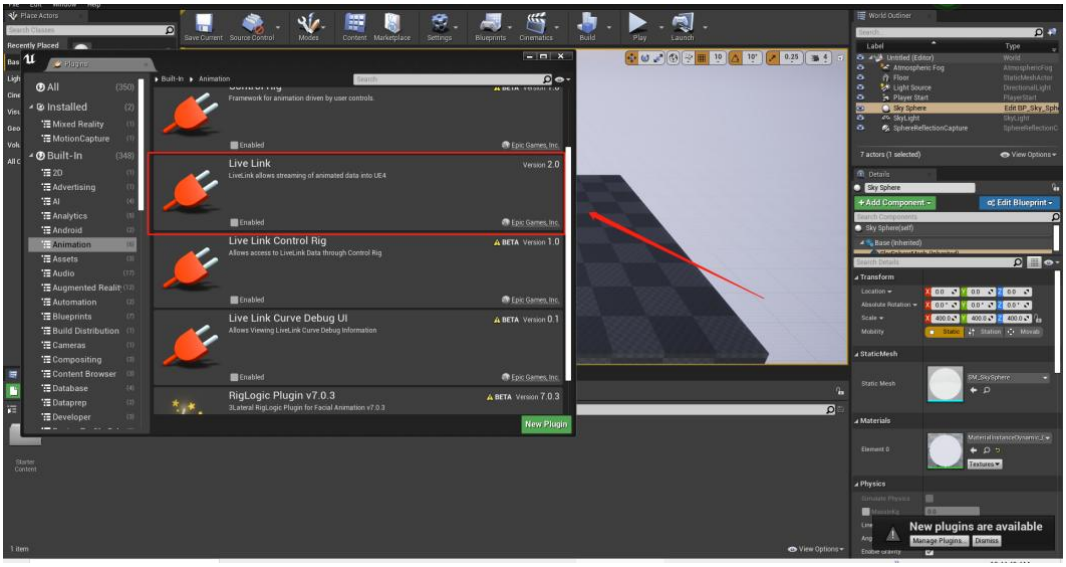
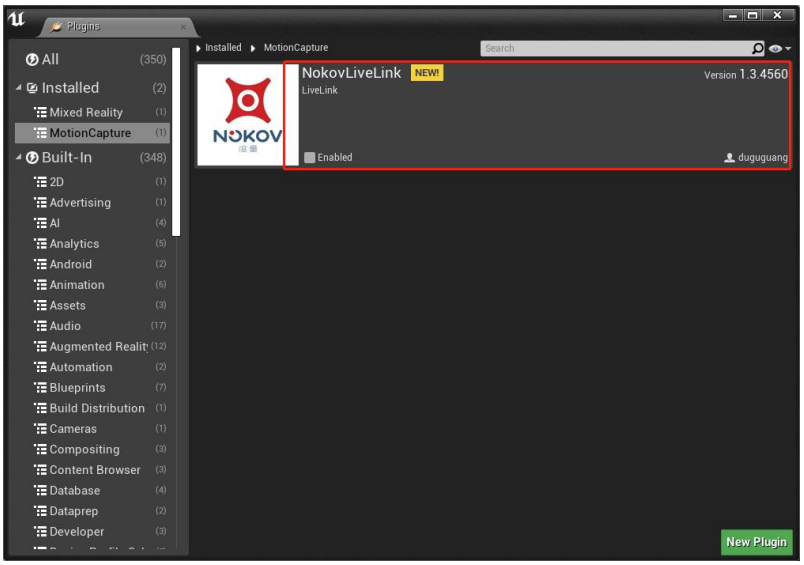
(2) After copying the plugin folder for version 4.26 to the corresponding location, open the UE_4.26 engine and create a project. Go to "Edit—Plugins", check "Animation—Live Link" and "Motion Capture—NokovLiveLink" (17.1.2, 17.1.3), and restart the software to activate the plugin. The steps are the same when using UE_4.27 or UE_5.0 or 5.1 engines;



17.1.2



17.1.3

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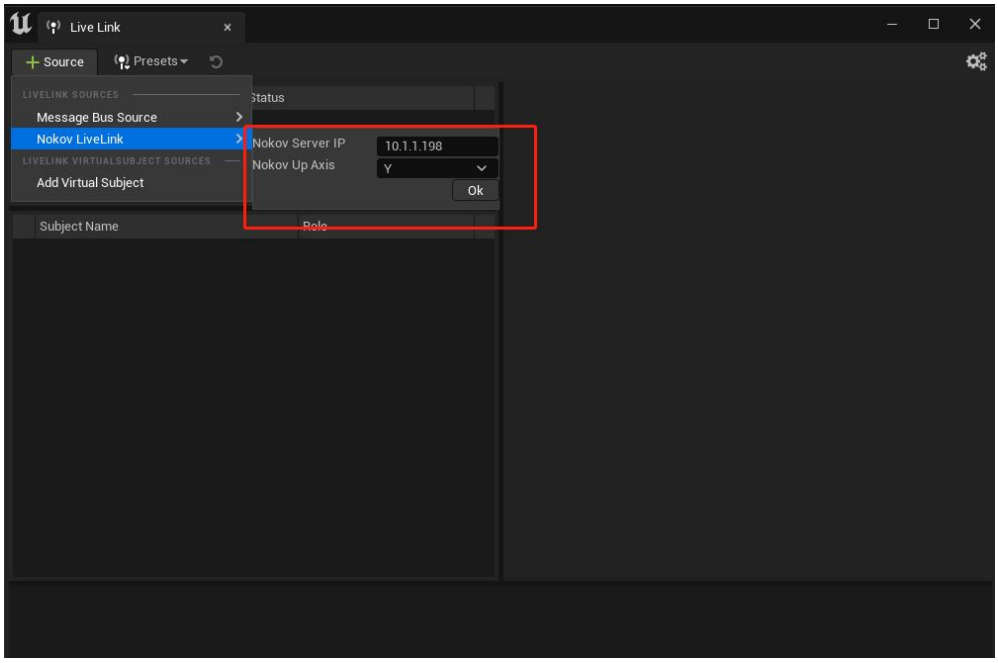
(3) In UE4.26, select "Window—Live Link," and click on "Source—Nokov Live Link," The ServerIP should be consistent with the network card address set in the data broadcast panel of the XingYing software, the default is 10.1.1.198, ensure the Up Axis is consistent with the setup in XINGYING, and click OK. Play XINGYING to receive motion capture data, and a green indicator light will illuminate (17.1.4);



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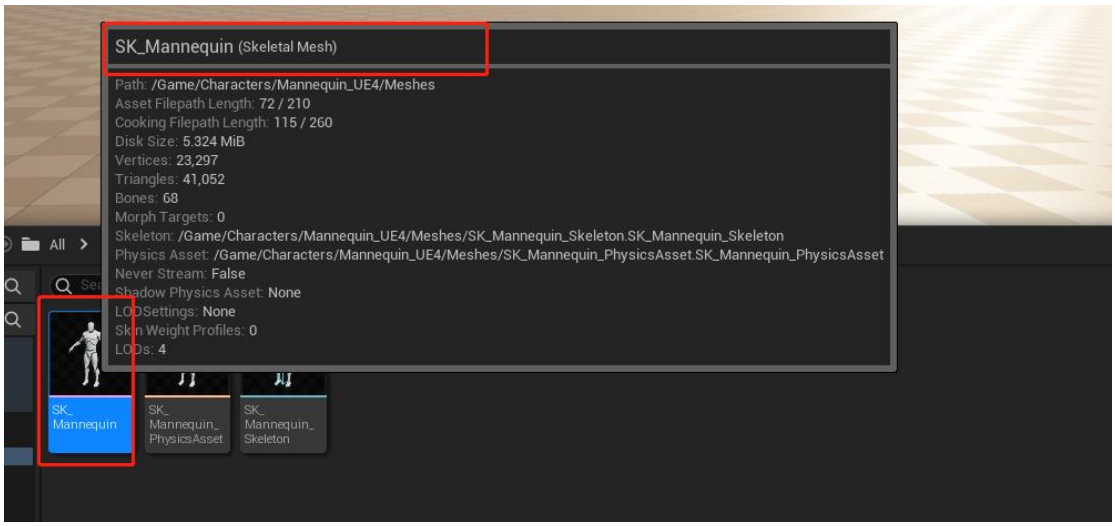
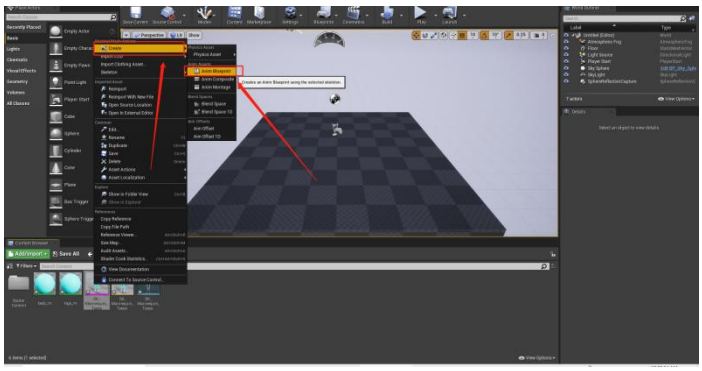
(4) Create an Animation Blueprint by locating a skeleton with a "Skeletal Mesh" in the menu bar (17.1.5), right-click on this Skeletal Mesh—Create—Animation Blueprint (17.1.6), and double-click to open the created Animation Blueprint. Right-click in the Animation Blueprint and search for "Live Link Pose," then double-click to open it (17.1.7);



17.1.5



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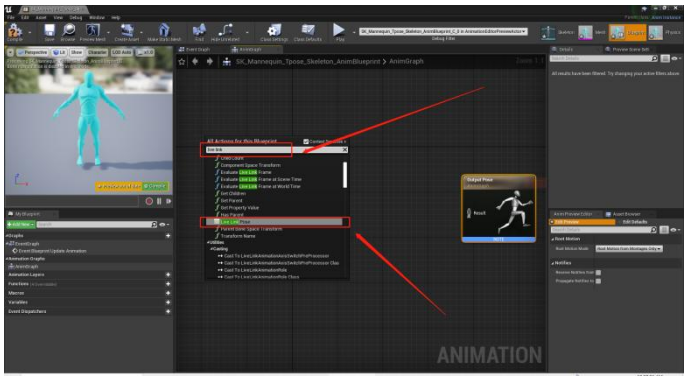
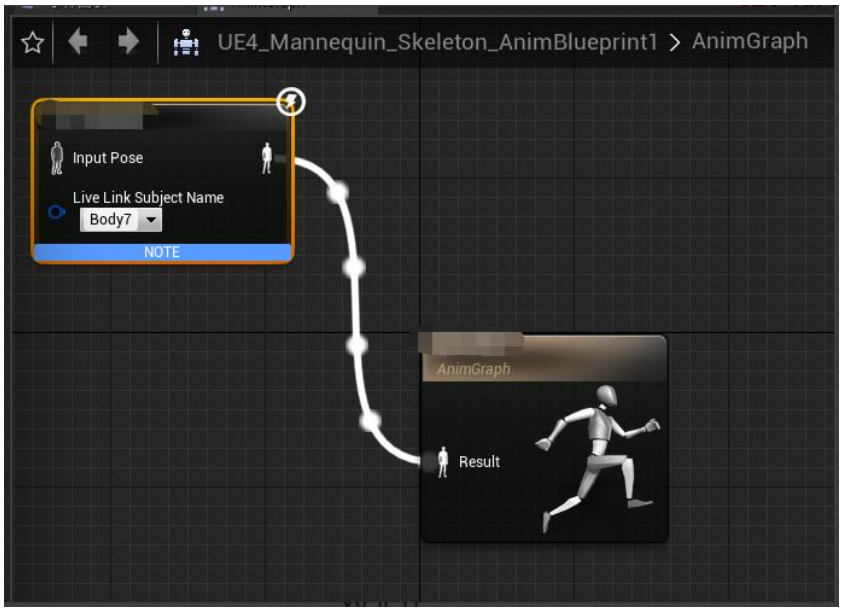


17.1.7

(5) In the "Live Link Pose," select the name of the target MarkerSet in "Live Link Subject Name" to drive the motion of the model in UE4 with that Markerset, and connect "Live Link Pose" to "Output Pose" by dragging (17.1.8). On the right side, select Retarget—Retarget Asset—NokovLiveLinkRetarget Asset (17.1.9);



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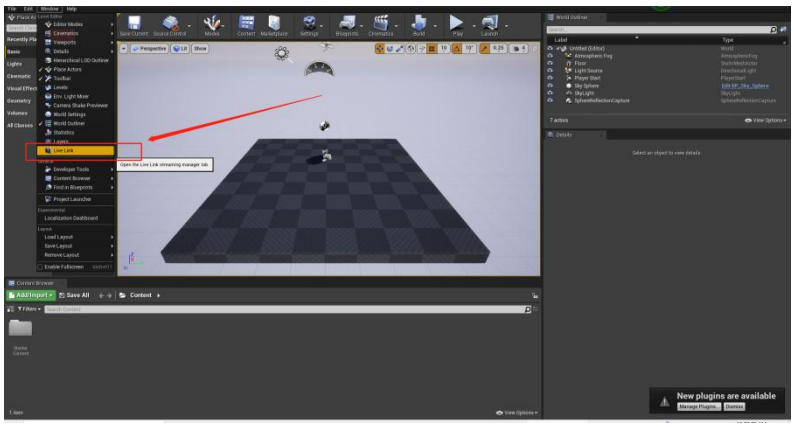
17.1.9

(6) Ensure that the human MarkerSet in XINGYING software stands in a T-pose position, click the Compile button in UE4, and when the human MarkerSet in XINGYING starts to move, the model in UE4.26 will be driven and move synchronously;

(7) The operation steps for UE_4.27, UE_5.0, UE_5.1, UE_5.2, UE_5.3 engines are the same as for UE_4.26. The difference is that for the UE_4.27 engine, you choose Window -> LiveLink (17.1.10), and for UE_5.0 and later versions, you choose Window -> Virtual Production -> LiveLink (17.1.11).



17.1.10

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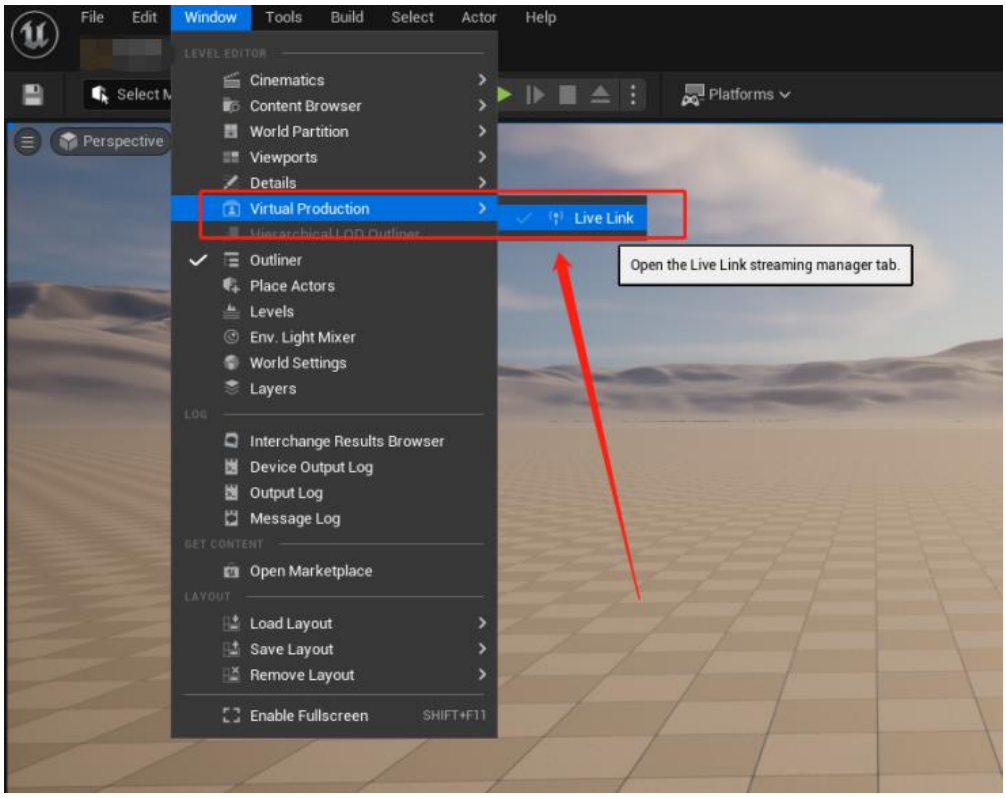

17.1.11

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■ Introducing Human Data with Skeletal Redirection into UE

(1) Human data from XingYing can be directly integrated into UE to drive the human model through a plugin. However, when there is a significant difference between the model and the model's body, driving the model directly may lead to issues like sliding steps. In such cases, you can bind and redirect through MotionBuilder, then drive the human model in UE via the MotionBuilder's UE plugin (MotionBuilder LiveLink, which can be downloaded from the UE official website or obtained by consulting Nokov engineers). You can also import the human model that needs to be driven into XingYing, then enable the redirection function. After the human data is transformed, the output data can bypass MotionBuilder and directly drive the human model in UE. For the specific operation steps of driving the model through the redirection function of XingYing, please refer to the detailed "Fifteen, Data Redirection" above.

(2) First, you need to create a human model in Live in XINGYING software or load human data in Edit modes, use the model asset import feature to import an FBX or HTR model file, and perform skeletal redirection. For detailed operation steps, please refer to the section "Fifteen, Data Redirection" above;

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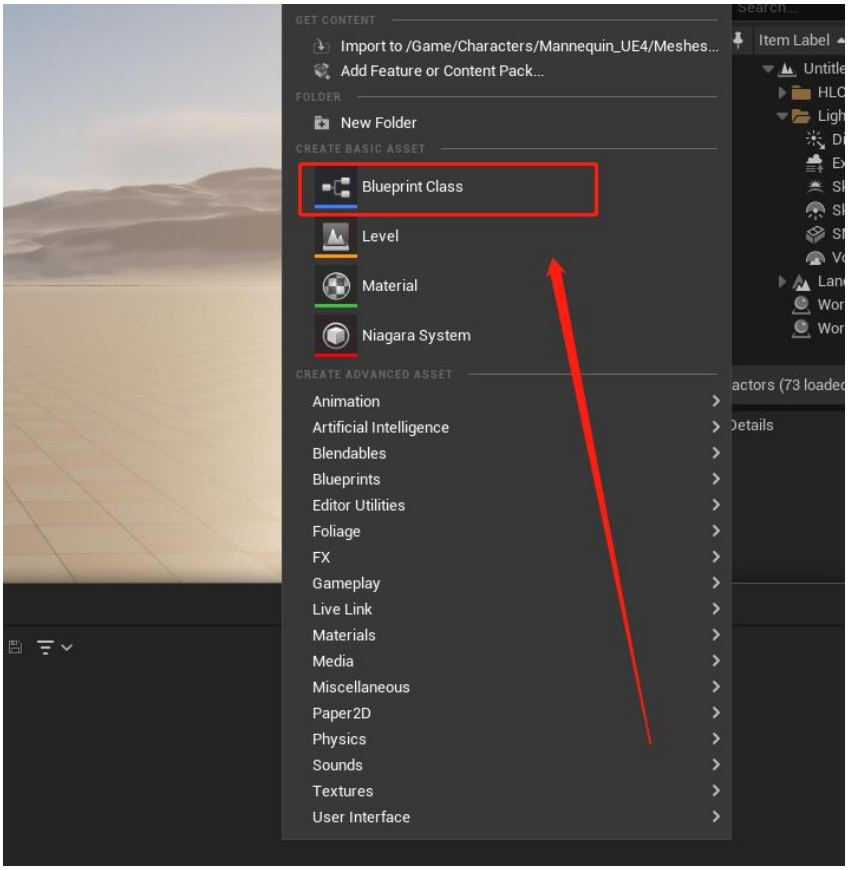
(3) After re-directing the human skeleton in XINGYING, in the settings turn on "Enable Redirected Data", open UE, import the model file with skeletal redirection done in XINGYING into UE, right-click in an empty space, select Blueprint Class (17.1.12), in the pop-up window's textbox input "Nokov", select “NokovLiveLinkRetargetAsset”, and click Select (17.1.13). Name the Blueprint Class, if not renamed, the class will default to the name “NewBlueprint”. At this point, you can see that we have successfully created a Blueprint Class with a cube icon in the content side menu.



17.1.12

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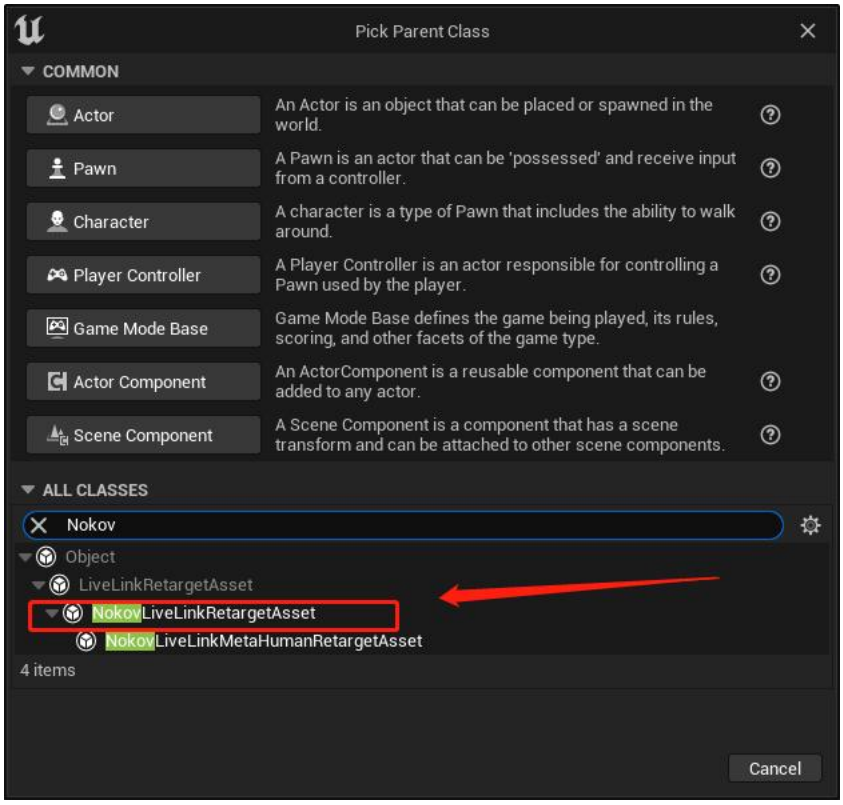

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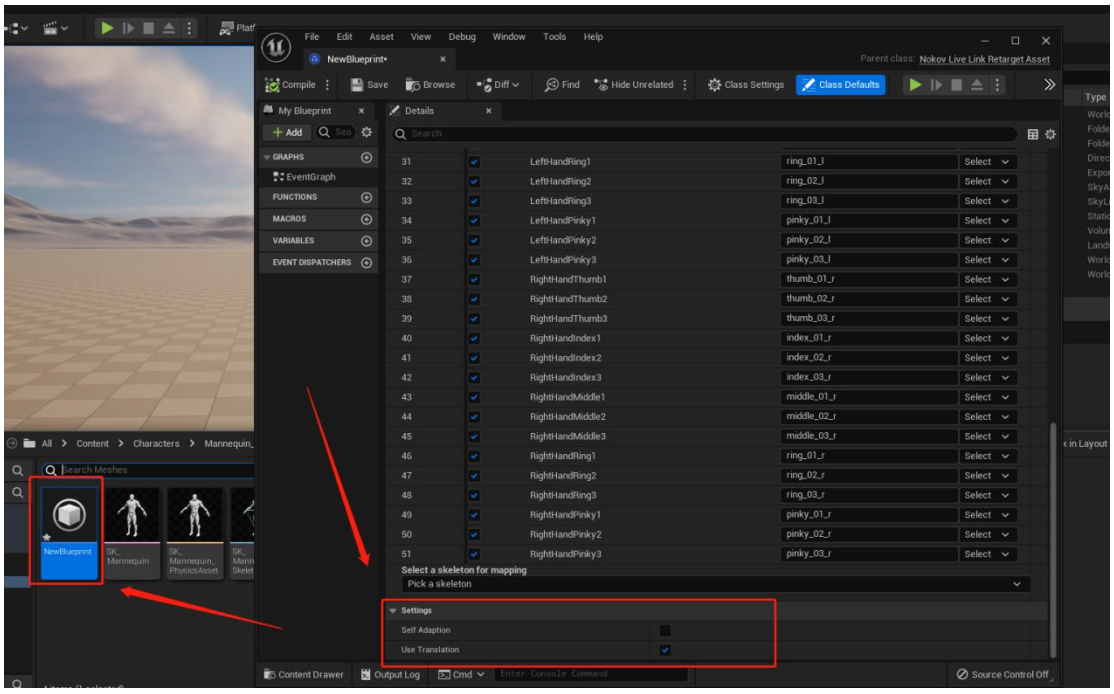
(4) Double-click on the Blueprint Class you just created, and you will see two options for "Self Adaptation" and "Use Translation" at the bottom of the popup window. The translation option is checked by default, and self-adaption is unchecked by default (17.1.14). If you are not using skeletal redirection to drive the UE model, check the self-adaptation option and uncheck the translation option, click Save, and then Compile. If you are using skeletal redirection, ensure the translation option is checked and the self-adaption option is unchecked; click Save, then Compile. Driving the UE model with redirected human data and checking the self-adaption option may cause abnormalities in the model's skeleton in UE.



17.1.14

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(5) To drive the UE model using the skeletal redirection feature and after unchecking the self-adaptation option in the Blueprint Class, you can refer to steps 5-8 above to drive the model. The only difference is that you need to select the name of the Blueprint Class with the cube icon (that has the translation option checked) from the Retarget—Retarget Asset drop-down menu on the right side of the window (17.1.15). After selecting it, click Compile. When XINGYING software plays and the MarkerSet starts to move, the model in UE will be synchronously driven.

(6) If you are not using skeletal redirection to drive the UE model, in the Blueprint Class check the self-adaptation option, uncheck the translation option, and select the name of the Blueprint Class with the cube icon (that has the self-adaptation option checked) from the Retarget—Retarget Asset drop-down menu. After selecting, click Compile. When the XINGYING software plays and the MarkerSet starts moving, the model in UE will be synchronously driven.

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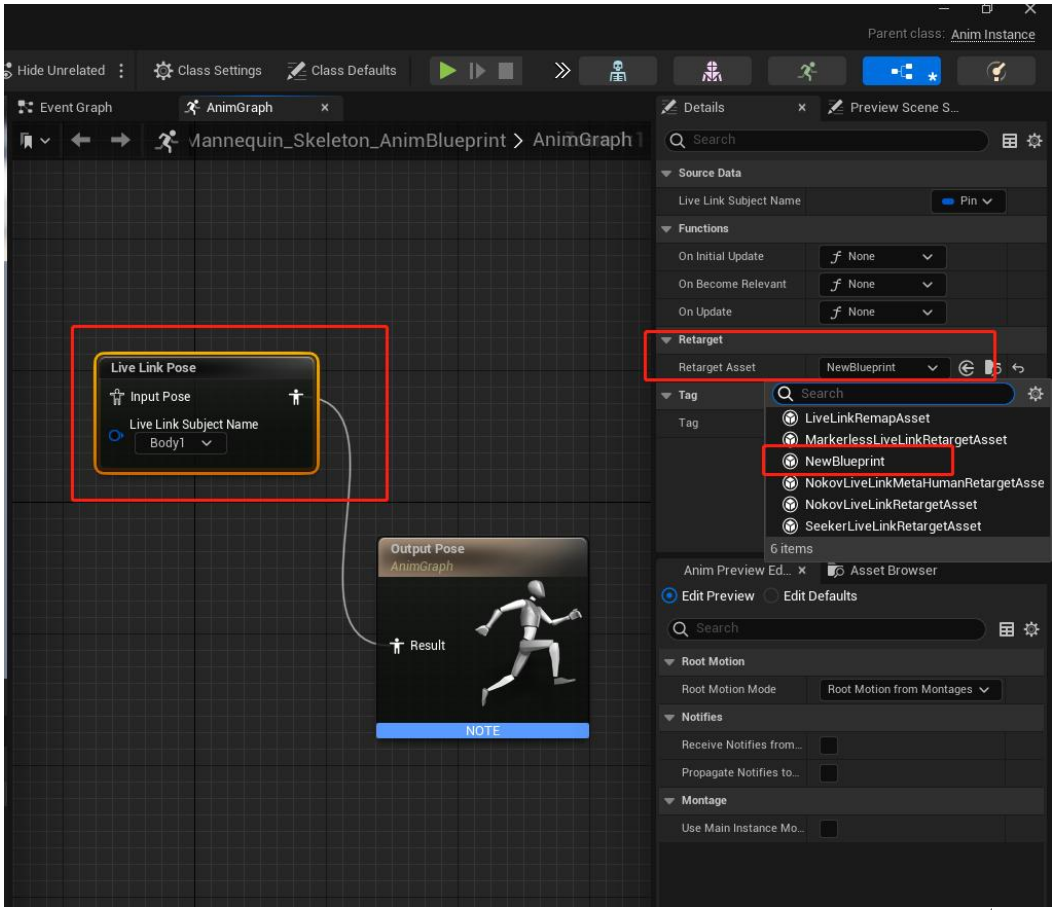

17.1.15

(7) When driving the UE model with redirected human data, if you haven't checked or forgot to enable the "Use Redirected Data" feature in XINGYING, you will need to turn on "Use Redirected Data" in XINGYING. After enabling it, disconnect the link between UE and XINGYING and re-establish the LiveLink connection. Otherwise, the inconsistency between the human data and the description information obtained by the SDK may lead to abnormalities in the model's skeleton in UE.

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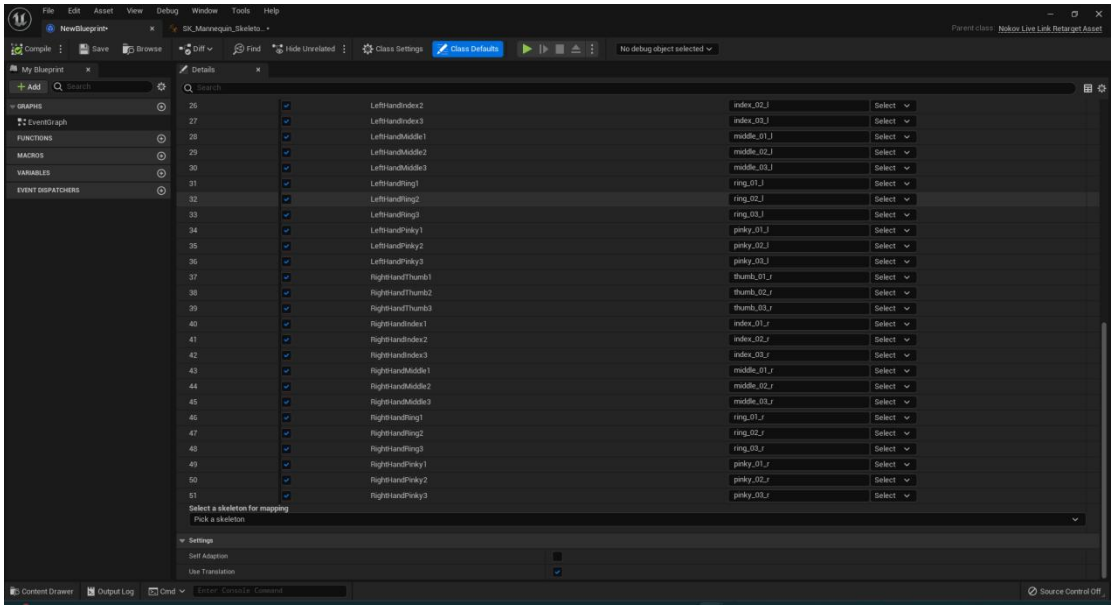
■ Blueprint Class

(1) Double-click on the created Blueprint Class to enter it (17.1.16);



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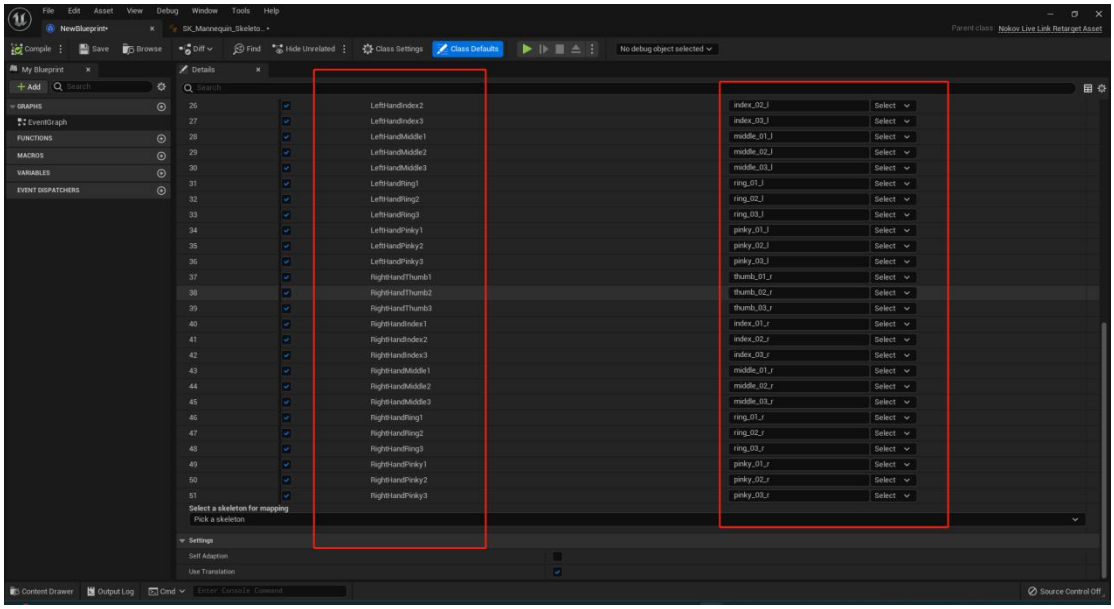
(2) The Nokov skeleton Mapping table shows XINGYING's human skeleton names on the left and UE model skeleton names on the right. By selecting the checkbox for Enable skeletonMapping in the Nokov skeleton Mapping option, you can edit the list below, otherwise, it's not editable. There is a checkbox on the left side of each joint skeleton name; if checked, this joint skeleton is involved in data driving; if not checked, the skeleton will not participate in data driving.



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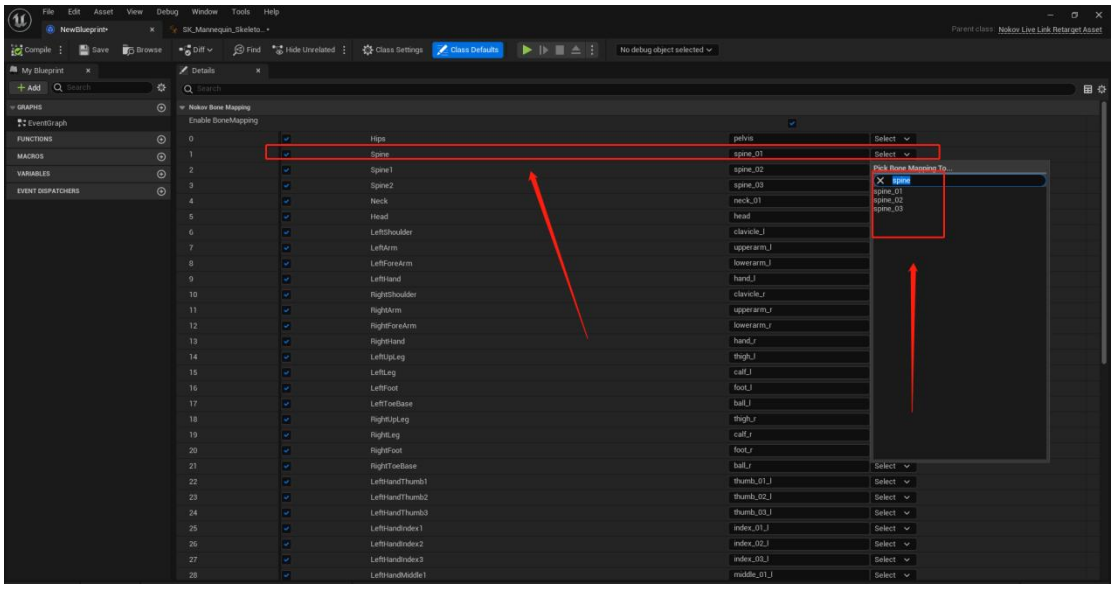
(3) Click the Select button to the right of an individual joint (row), and enter the skeleton name in the search box to fuzzily match the target joint. For example, if you select the "Spine1" skeleton and click the Select button, you can enter "Spine" in the search box to fuzzily match the target joint (17.1.18);



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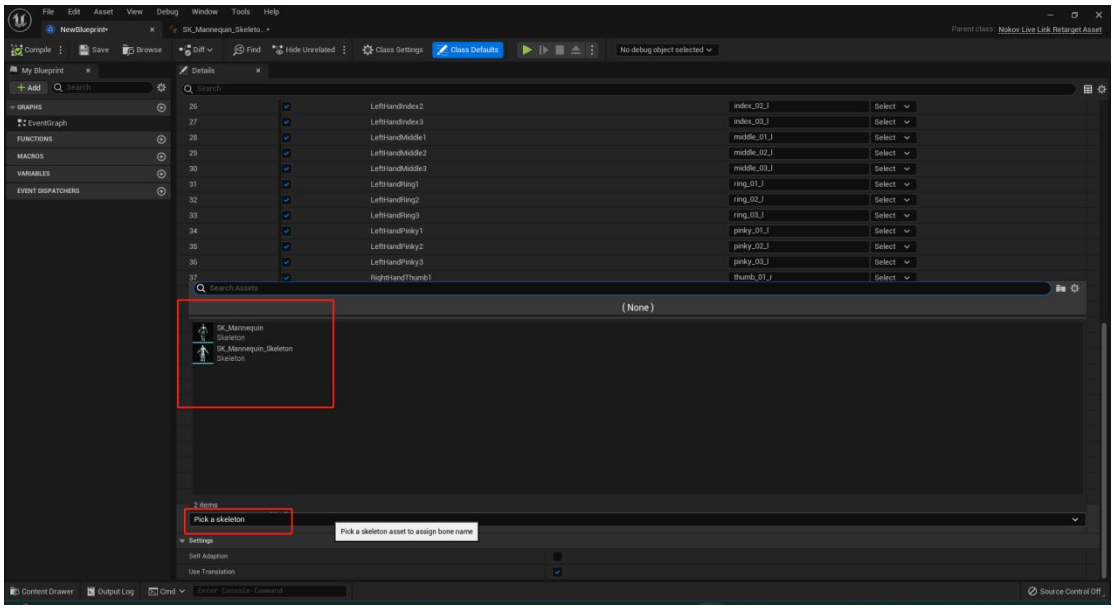
(4) Click "Select a skeleton for mapping" at the bottom of the window, which will display all the skeleton resources (17.1.19). Select a skeleton resource to apply that skeleton and check if the skeleton names in it correspond correctly with the skeleton names of XINGYING's human model. If there's a mismatch, you can use the Select button to match the target joints via fuzzy search;



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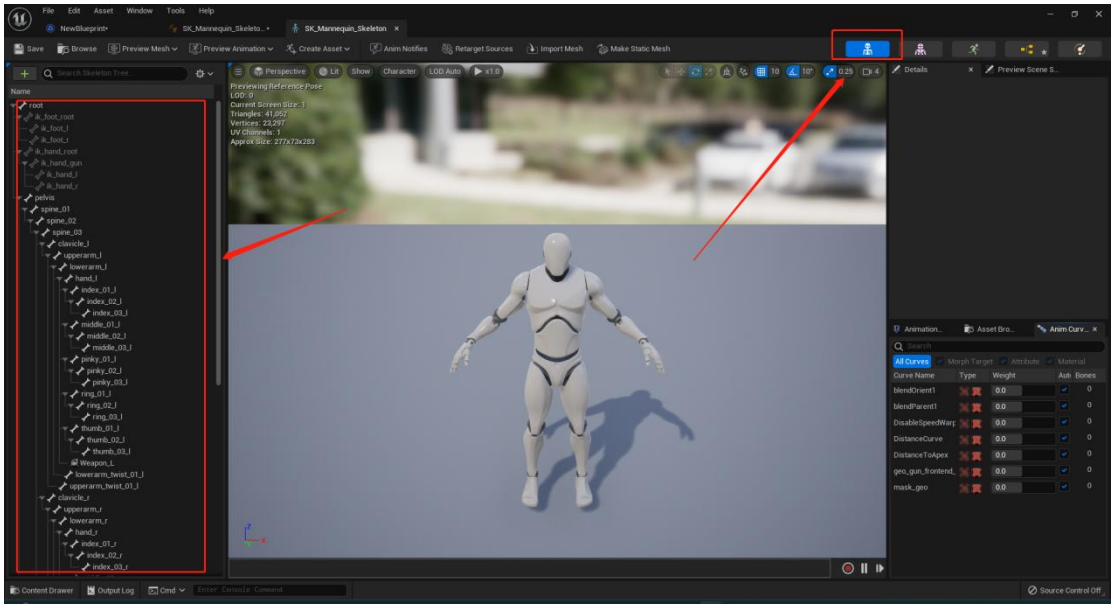
(5) If you are using motion capture data to drive the UE model and the model's skeleton display abnormalities or incorrect positions, this may be due to some skeleton names being inconsistent with those in XINGYING software, leading to abnormal skeletons when driven in UE. In this case, you need to check the mapping of the skeleton names. Double-click on the created Blueprint Class, check the skeleton joints on both sides in the Nokov skeleton Mapping list to ensure they correspond correctly. If there's a mismatch, after making the necessary changes, save and click Compile. Then, select the name of the Blueprint Class we just modified in the Retarget—Retarget Asset drop-down menu and click Compile to successfully drive the model's movement;

(6) To see the skeleton names and hierarchy of the model file imported into UE, double-click on the model, click on the skeleton icon in the model window, and you will see a tree diagram on the right side showing the skeleton names of the model (17.1.20);



171.20

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(7) When selecting a part of the model's skeleton from the skeleton name tree diagram, the middle of the model will display the specific location of that skeleton on the model's body. This method is used to verify that the UE skeleton names correspond correctly with the XINGYING human model's skeleton names. For example, select the UE model's forearm skeleton, and check in the Nokov skeleton Mapping list if the UE forearm skeleton name corresponds correctly with the XINGYING human body's forearm skeleton. If you find that the UE forearm skeleton is incorrectly mapped to the XINGYING body's upper arm skeleton, copy the name of the forearm skeleton from the UE model and correspond it to the forearm skeleton of the XINGYING body in skeleton Mapping. Do this for each skeleton to ensure all names match correctly. After completing the checks, click Save. You can view the XINGYING human model's skeleton positions and their names by clicking the "Joints" list in the XINGYING assets panel;

(8) If the skeleton are correctly mapped between XINGYING and the UE model, but the model still shows abnormalities in UE, please contact our technical engineers for assistance.

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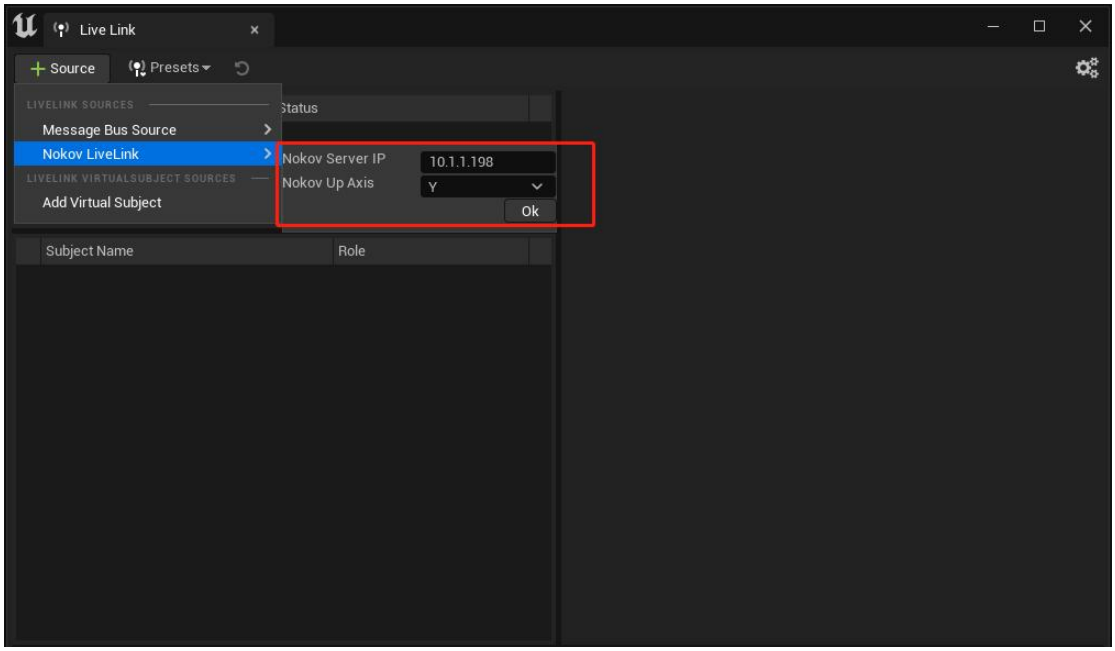
■ LiveLink Rigid Body Application

(1) To use UE rigid body application, first place an object with reflective markers in the motion capture area, and in Live mode, use the one-click create rigid body function to create a Markerset. After successfully creating the rigid body, open the Soft Data Broadcast panel and enable "Enable SDK";

(2) Open the UE project file. If creating the UE project for the first time, please contact our technical engineers to obtain the corresponding plugin version and refer to the above "1) UE Plugin" to correctly configure our plugin;

(3) Click Window — Virtual Production — LiveLink in UE. In the LiveLink window, click to add a source, select "Nokov LiveLink". Keep the IP address consistent with the XINGYING software, defaulting to 10.1.1.198, and ensure the axis directions match those in XINGYING software, which defaults to Y-up (17.1.21);



17.1.21

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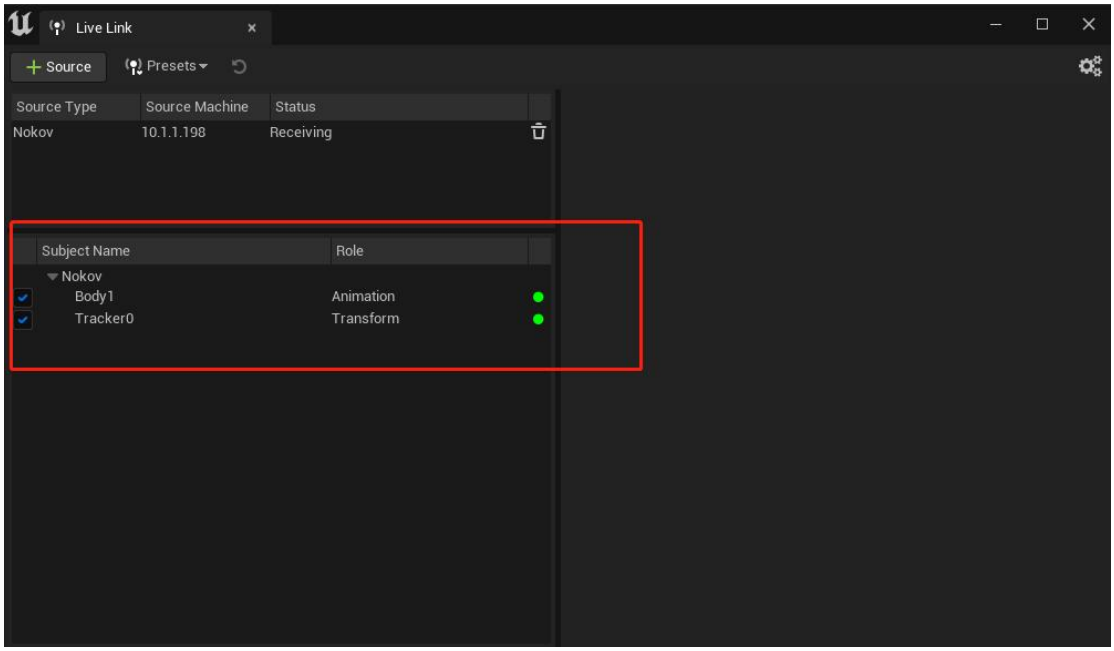
(4) After completing the settings, click OK, play the XINGYING software, and you will see a green light indicating that it is active, displaying the names of all connected Markersets. A character name of "Transform" represents that the MarkerSet is a rigid body, while a name of "Animation" indicates that the MarkerSet is a human (17.1.22);



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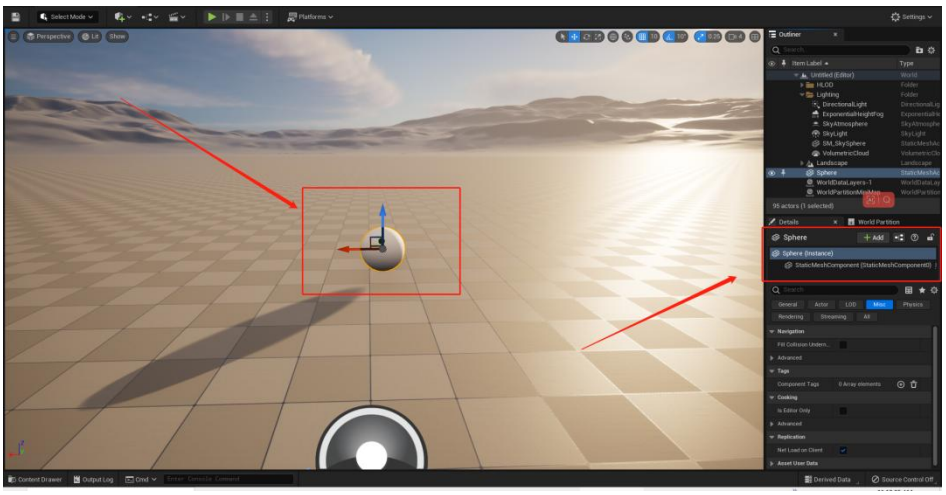
(5) Next, quickly create a static mesh in UE and add it to our project, select a geometry shape (17.1.23),

17.1.23

(6) After creation, you can see the instance we just created in the "Details" property bar on the right, and the geometry sphere has been added to the view (17.1.24). Click the add button, enter "LiveLink", and select the "Live Link Controller" component (17.1.25);



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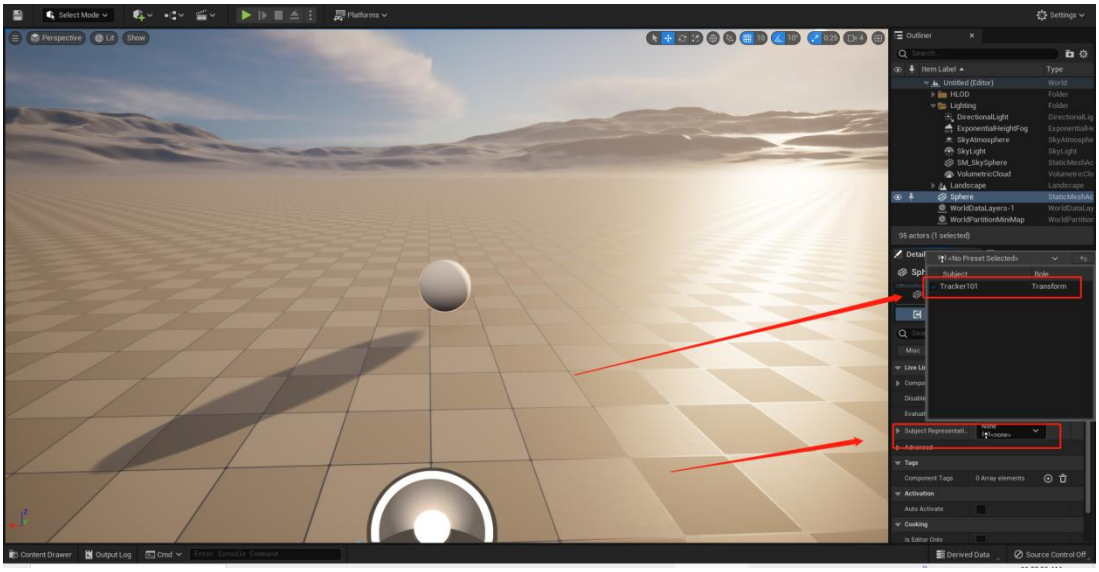
17.1.25

(7) After adding the LiveLinkComponentController component, select the component. In the dropdown menu on the right side of "Subject Representation," select the name of the rigid body that we connected earlier in the LiveLink tab, click on "Tracker0" (17.1.26), to use the rigid body named "Tracker0" to drive the geometry sphere we added in UE;



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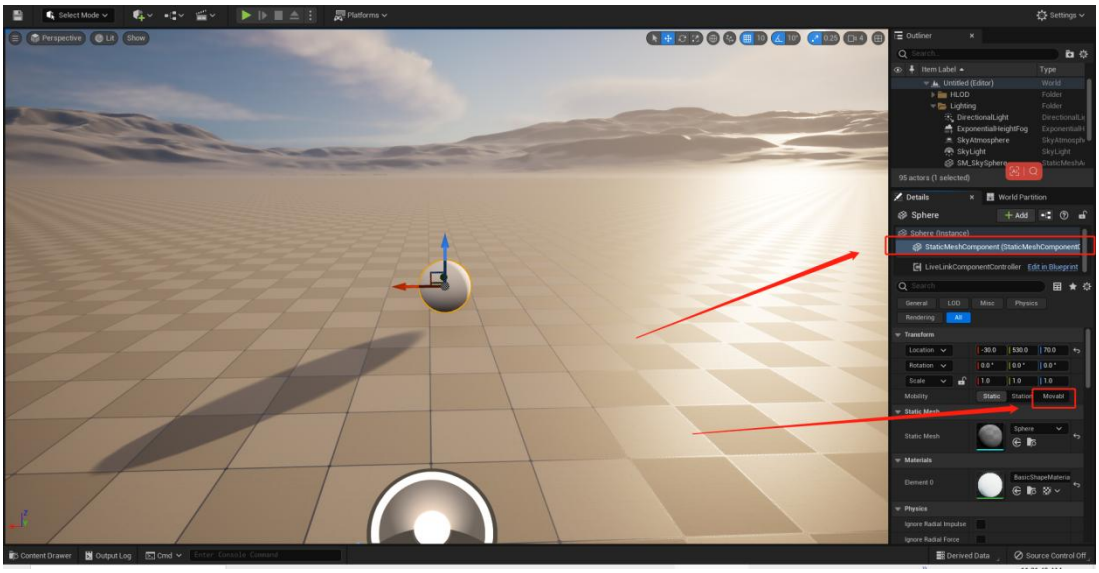
(8) Select the root component of the default scene and change the component's mobility to movable (17.1.27);



17.1.27

(9) Next, just play the XINGYING software, and as the "Tracker0" rigid body moves, the sphere in UE will move in synchronization with the rigid body.

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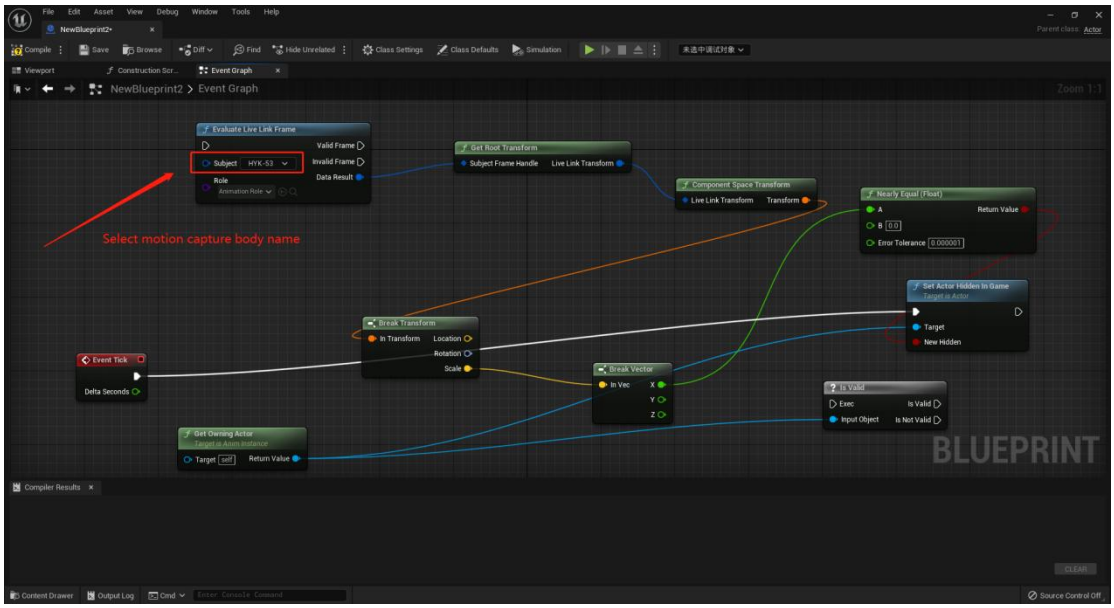
■ Solutions for UE Engine Refresh Issues

(1) When using the XINGYING plugin to drive a model in UE, if XINGYING loses the human body and re-recognition does not display the model in the UE scene, this phenomenon is caused by a refresh issue in the UE engine. To solve this refresh problem, after linking the Live Link Pose to the Output Pose to drive the model in the Animation Blueprint, you also need to add nodes in the event graph of the Animation Blueprint and connect the added nodes (17.1.28). Doing this can solve the problem of the UE engine not refreshing.



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2. Handle Connection Instructions and VRPN Data Integration with UE Guide

■ **MOCUTE-052F Controller**

(1) The MOCUTE-052F controller is connected to the computer via Bluetooth. To connect the controller, slide the switch on the side of the controller to the GAME position, power on the controller, and set it to AUTO mode (by default, it is set to AUTO mode out of the factory). Then, on your computer, turn on Bluetooth and connect to the controller device.

(2) **MOCUTE-052F Controller Operation Instructions:**

- Power On: Press and hold the button , until the indicator light comes on (about 2 seconds), and the system starts. (You need to install the batteries first)
- Power Off: Press and hold the button, until the indicator light goes off (about 5 seconds), and the system will turn off. Note: If no wireless device is connected after starting up, the system will automatically shut down after 5 minutes; if a wireless device is connected, and no operation is performed for 30 minutes, the system will also automatically shut down.

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- Pairing and Connecting: After starting up, the LED indicator light will flash and automatically enter the wireless pairing mode. Search for the address and name of the joystick (MOCUTE-052F-xxx) and click connect. After a successful connection, the LED indicator light will go off. The next time you start, it will automatically connect to the last paired wireless device.

- Unpairing: In the shutdown state, hold the key for more than 8 seconds when starting up, the indicator light will flash, at this moment it enters the re-pairing mode and will not automatically connect to the last paired device.

- Startup Mode (The factory default is AUTO mode).The joystick is automatically set to AUTO mode by default at the factory. Just press the power button to start, the wireless name MOCUTE-x-AUTO will be displayed.

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(3) **Precautions when using MOCUTE-052F joystick:**

- If abnormal situations lead to inability to turn on or turn off, please remove the batteries and then reinstall them.
- If you can't connect, please press B+Y+Power button to start the joystick and rotate the joystick two rounds (calibration) before turning it off, this will restore the factory settings.
- If pairing is abnormal or the wireless name can't be found, turn off the joystick, press the power button for more than 8 seconds until the light flashes, then release, this will cancel and ignore all the wireless pairings on the device and then you can re-pair again.

(4) **Motion capture settings:**

- Turn on "VRPN" in software settings , connect the camera for playback.
- Note: Up to two joysticks can be connected at the same time for joystick and motion capture connections. According to the order of joystick access, the joystick names will be "joystick1" and "joystick2" respectively. The joystick connection must be done on the same computer as the XINGYING software.

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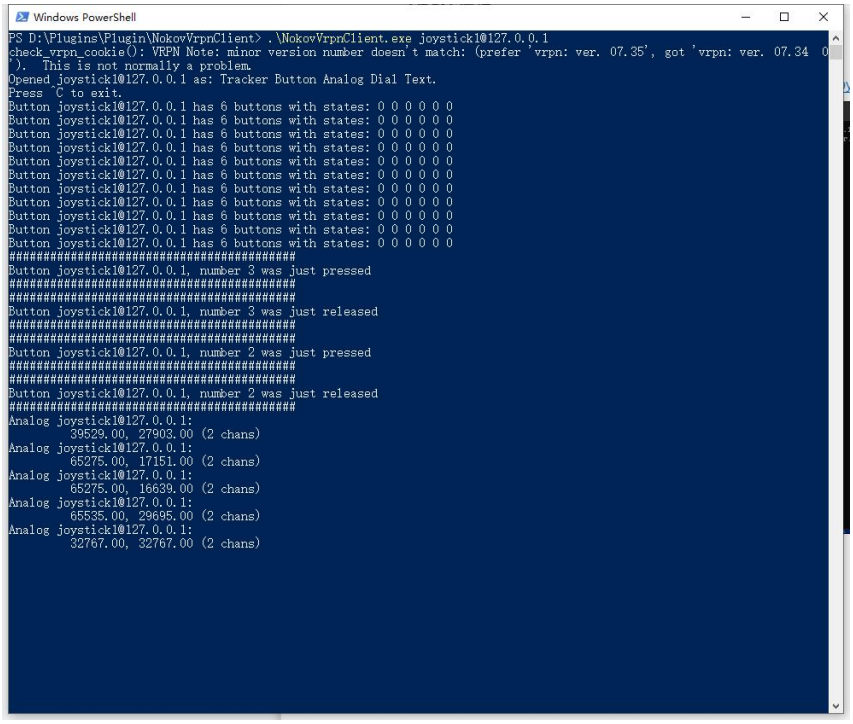
(5) **Connect VRPN**

- Use the test tool "NokovVrpnClient.exe" to connect the joystick. Run "NokovVrpnClient.exe" in the "NokovVrpnClient" folder. In the PowerShell terminal, type "./NokovVrpnClient.exe joystick1@127.0.0.1"(17.2.1),or type "NokovVrpnClient.exe joystick1@127.0.0.1" in the Command Prompt. After pressing the buttons on the joystick or sliding the joystick wheel, the terminal will print out the corresponding relationship and its data for the button. When the terminal has successfully responded to the joystick button, it means that the joystick has successfully connected with XINGYING.



17.2.1

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- Note: Please ensure that the XINGYING software is in the play state when using "NokovVrpnClient.exe";
- If two joysticks are connected, when connecting the second joystick, change "joystick1" to "joystick2" in the terminal;
- Button corresponding relationship (17.2.2).
- Slider Coordinate Description: The coordinate range is 0-65535, with the upper left being the starting coordinates of x and y respectively (0,0).

17.2.2

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(6) **Joystick Access to UE**

- Click on "Window>LiveLink", add "LiveLinkVRPN Source" in the "LiveLink" window. Now we add the topic for the joystick wheel:
- In "Connection Settings", do not modify the "IPAddress" by keeping it as default.
- The frame rate in "Local Update Rate in Hz" should be consistent with the frame rate set in the VR Tracker software.
- In "Device", enter the name of the joystick you need to connect. For example, if you are connecting the first joystick, then enter "joystick1" here.
- "Subjectname" represents the subject naming, choose "Analog" for "Type".
- After all the parameters are set, click add (17.2.3). Now slide the joystick wheel, the theme of the wheel will be successfully added below. Select the theme name of the wheel, click "View Options" on the right, choose "Show Frame Data" in the dropdown menu, "Expand Property Values", and the attributes value will change (17.2.4) when you slide the joystick wheel.

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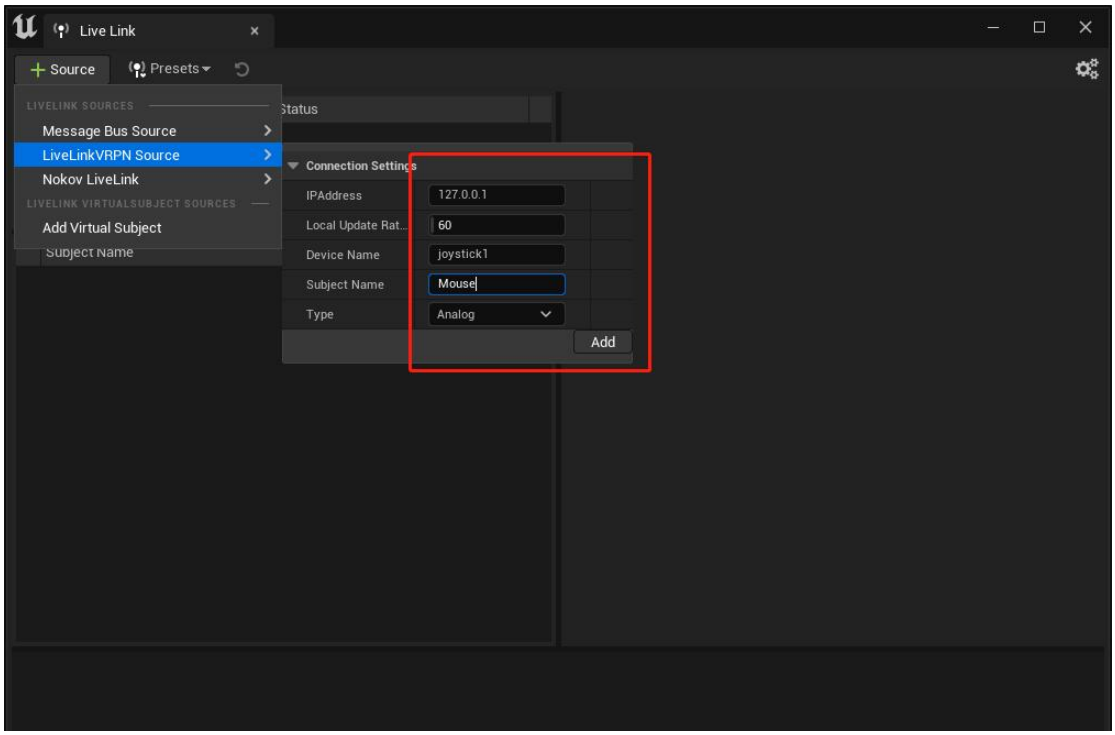
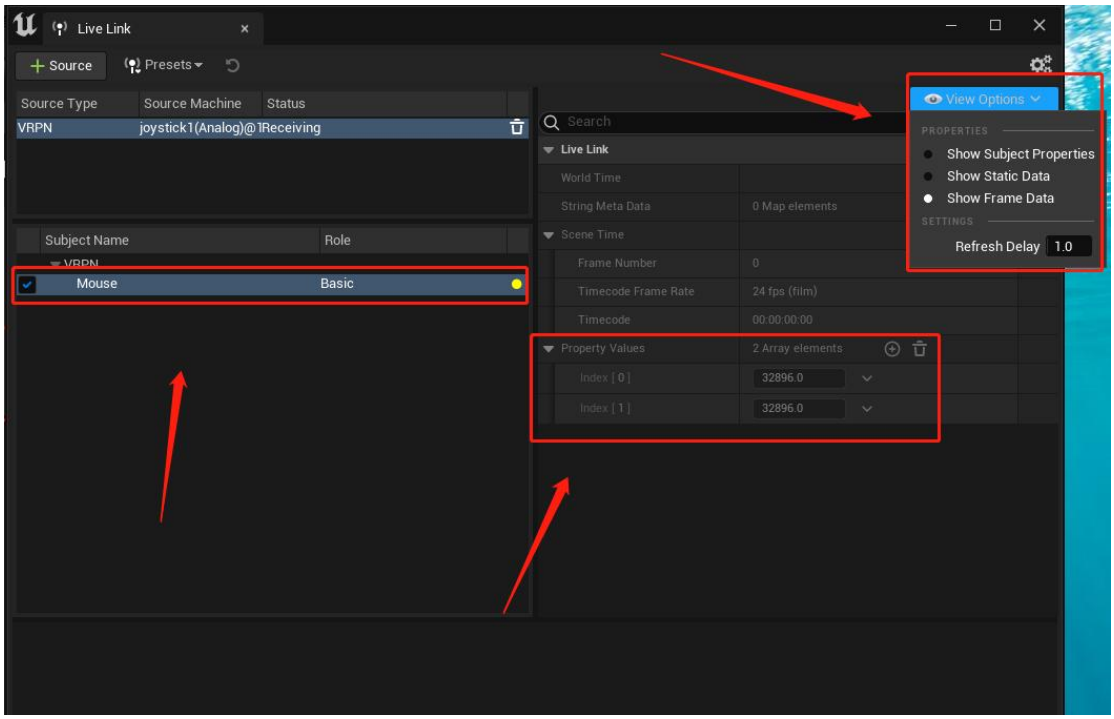


17.2.3



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- Adding Button (joystick key position) subject: Please keep the "IPAddress" as default, and the frame rate in "Local Update Rate in Hz" should be consistent with the frame rate set in the VR Tracker software. In "Device", enter the name of the joystick you need to connect. For instance, if you're connecting the first joystick, then enter "joystick1" here. "Subjectname" is for subject naming (please avoid duplicating the wheel topic name), and choose "Button" for "Type" (17.2.5). Click add, then press the joystick button, and the Button topic will be added to the topic list. Select the Button topic, expand the property values, and now when you press the corresponding key, "Property Value 0" will display the number of the key that's pressed. When the key is pressed, the number of "Property Value 1" will change from "0" to "1" (17.2.5).

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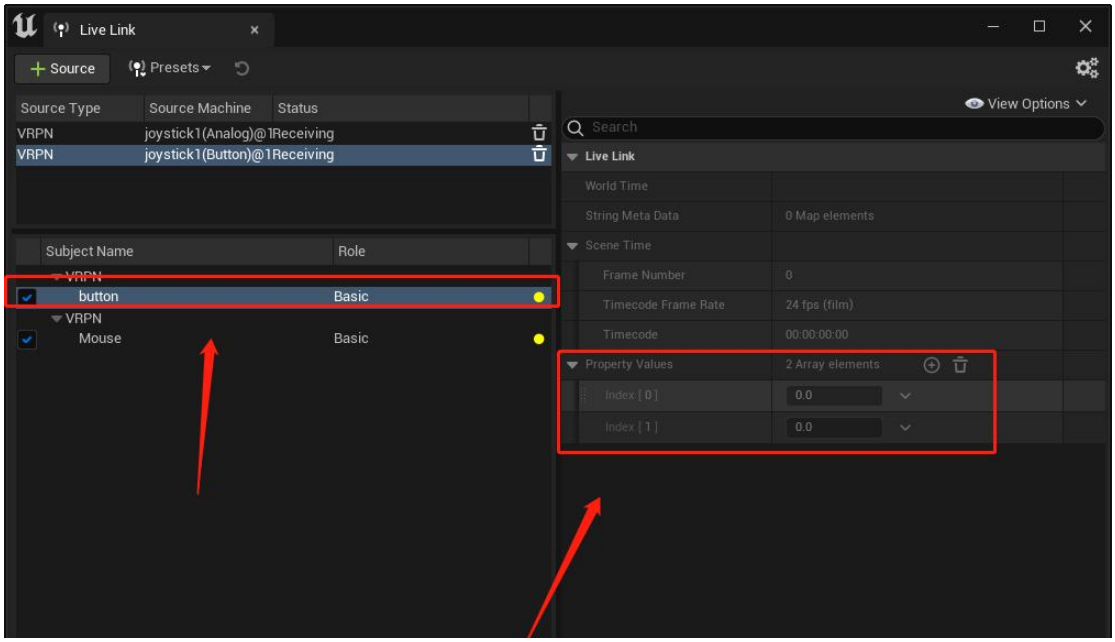

17.2.5

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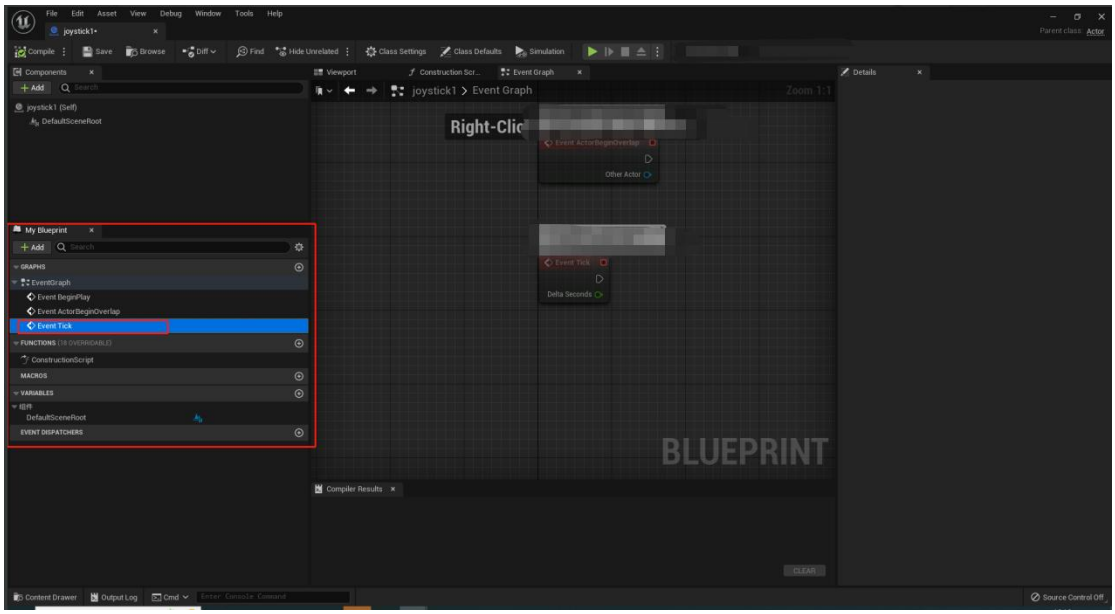
(7) **Create a Blueprint Class**

- Right-click in the Content Browser to create a Blueprint class. Choose to create an "Actor" Blueprint class. Double-click on this "actor" blueprint, then add various nodes in "My Blueprint → Event Tick" (17.2.6). Please note, after adding the two nodes of "Calculate Live Links", select "Button Theme Name" and "Roulette Theme Name" respectively in the "Object" of this node (17.2.7)."

- Following the addition of each node, click on Compile and Save.



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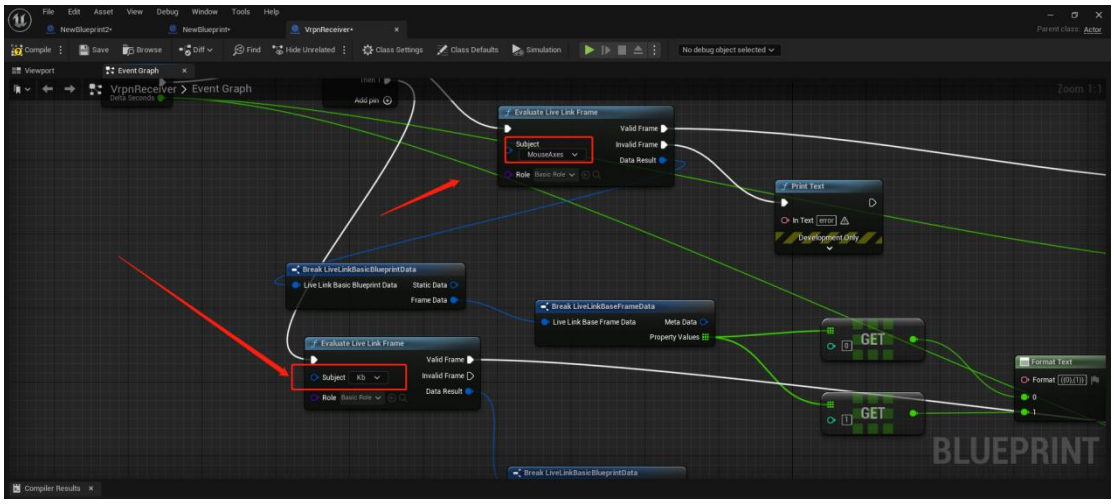
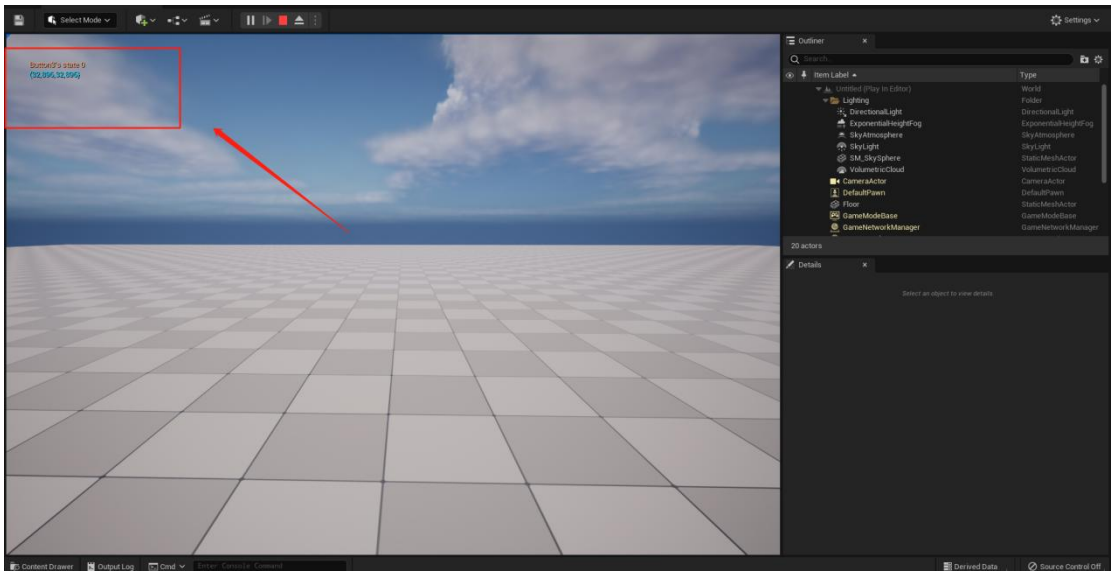


17.2.7

(8) **Using the Controller in the UE scene**

- Drag the "Actor" Blueprint class from the Content Browser into the UE scene. Click on play. Now, by sliding the controller wheel or pressing different keys, the UE scene will display the Button number, status, and coordinates (17.2.8).



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■ **XBOX 360 Controller**

(1) The XBOX 360 controller connects to a computer through a USB cable. Insert the USB cable of the XBOX 360 controller into the computer where the XINGYING software is installed. The button mapping for the XBOX 360 controller is as follows:

(2) The usage of the XBOX 360 controller is identical to that of the MOCUTE-052F controller. For specific operating instructions, please refer to the "Section XVII: Controller Connection Instructions and VRPN Data Integration into UE Instructions," steps four to eight.

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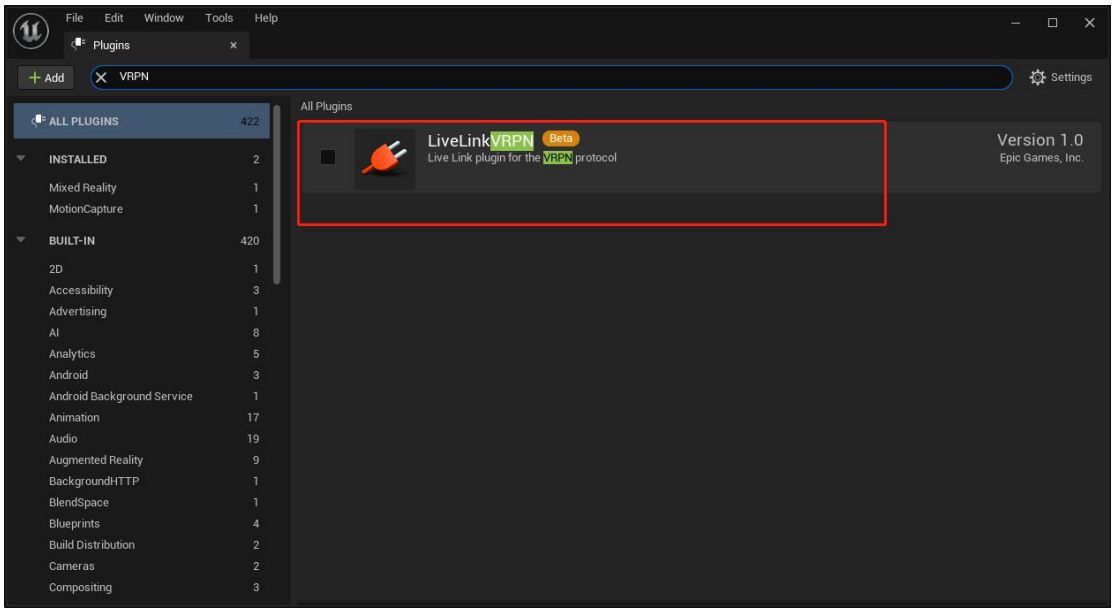
3. Use VRPN Data to Drive Rigid Body in UE

(1) To transmit rigid body data to UE using VRPN, you drive objects in the UE scene using the rigid body from the motion capture software. First, enable the "VRPN" function in XINGYING, attach reflective markers to the object being tracked, create a rigid body in Live mode, and ensure the software is in play mode.

(2) Open the XINGYING settings interface, and since UE's VRPN processes incoming data in meters, change the data unit to meter in motion capture.

(3) Open the UE software, click on "Edit → Plugins" in the upper left corner to open the plugin settings window, and enter "VRPN" and "Live" in the search box. Check both "LiveLinkVRPN" and "LiveLink," then restart the UE software (version 17.3.1);



17.3.1

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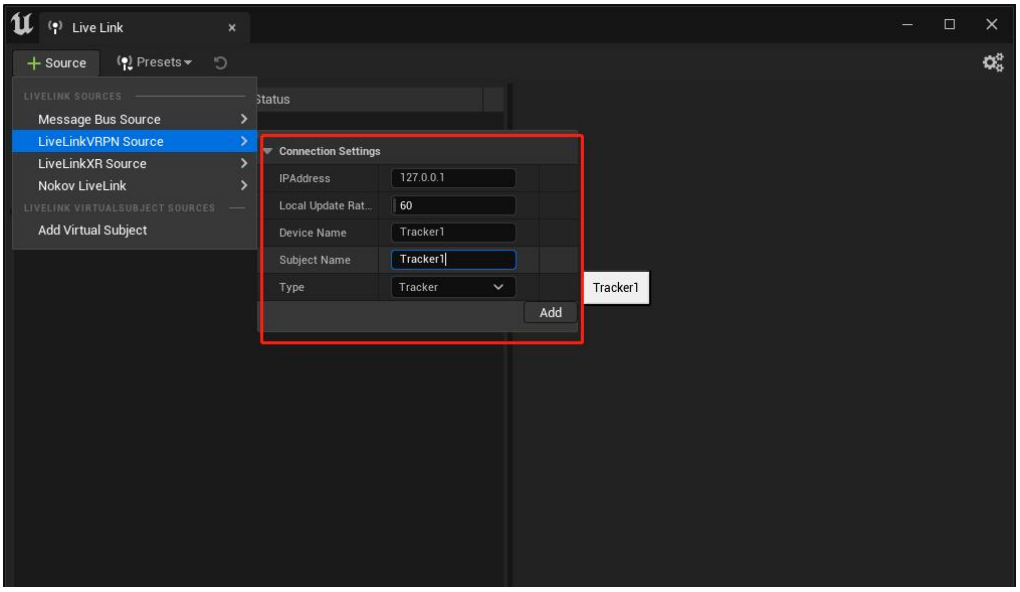
(4) Click on "Window → LiveLink" and in the "LiveLink" window, add a "LiveLinkVRPN Source." In the "Connection Settings," keep the "IPAddress" default without changing it. The frame rate in "Local Update Rate in Hz" should match the frame rate set in the VR Tracker software. Enter the name of the rigid body created in VR Tracker for "Device," for "Subject Name" enter the name for the subject, select "Tracker" for "Type" (17.3.2), then click to add. The topic of the rigid body will be added.



17.3.2

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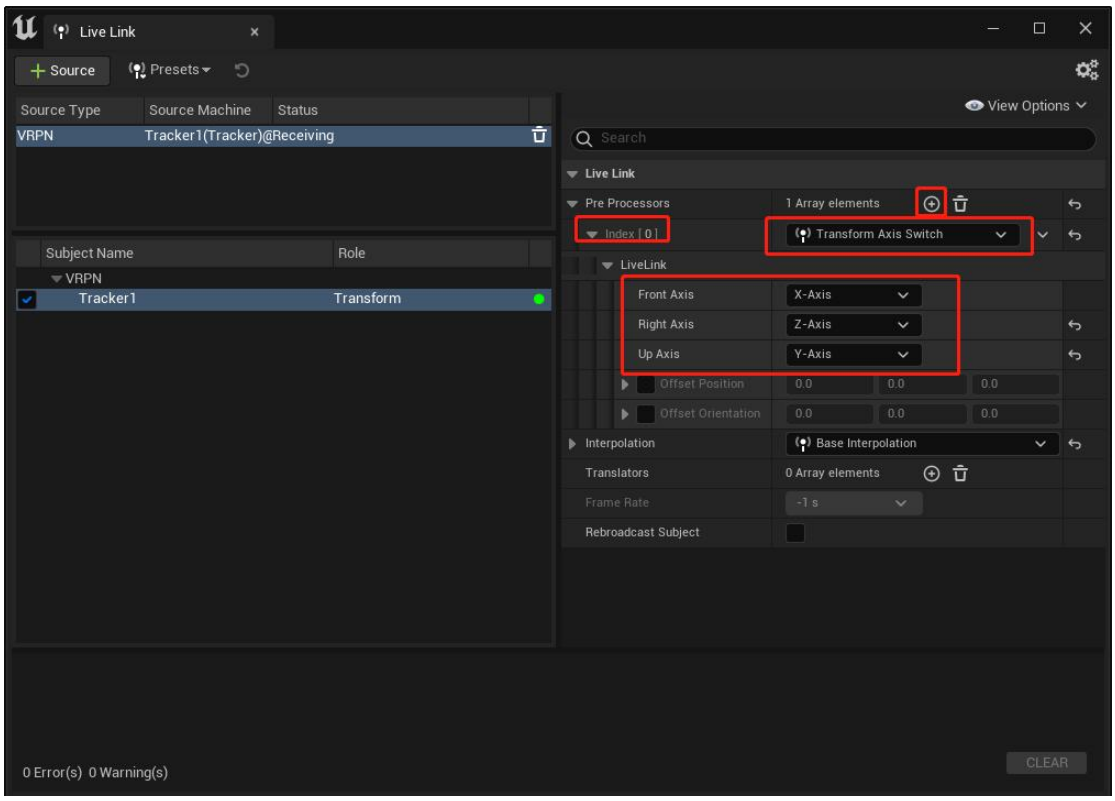
(5) Select the topic of the rigid body, click the "+" next to "Pre Processor," and in the drop-down, choose "Transform Axis Swap." In the drop-down for "Transform Axis Swap," modify the "Forward Axis," "Right Axis," and "Up Axis" (17.3.3) so that the transformation axes in UE coincide with the coordinate system axes calibrated in the VR Tracker software. For instance, if the Y-axis is up in the VR Tracker software, one can see that when the coordinate system is Y-axis up, then forward axis is X, right axis is Z, up axis is Y. Therefore, in UE, the forward axis, right axis, and up axis should be set to "X, Z, Y" respectively;



17.3.3

(6) For the following steps, refer to the previously mentioned "Section XVII, Plugins & SDK (I) UE Plugin LiveLink Rigid Body Application," steps 5 to 9.

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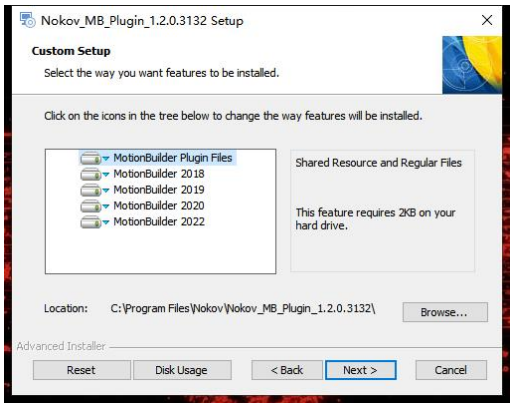
4. MotionBuilder Plugin

■ Plugin Installation

(1) Download the latest plugin version "Nokov-MobuPlugin.XXX.exe," which is compatible with MotionBuilder 2018-2022. Extract the plugin installer package, double-click on the extracted plugin, and install the plugin into the directory of the software (17.4.1). After completion, click Finish, and the plugin will be installed (the application of the glove human body in Motionbuilder is the same as below).



17.4.1

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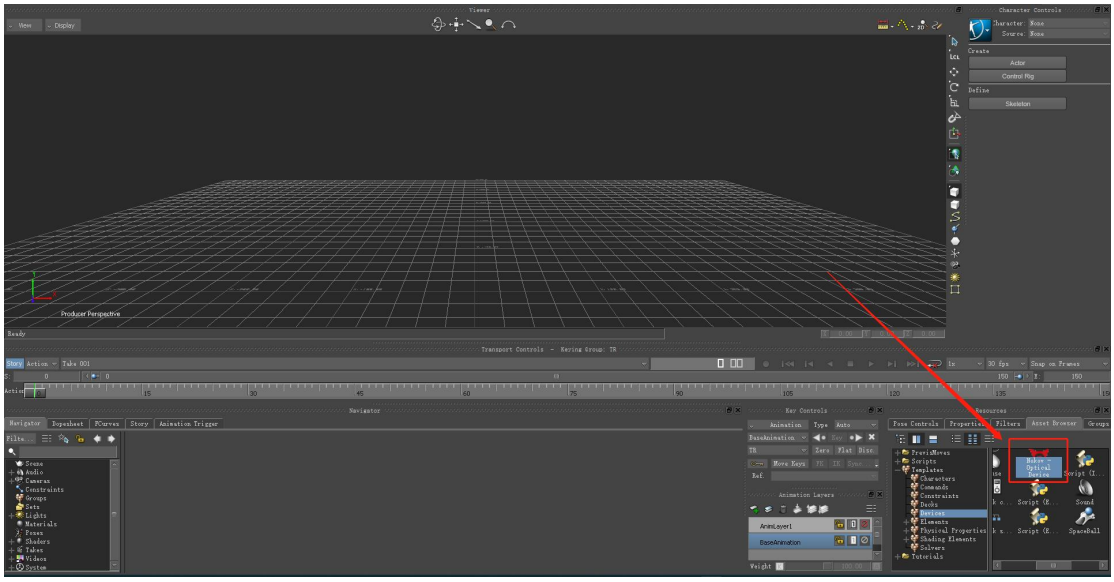
■ MotionBuilder Setup and Use

(1) Open MotionBuilder, click on "Resources—Asset Browser—Devices," find "Nokov- Optical Device," and drag it into the Viewer view (17.4.2).



17.4.2

(2) Click the Online button in the interface at the bottom "Navigator—I/O devices—I/O Seeker - Optical Device" to enter the Live status, click "Model binding," choose the Create button, and below "Optical model," click on "Generate a new optical model." After playing, uncheck and recheck Live, then move the human body in XINGYING software, and the model in MotionBuilder will be driven to move in sync (17.4.3).

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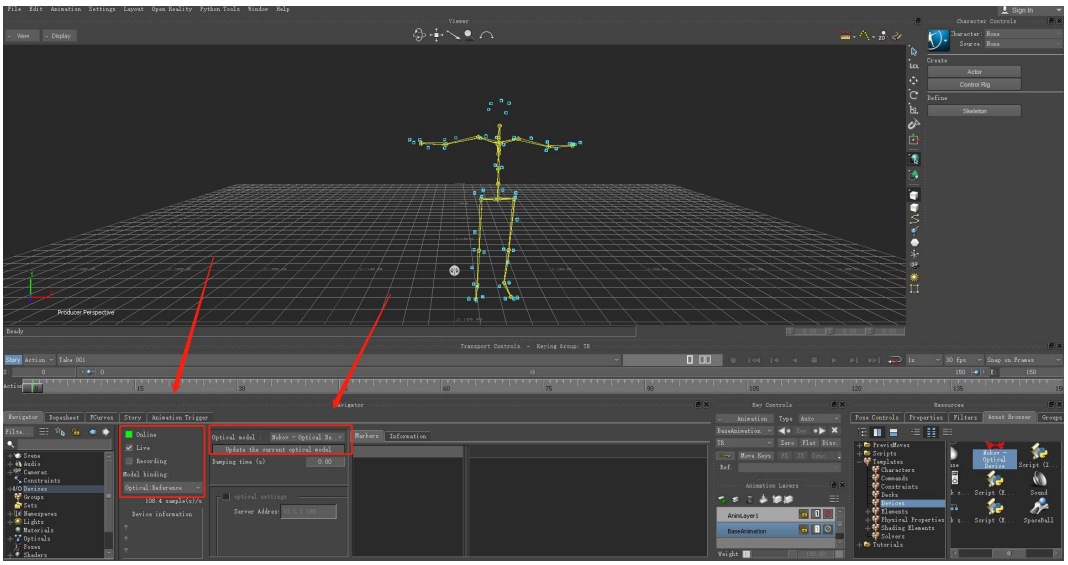
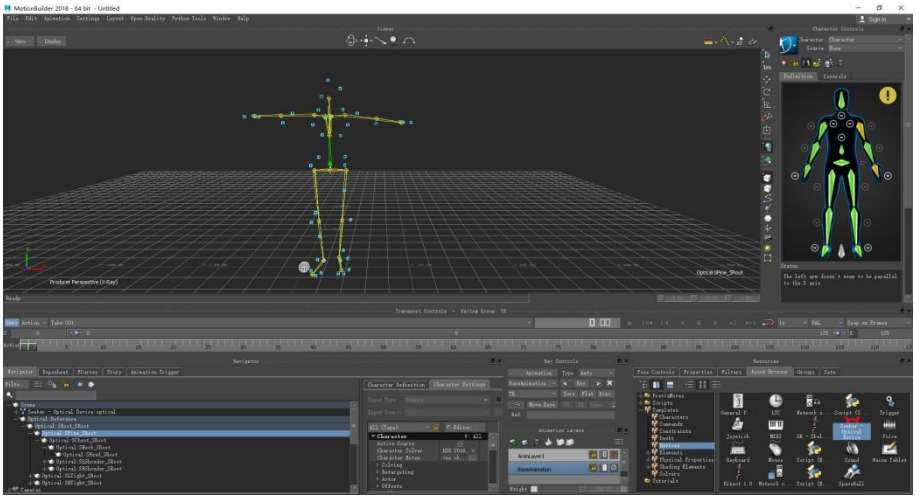


17.4.3

(3) Select "Define—Skeleton" in the right window, then click Characterize Definition in Navigators. In the scene, select a joint, right-click assign skeleton skeleton in the definition to bind it. After all joints are bound, click the lock icon (Lock character), and select "biped" to complete characterizing (17.4.4).



17.4.4

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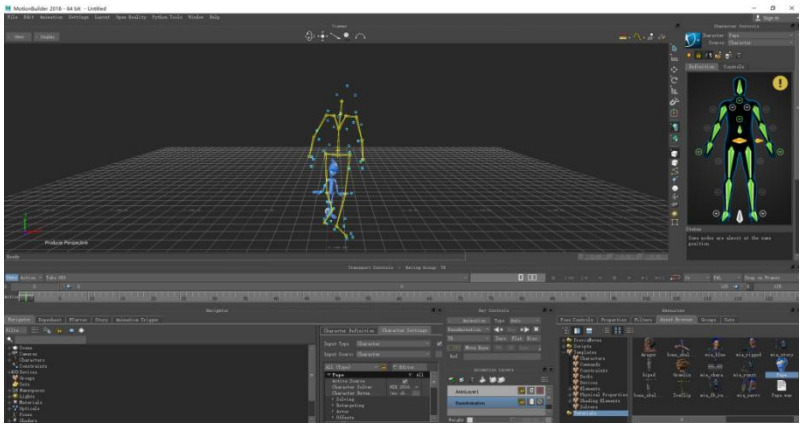
(4) Import the model that needs to be driven into MotionBuilder and perform the characterization process as in step 4. In the "Character Controls" window, select the imported model character in the Character column, and select the XINGYING human skeleton character in the Source column. Let the movement of the human body in XINGYING software drive the model (17.4.5).



17.4.5

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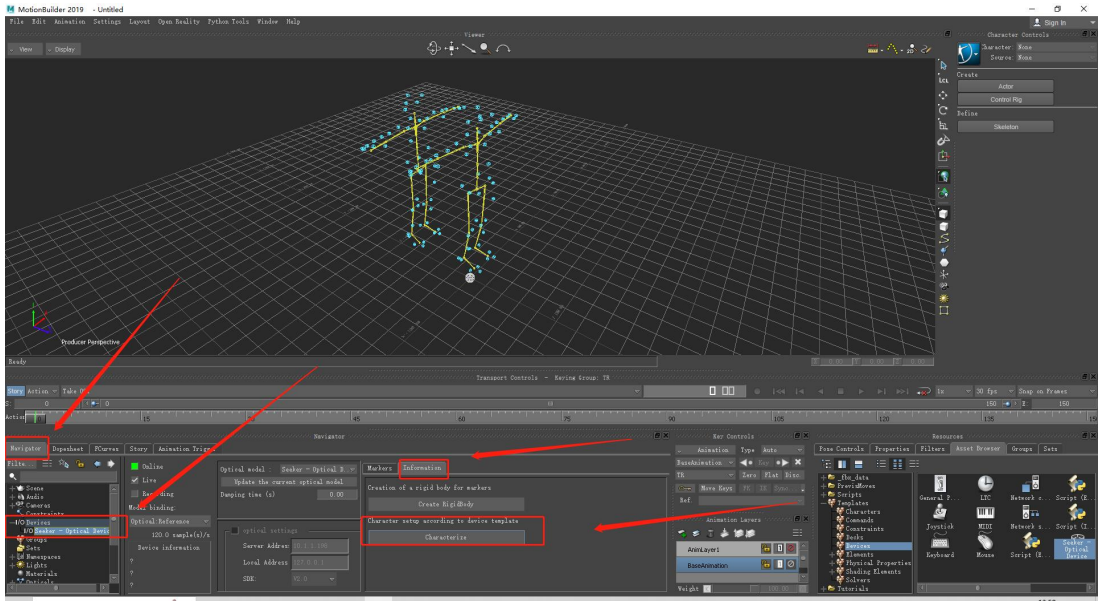
■ MotionBuilder Auto-Binding Feature

(1) When redirecting motion capture data to a skeleton, you can use MotionBuilder's auto-binding feature to bind in one click;

(2) First, connect the motion capture human body data; in Live mode, have the human body stand in a standard T-Pose and pause the motion capture playback, if using Edit mode, then pause the human body data at the first frame;

(3) Open the settings in the motion capture software, set the IP network card address to "10.1.1.198," and check the "SDK" option. Connect the motion capture data in MotionBuilder, with specific steps referenced from the earlier "MotionBuilder Setup and Use";

(4) In MotionBuilder's lower left-side "Navigator" tab, expand "I/O Devices," click on "I/O Seeker-Optical Device," and in the middle right "Information" section, click "Characterize" (17.4.6);



17.4.6

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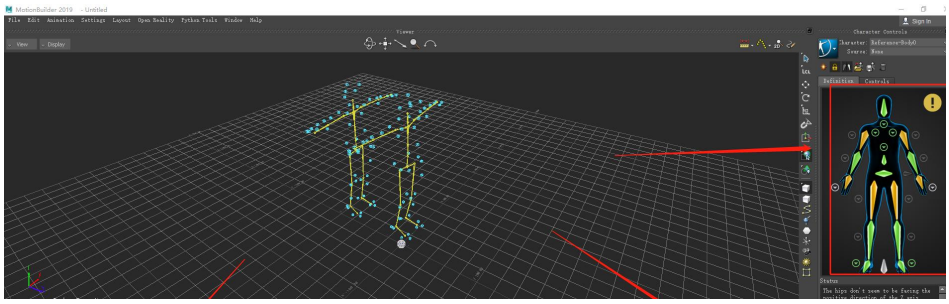
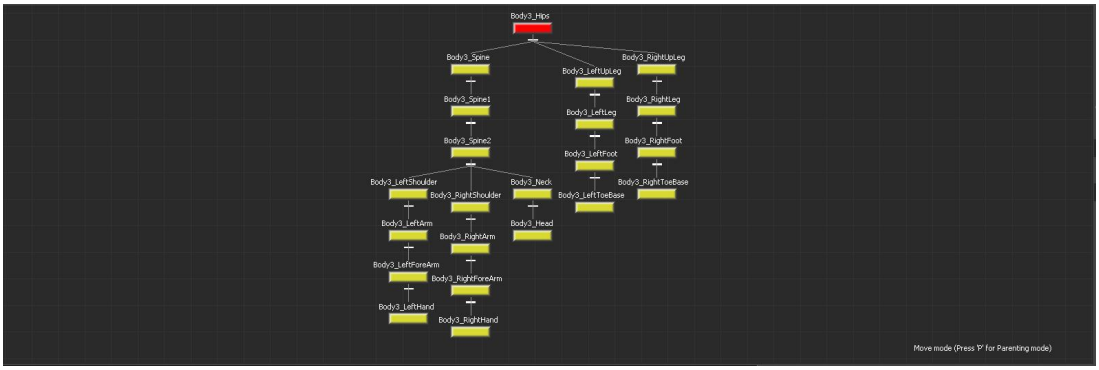
(5) At this point, the motion capture human skeleton will be automatically bound in MotionBuilder (17.4.7), expanding "Characters" will display the bound human body name, which will match the human body name in the motion capture data.



17.4.7

■ **MotionBuilder Characterization Requirements**

(1) When characterizing motion capture data in MotionBuilder, the imported model's skeleton should match the XINGYING human skeleton as closely as possible, and the hierarchy of the model's skeleton should align with the hierarchy of the XINGYING human skeleton. The hierarchy of the XINGYING human skeleton (17.4.8), skeleton names (17.4.9), and the skeleton prefix "Body3" refers to the XINGYING human body name.



17.4.8

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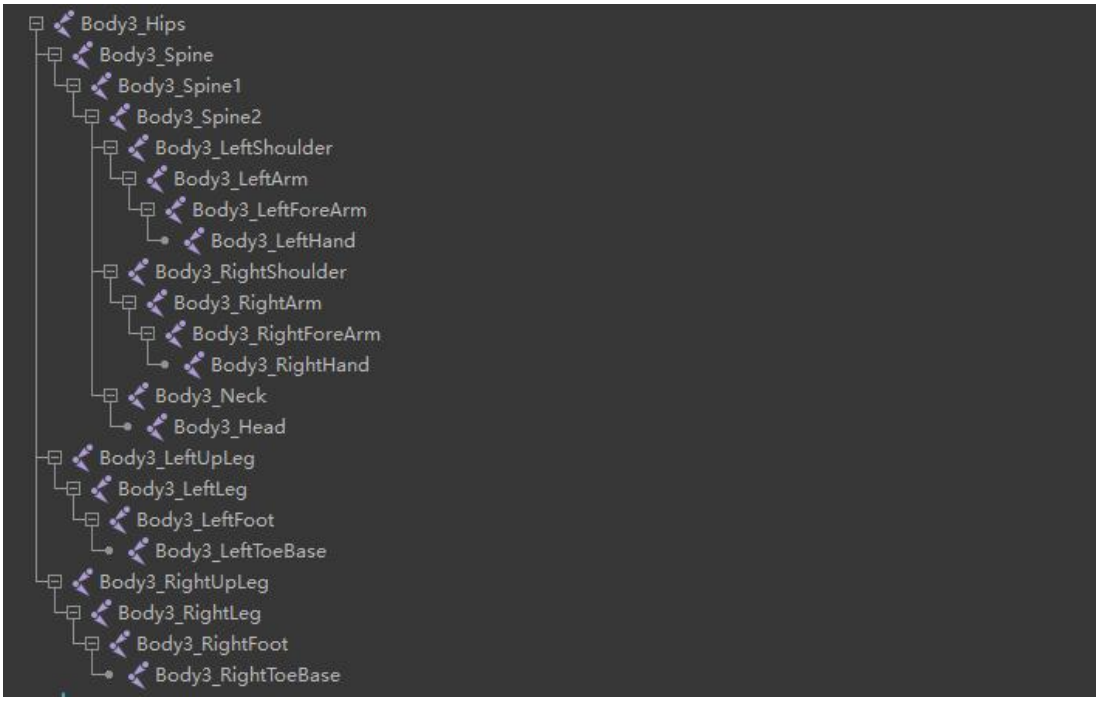
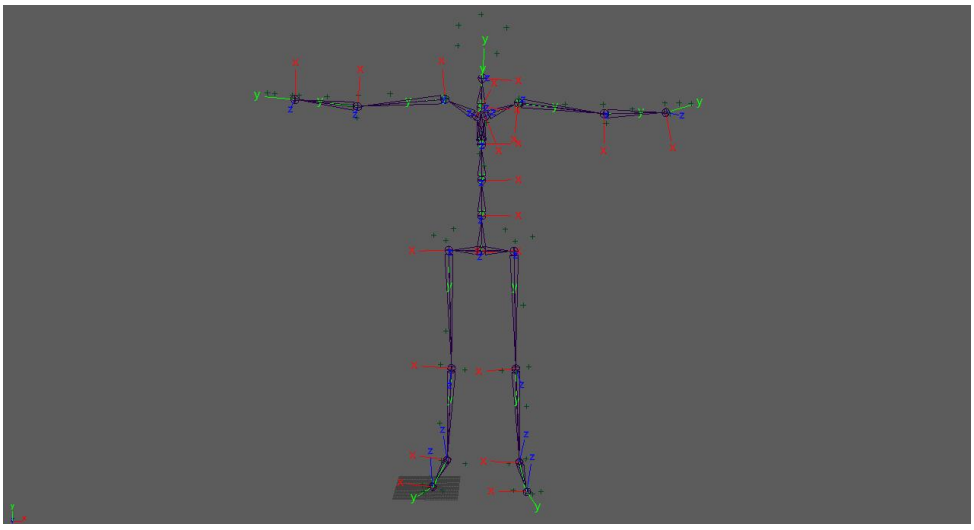


17.4.9

(2) After importing the model into MotionBuilder, please adjust the model's pose to a T-Pose, and ensure it matches the T-Pose of the XINGYING human body before driving the motion; The skeleton axes of the model must be consistent with the axes of the XINGYING human skeleton. The axis configuration of the XINGYING human skeleton (17.4.10).



17.4.10

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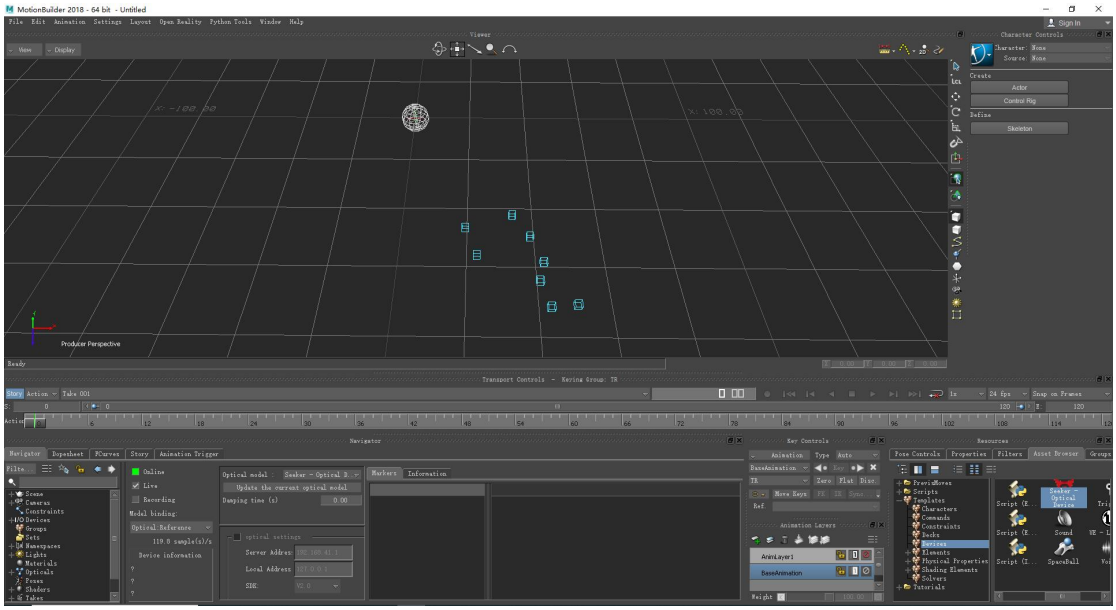
■ Creating Rigid Bodies in MotionBuilder

(1) Create a rigid body in the XINGYING Live mode or load rigid body data in the Edit mode, open MotionBuilder software, drag the XINGYING plugin into the scene, click the Online button in the lower interface "Navigator—I/O devices—I/O Seeker - Optical Device" to enter Live status, click "Model binding," choose the Create button, and under "Optical model," click "Generate a new optical model". Play XINGYING software, and Marker points will then be displayed in the MotionBuilder scene (17.4.11);



17.4.11

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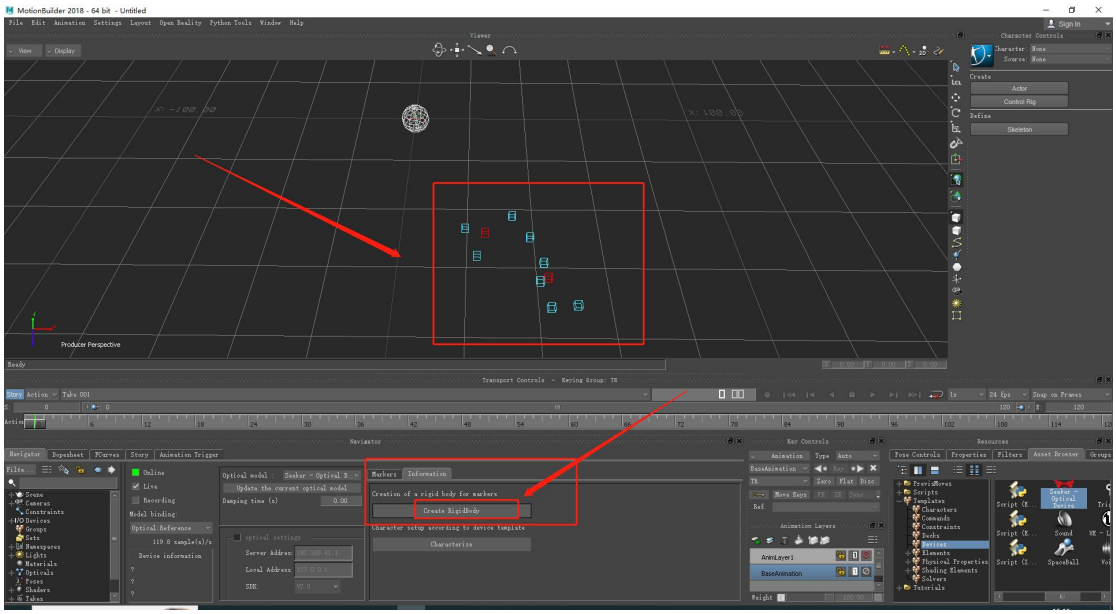
(2) In the lower left "Navigator" tab of MotionBuilder, expand "I/O Devices," click "I/O Seeker-Optical Device," and in the middle right "Information" section, click "Create RigidBody." After that, the rigid body is successfully created (17.4.12).



17.4.12

(3) In the "Navigator" tab, expand "Scene," in "Scene" expand Seeker-Optical Device: Optical, scroll to the bottom, and you will see the created rigid body's name that matches the rigid body name in XINGYING. Double-click the rigid body name, and the rigid body in the scene will display connections, and the selected rigid body will be highlighted, changing from red to green (17.4.13).

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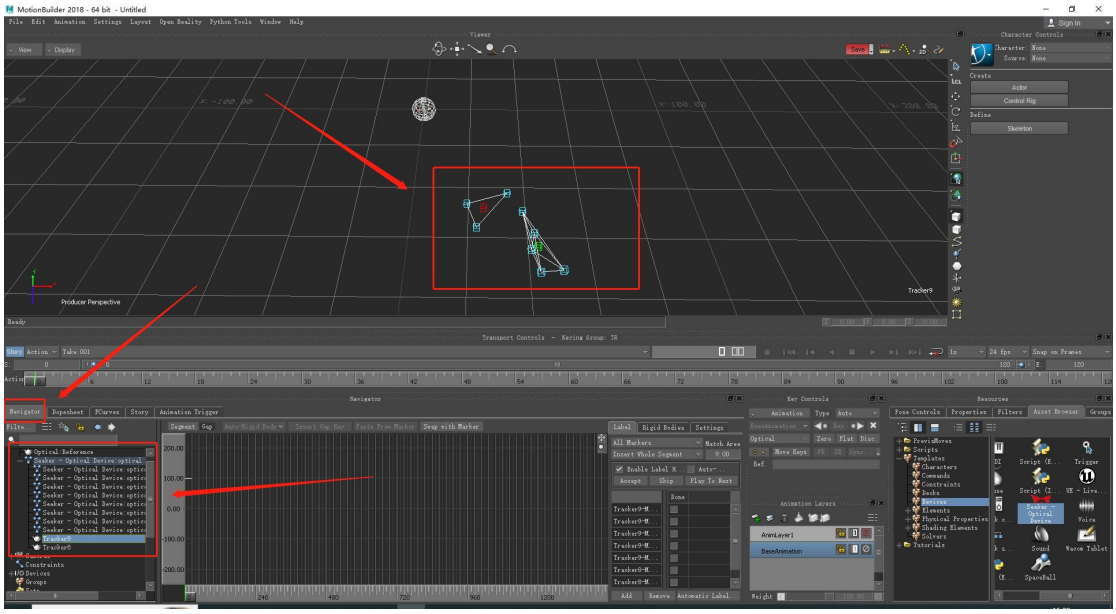

17.4.13

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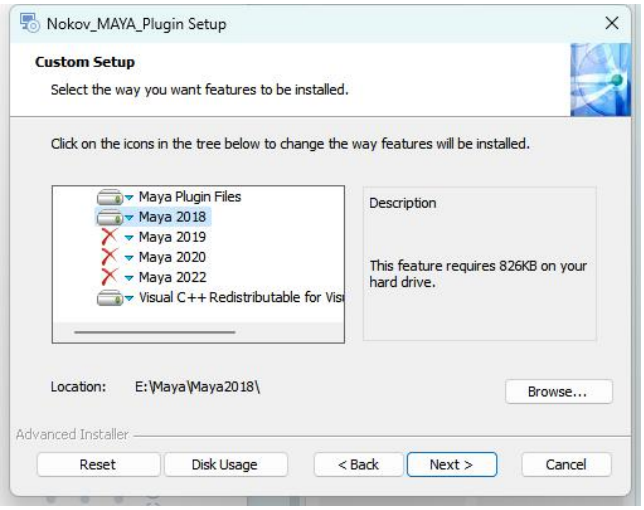
5. Maya Plugin

■ Plugin Installation

(1) Download the latest plugin version: Nokov MayaPlugin XXX (2018-2022). exe;

(2) Extract the 2 plugin installation package, double-click the extracted plugin, and install it in the software directory (17.5.1). After completion, click Next - Install and wait for the plugin installation to complete (the same applies to the glove body in Maya);



17.5.1

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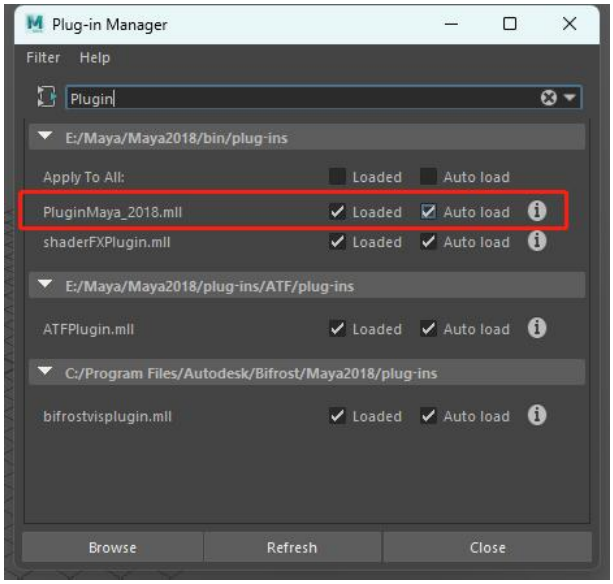
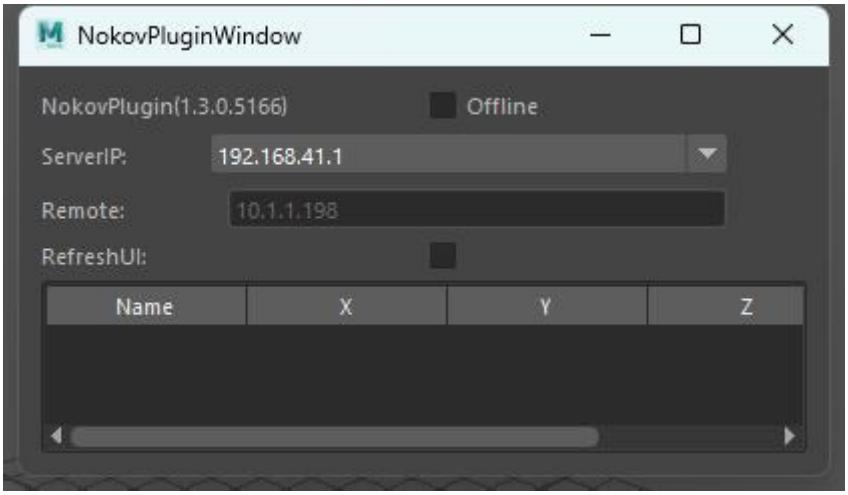
■ **Settings and usage of Maya**

(1) Click on "Window Settings/Preferences Plugin Manager", search for "Plugin" and check the two windows of "PluginMaya. mll" (17.5.2). Mouse over the icon to see detailed information;



17.5.2

(2) Close the plugin manager, search for "NokovPluginWindow" in the MLE window below Maya, and press Enter to call up the plugin (17.5.3)



17.5.3

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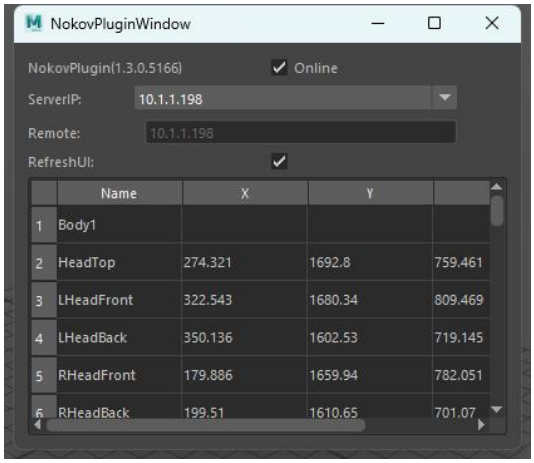
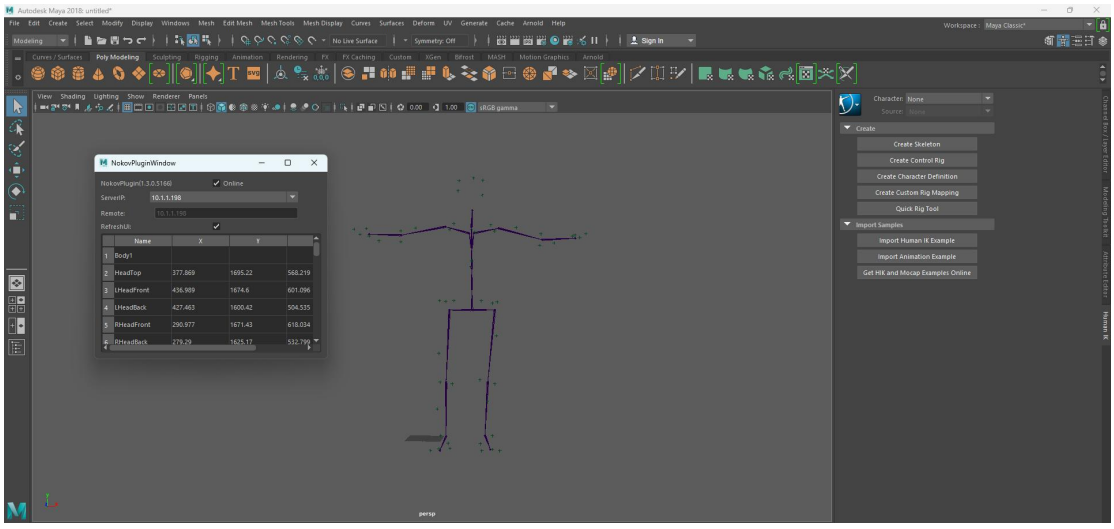
(3) Select the network card address that is consistent with the XINGYING software, click Offline, and bring it to the Online state. Check RefreshUI and after playing the motion capture software, Maya will continue to receive data from motion capture (17.5.4);



17.5.4

(4) Note: Due to the fact that Maya's skeleton nodes do not allow numerical names, the human Markeset name in XINGYING software cannot start with a number or be a pure number, otherwise the skeleton will not be displayed in Maya;

(5) After the human body in 5XINGYING software moves, the model in Maya will be driven to perform synchronous motion (17.5.5).



17.5.5

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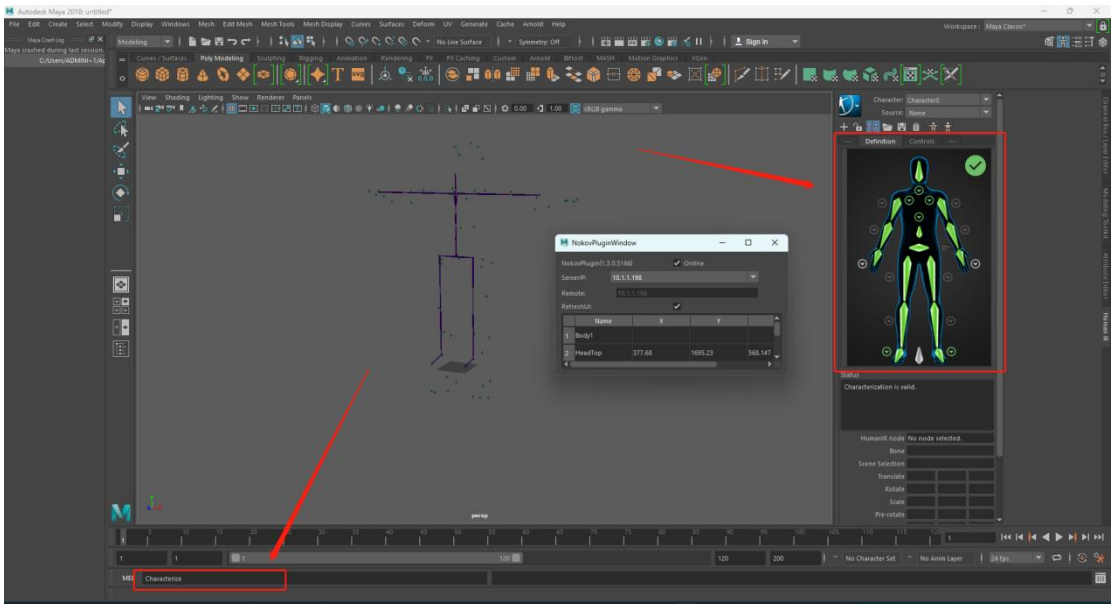
■ Characterization

(1) Taking the Edit mode of the motion capture software as an example, after obtaining the human body data of the motion capture, drag the motion capture data to the first frame, maintain the T-Pose posture of the human body data, and pause the motion capture software. Search for "Characterize" in the MLE window below Maya, press the Enter key, and the characterization of the motion capture human body data has been completed in the Maya software (17.5.6). Search for 'Lock' in the MLE window and press the Enter key to lock the fully characterized manikin.



17.5.6

(2) In Maya, it is also possible to manually create characterization of motion capture human body data. After the model T-post stands, pause the XINGYING software playback, click the "Switch Character Control" option in the upper right corner, and then click "Create Character Definition" (17.5.7);

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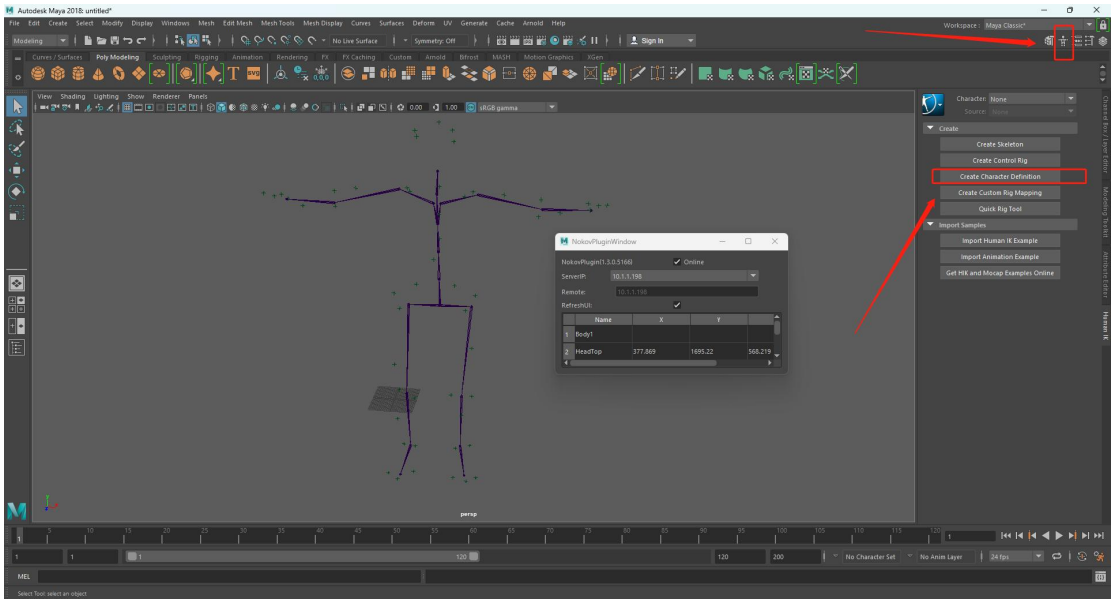
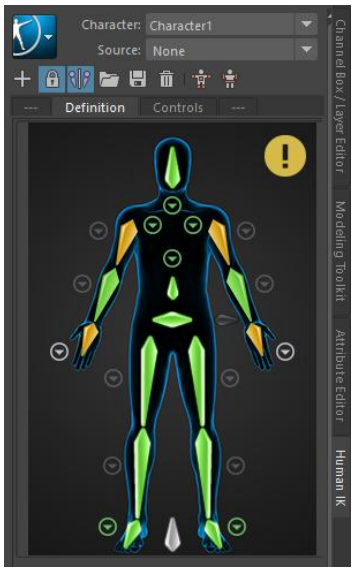


17.5.7

(3) Perform the "Assign Selected skeleton" operation on each skeleton of the character. After all skeleton are bound, the characterization is successful (17.5.8);



17.5.8

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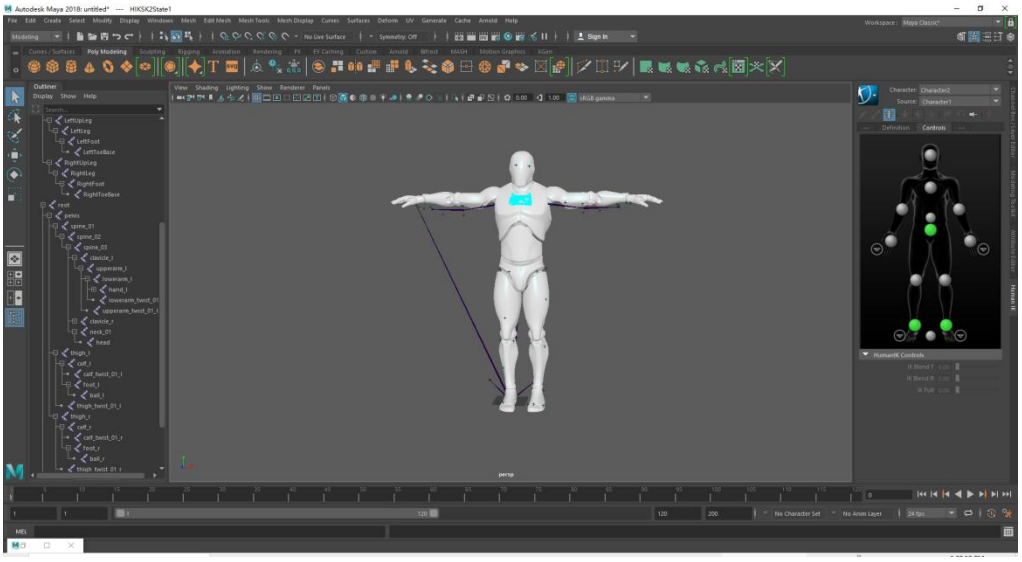
(4) Import the model you want to drive into Maya and repeat the above steps to create a characterization for the imported model. After creation, select character 2 on the right and character 1 as the source to bind the skeleton to the model. After playback, the model will be driven (17.5.9).



17.5.9

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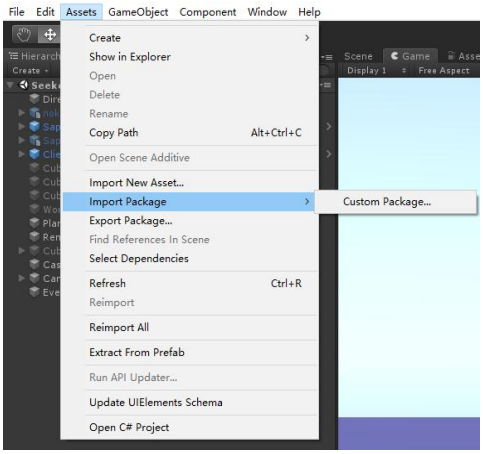
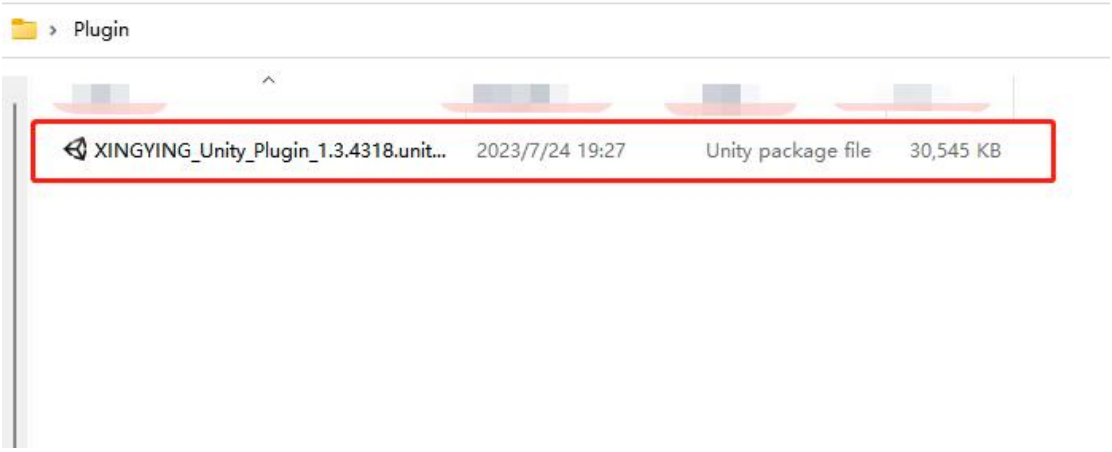
6. Unity plugin

■ Import of plugins

(1) Extract the plugin installation package for 'XINGYING_Unity_Plugin_XXXX.unitypackage', create a Unity project, click on Assets (17.6.1), and select 'Import package - CustomimPackage...', Import the extracted Unity plugin (17.6.2);



17.6.1



17.6.2

(2) For the first time importing, there are red compilation errors in the log panel, warning to open project properties, and setting to allow unsafe code. Check the Edit>ProjectSettings>Player Allow Unsafe code above Unity (17.6.3);

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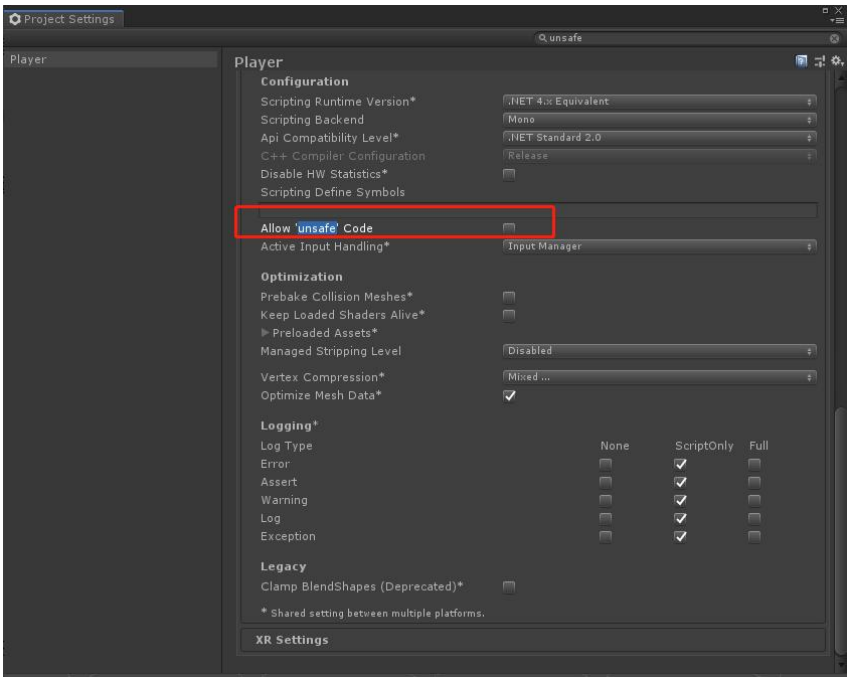
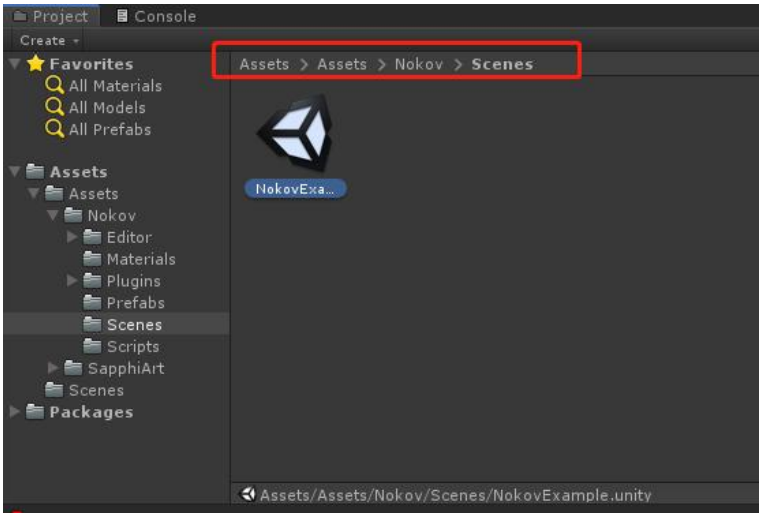
■ Unity settings and usage

(1) Select "Assets Nokov Scenes NokovExample" in the imported installation package and double-click to open it (17.6.4);



17.6.3



17.6.4

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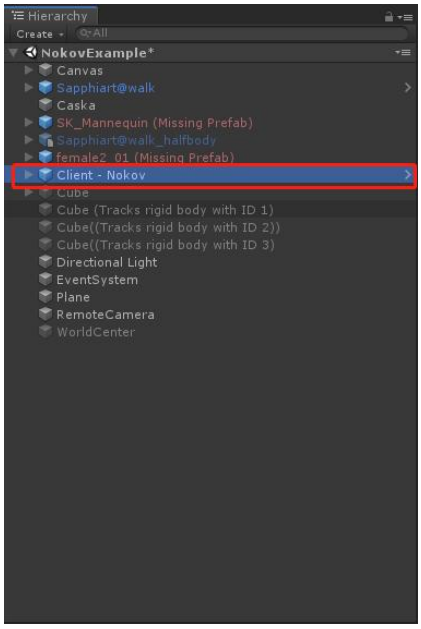
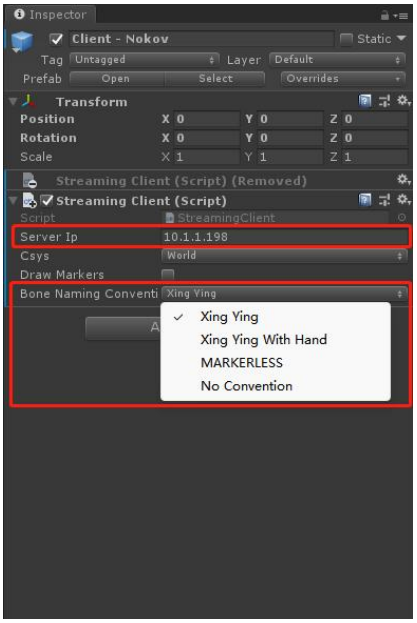
(2) Click on "Client Nokov" in the Hierachy panel, modify the Host Ip on the right to 10.1.1.198, and select "XINGYING" (17.6.5, 17.6.6) for skeleton Naming Convention. If the XINGYING software is playing glove human body data, please select "Xing Ying With Hand" for skeleton Naming Convention;



17.6.5



17.6.6

(3) Click on "in the scene Sapphiart@walk " Ensure that the three modules in the Inspector are checked, and ensure that the name of "Skeleton Asset Name" in "Nokov Skeleton Animation (Script)" is consistent with the name of the human body in XINGYING (17.6.7, 17.6.8). After modification, press Enter to save;

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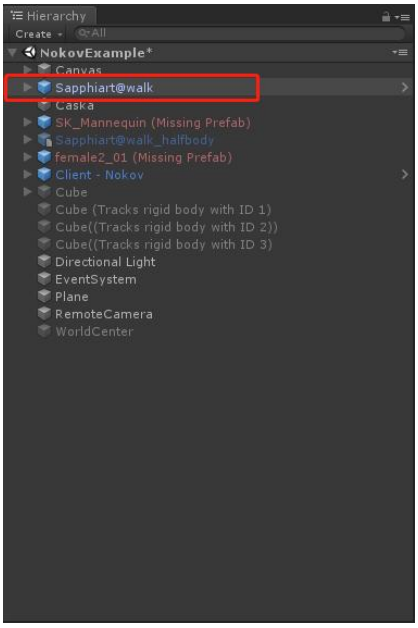
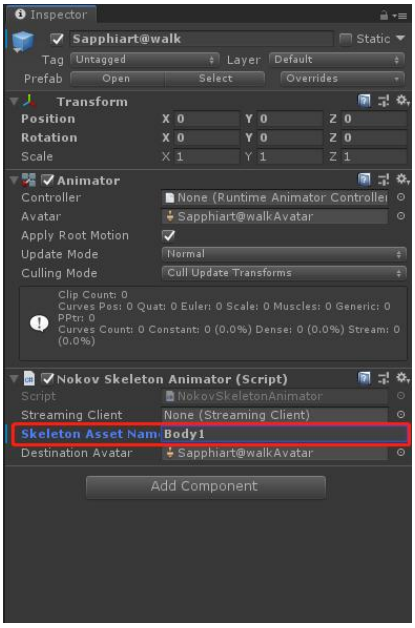
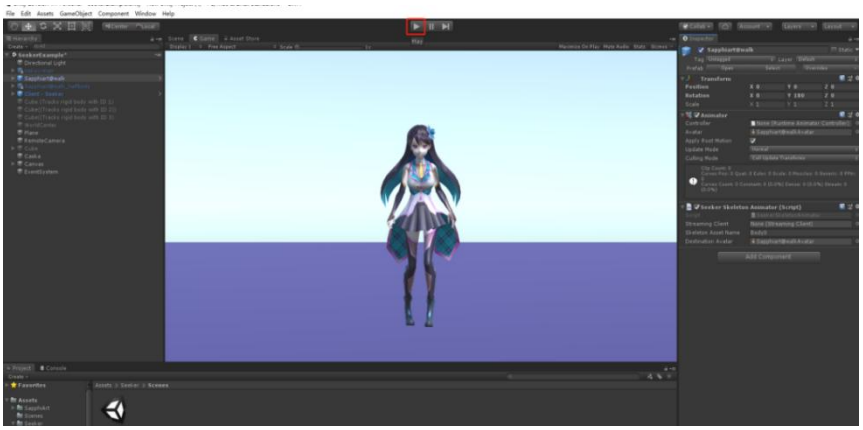


17.6.7



17.6.8

(4) Ensure that the XINGYING software is in a playback state, click the playback button in Unity, and let the human body in XINGYING move. The model in Unity will be driven to perform synchronous motion (17.6.9);



17.6.9

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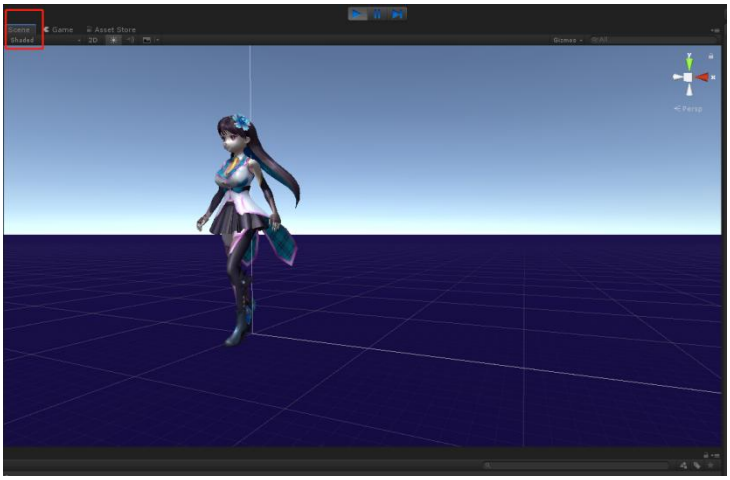
(5) You can switch to the Scene view to observe different angles of the model (17.6.10).



17.6.10

■ **VRPN handle access to Unity**

(1) Please first follow the instructions in "17. Handle Connection Instructions and VRPN Data Access UE Instructions" to set up the connection and dynamic capture of the handle;

(2) Attach reflective markers to the captured object and create a rigid body in Live mode using XINGYING software.

(3) Open Unity and create a new project.

(4) Drag the plugin into "Assets" (17.6.11), click "Import" to import, and then double-click "Demo" in the "Assets - UVRPN - Sensors" directory to enter the Unity scene (17.6.12) and switch to "Sense" (17.6.13);

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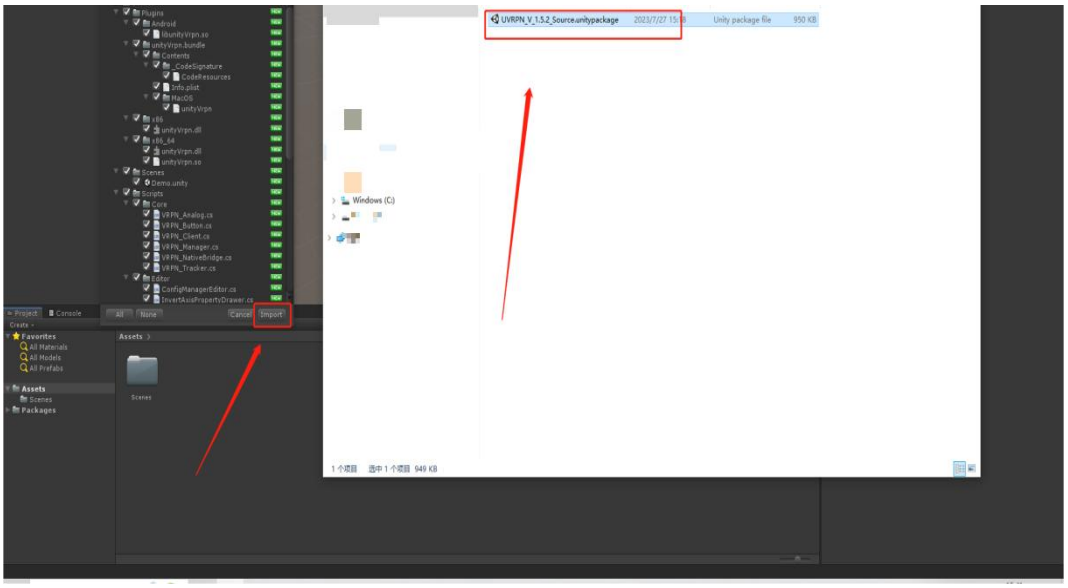
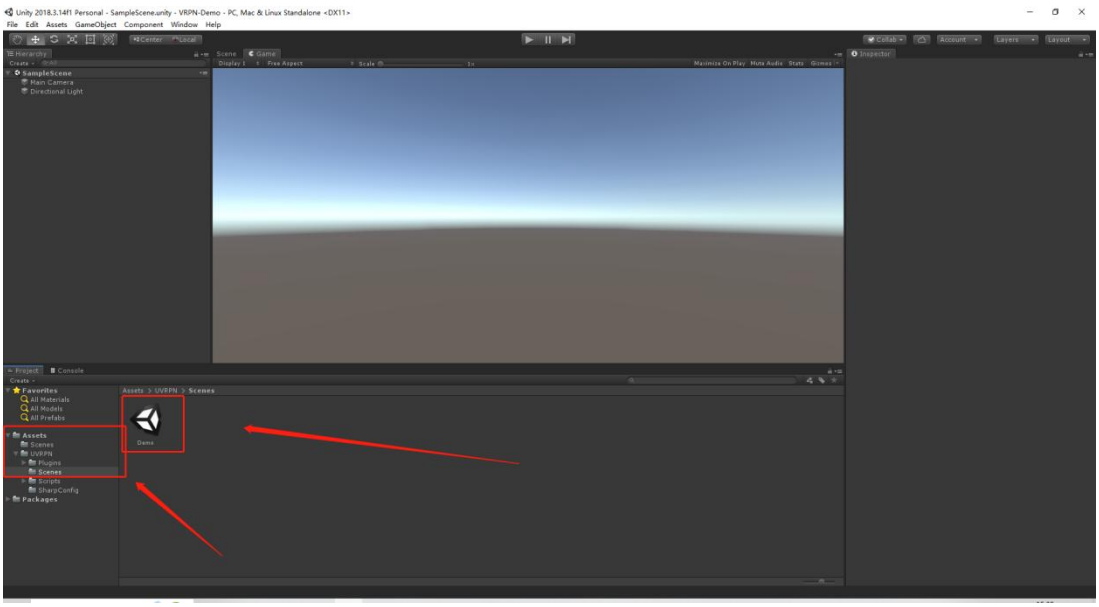


17.6.11



17.6.12

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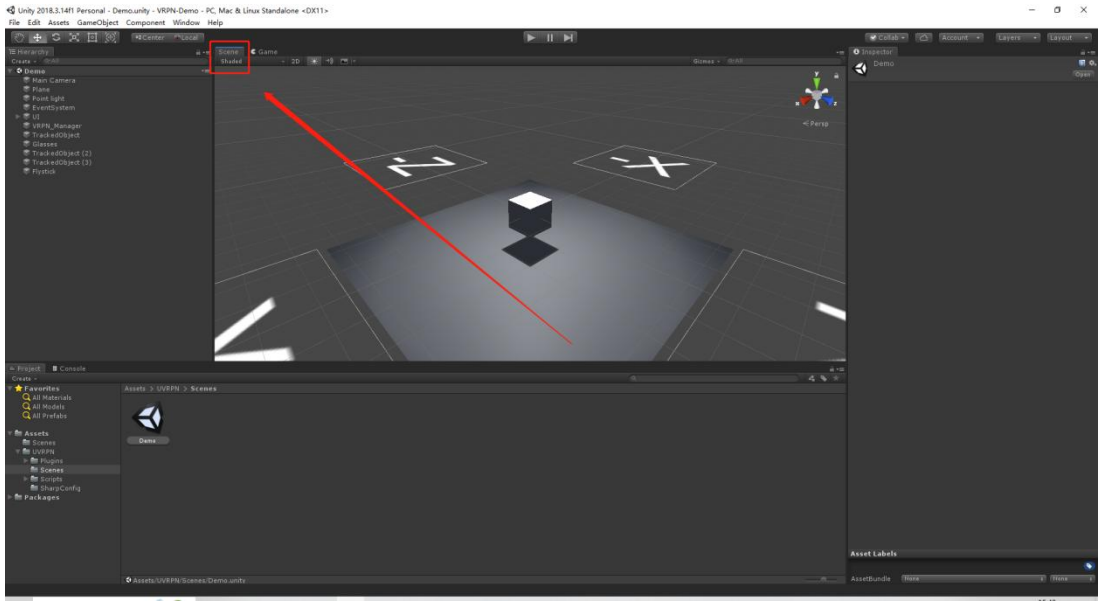
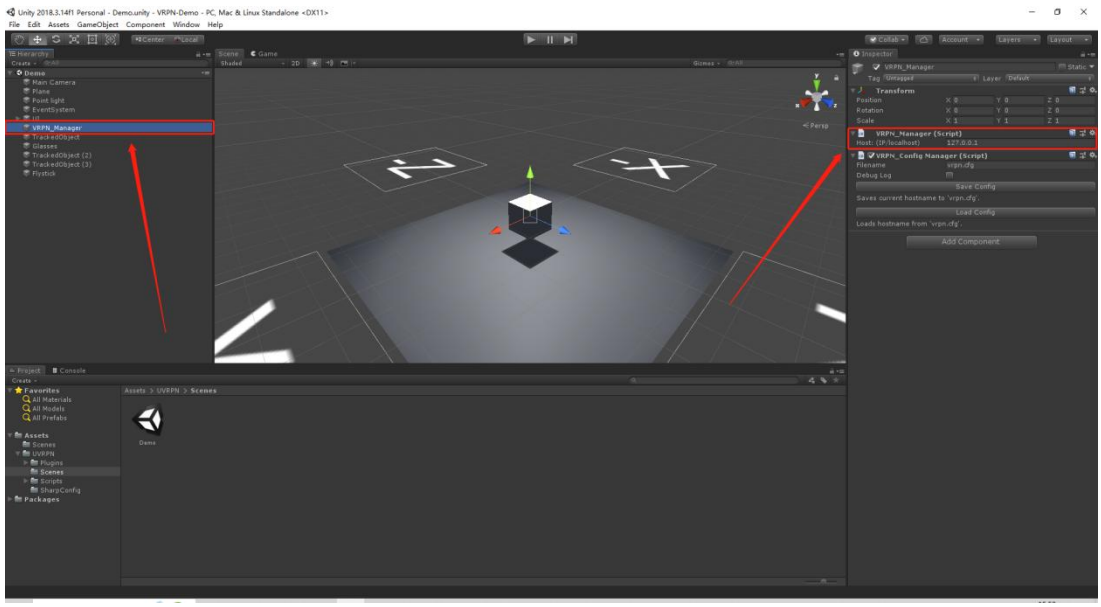


17.6.13

(5) Parameter settings:

- Set the local address: Set the address of "Host: (IP/localhost)" to "127.0.0.1" (17.6.14) in "VRPN-Manager". If connecting to another host, change the IP address here to the server IP address of the other host. After setting the IP, press Enter and Ctrl+S to save;



17.6.14

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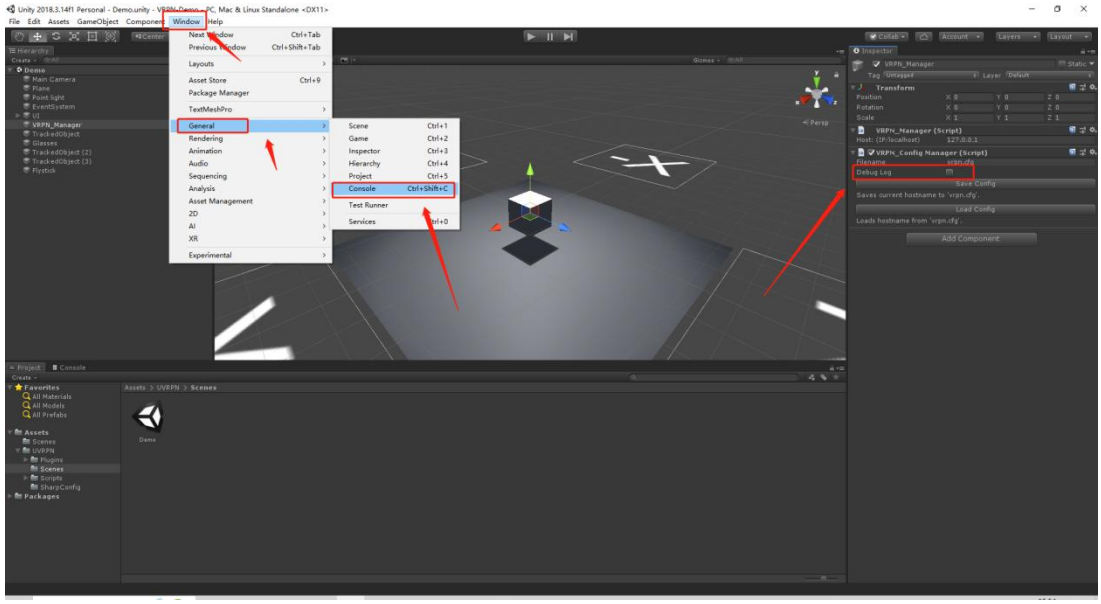
- Turn on log: Turning on the log allows you to see detailed printing information about the pressed button on the handle. Printing the error log can help identify the problem and solve it. Select 'Window General Console' and check 'Debug Log' (17.6.15);



17.6.15

- Set Flystick: Click on "Flystick" and enter the name of the rigid body created by VR Tracker software in the "Tracker" input box in the "VRPN_Tracker (Script)" module. Set "Channel" to 0 and press Enter to save (17.6.16).

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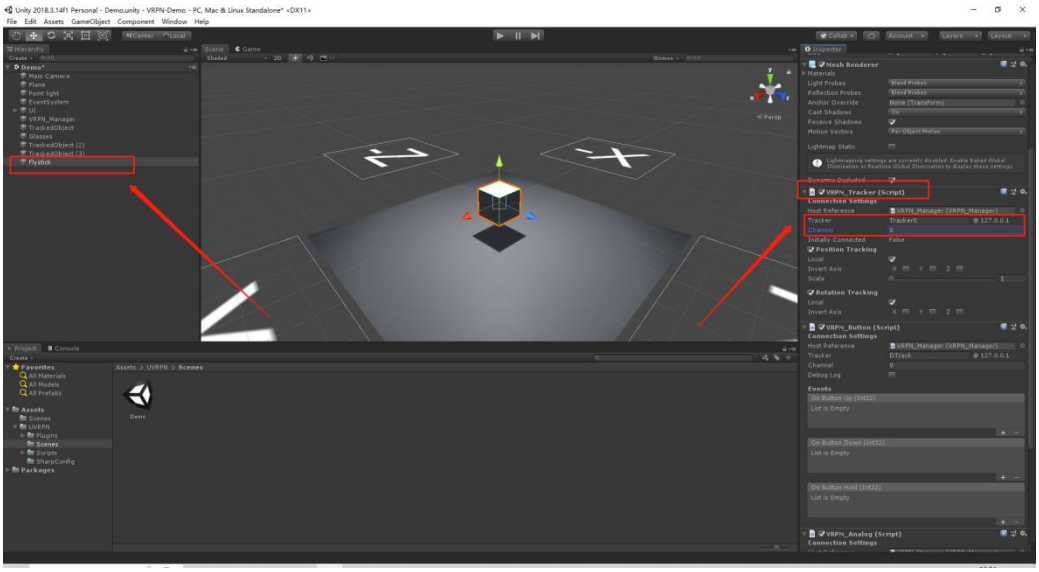
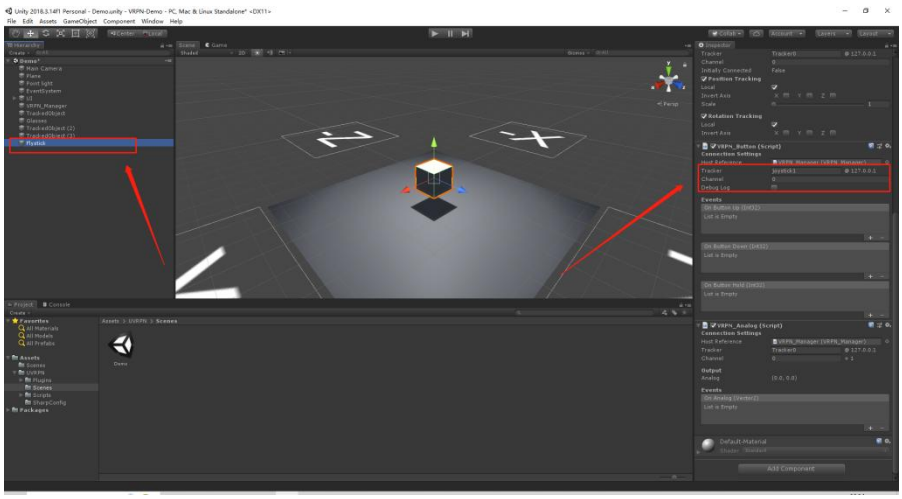


17.6.16

- In the "Tracker" input box of the "VRPN_Button (Script)" module, enter the name of the handle (joystick1, joystick2), check "Debug log" to facilitate printing of log information (17.6.17). If the first handle is connected, enter "joystick1" and press the Enter key. The "Channel" value here represents the number of the corresponding handle key position;



17.6.17

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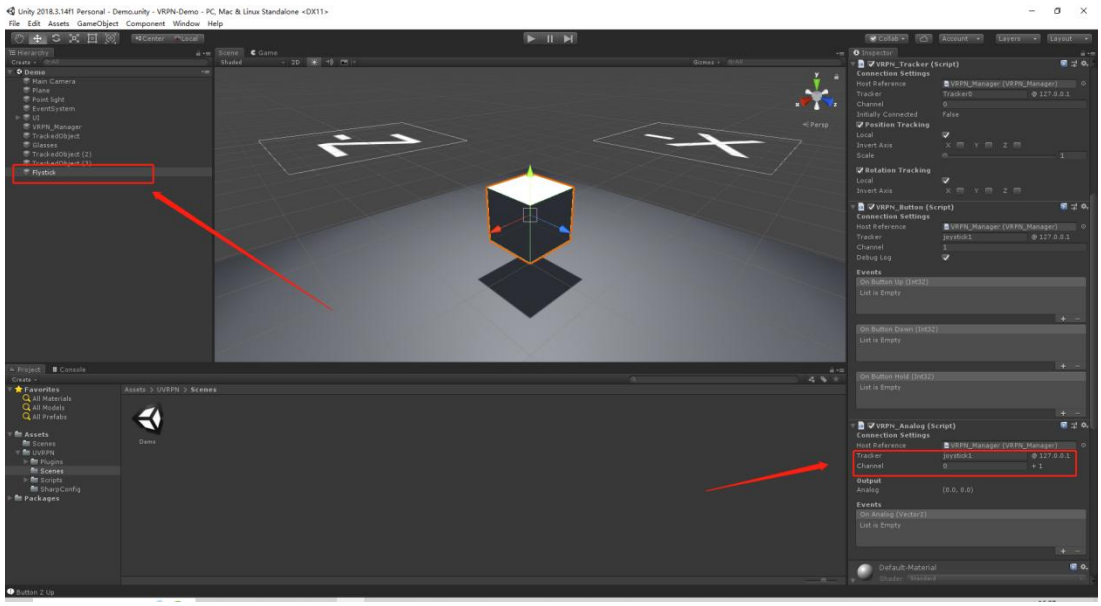
- Enter the name of the handle (joystick1, joystick2) in the "Tracker" input box of the "VRPN_Analog (Script)" module, and set "Channel" to 0 (17.6.18).



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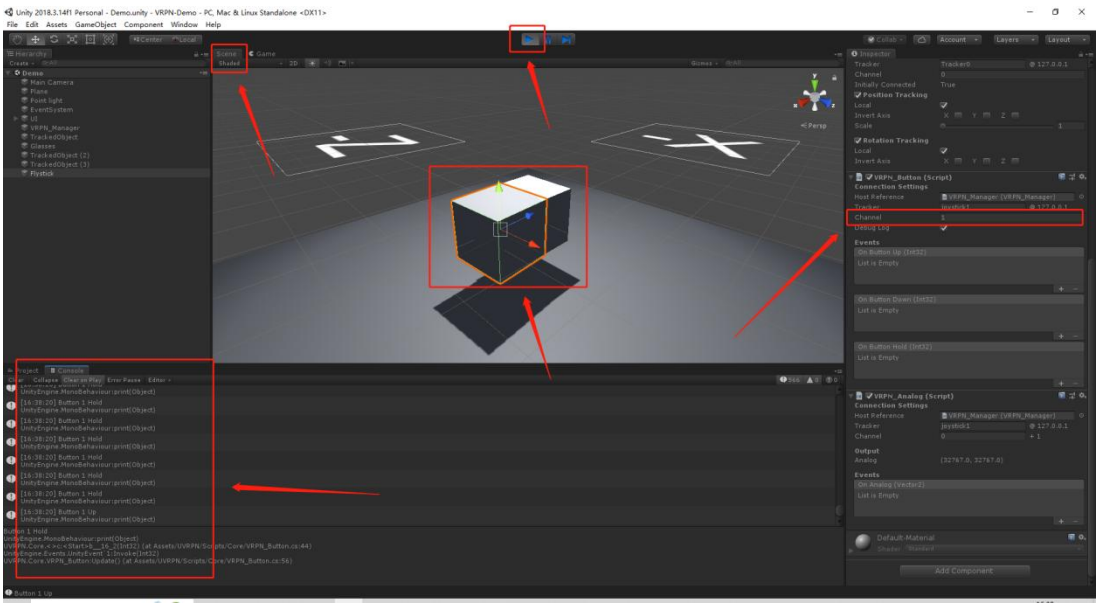
(6) Real time Drive Tracker

- After all the above configurations are set, set the "Channel" value in the "VRPN_Button (Script)" module to 1, press the Enter key to save the configuration, click Play to switch to "Sense" to display the scene, and after moving the rigid body, the objects in Unity will also be synchronously driven. At this time, press the button numbered "1" on the handle, and the "Console" in Unity will print the information of the handle key position, Button 1 Hold "indicates that button 1 of the handle is pressed, and" Button 1 Up "indicates that button 1 of the handle is released after being pressed (17.6.19).



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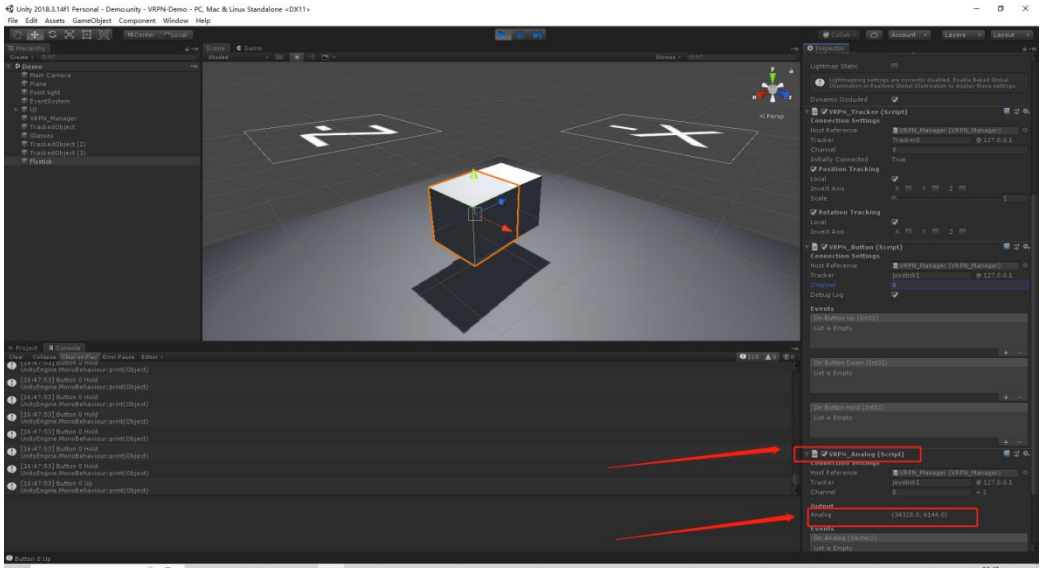
- If you need to use other buttons on the handle, set the "Channel" value to the corresponding number in the "VRPN_Button (Script)" module.

- If a handle wheel is used, there is no need to set it in the "Channel". Simply slide the wheel and the "Analog" coordinate value in the "VRPN_Analog (Script)" module will change in real time (17.6.20);



17.6.20

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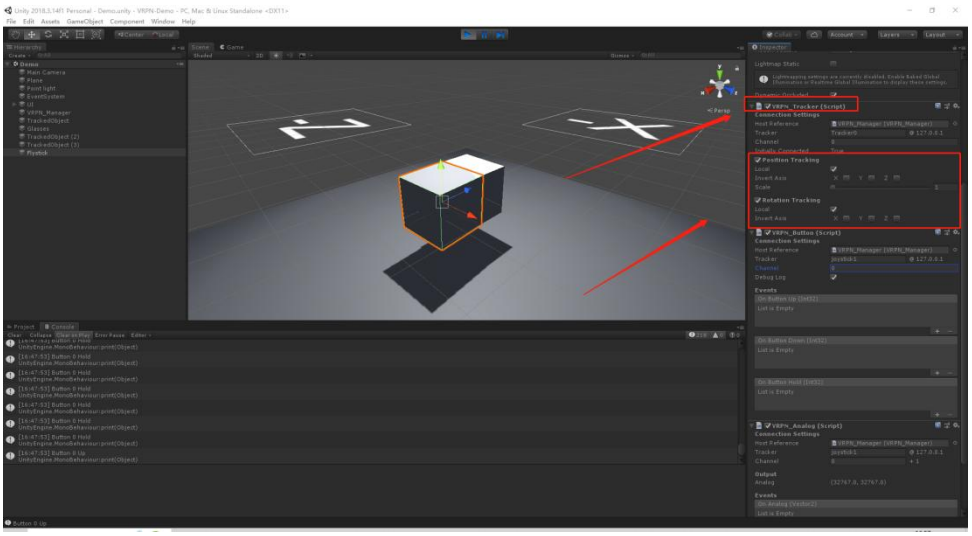
- Inversion of displacement and rotation: When using a rigid body to drive objects in a Unity scene in Live, the displacement and rotation of the rigid body data can be reversed. In the "VRPN_Tracker (Script)" module, "Position Tracking" represents the displacement of the rigid body, "RotationTracking" represents the rotation of the rigid body, and checking "X, Y, Z" represents the inversion of the coordinate values of the "X, Y, Z" axes (17.6.21).



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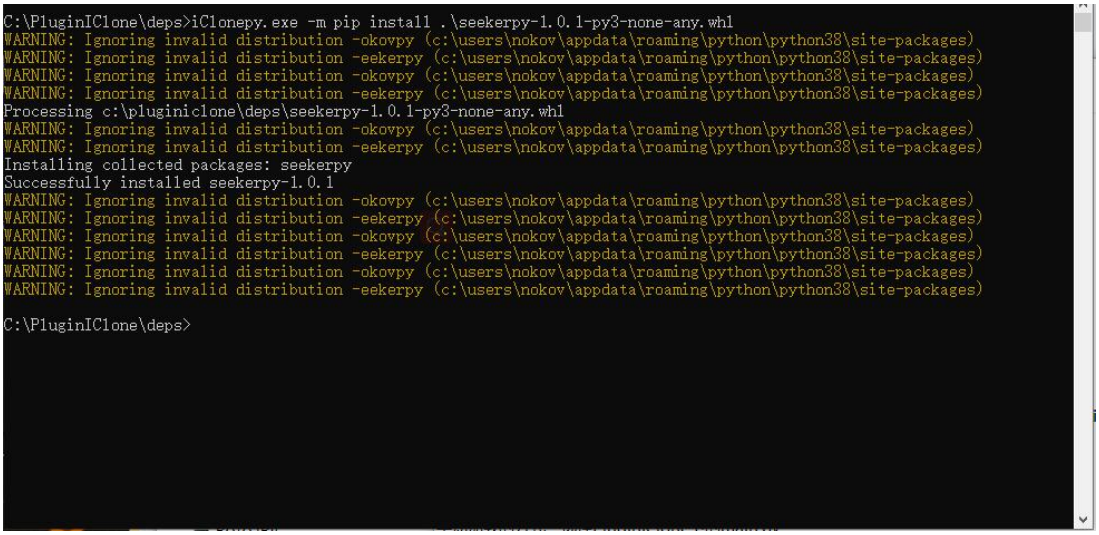
7. IClone plugin

■ Configure the Python environment for IClone

(1) Enter the following website address:

- " https://wiki.reallusion.com/IC_Python_API:Python_Extension_Libraries " Follow the steps on the webpage to configure the Python environment;
- Install dependency libraries
- At the command prompt, switch the path to "deps" in the "PluginClone" folder and install our dependent libraries in the "deps" directory;
- At the command prompt, enter "iClonepy.exe - m pip install. seekerpy-1.0.1 py3 none any. whl" (17.7.1);



17.7.1

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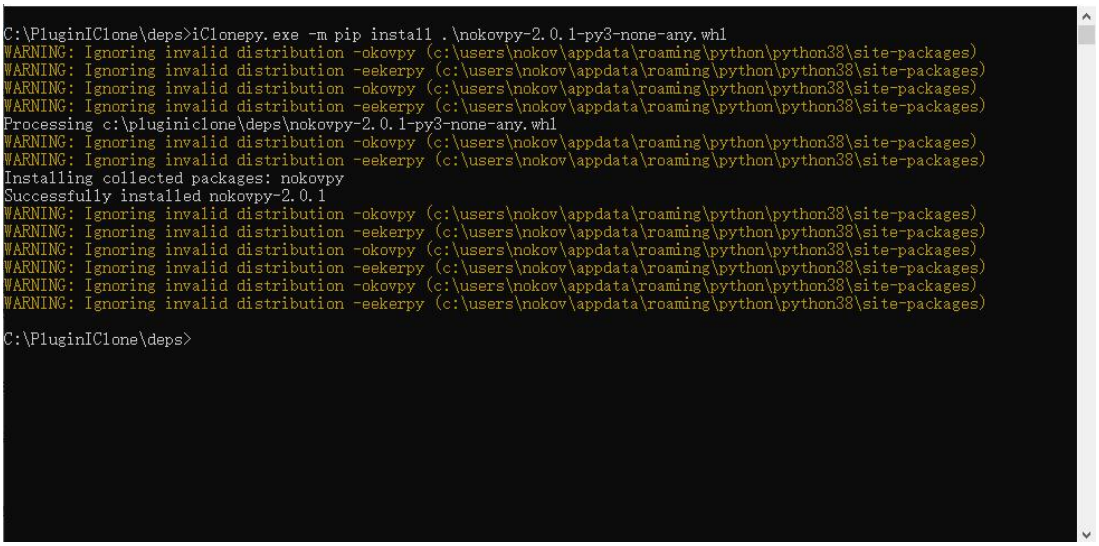
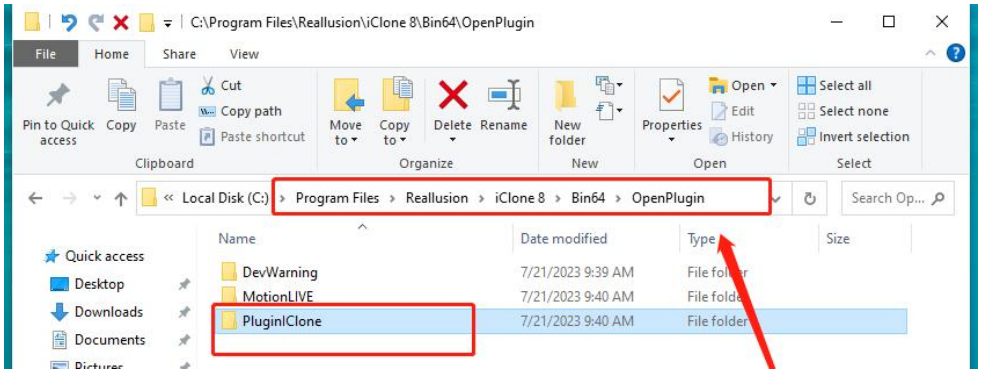
➢ At the command prompt, enter "iClonepy.exe - m pip install. nokovpy-2.0.1 py3 none any. whl" (17.7.2).



17.7.2

■ Run plugin - Method 1

(1) After installing the dependency library, you can run the plugin in two ways. The first way is to find the IClone software diagram on the desktop, open the IClone file location, and copy the "PluginIClone" folder to this path (17.7.3) in the "Reasoning iClone 8 Bin64 OpenPlugin" directory;



17.7.3

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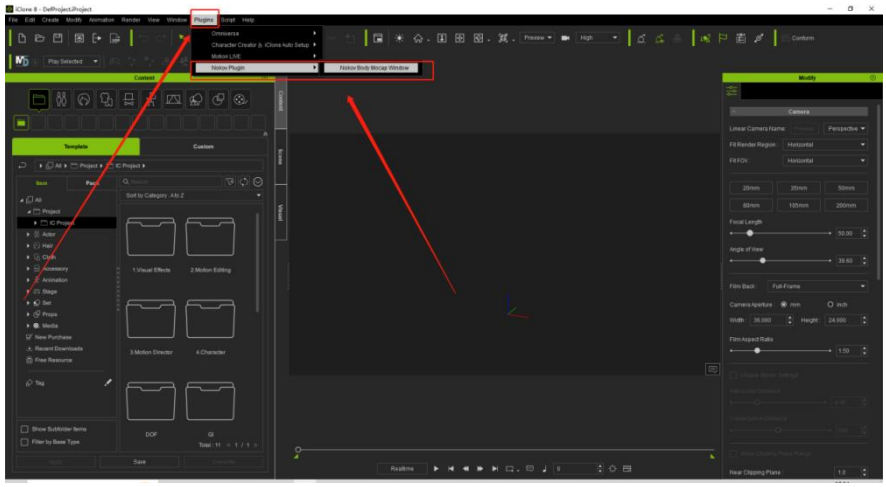
(2) Next, play human body data in XINGYING Live mode or load a set of human body data in Edit mode. At the same time, open the settings in XINGYING software, set the network card address to "10.1.1.198" in the "Data Broadcast" panel, and enable "Enable SDK".

(3) Start IClone and drag the "Test. iAvatar" model from the "PluginIClone ->models" folder to the IClone scene;

(4) Open the plugin window (17.7.4) in the menu bar "Plugins ->NokovPlugin ->Nokov Body Mocap Window", set "Type" to "V2" in the plugin window, enter "10.1.1.198" in "Server", and enter ServerIP as the SDK broadcast address set by the capture software;



17.7.4

(5) Click the Connect button, and the log window will print connection information (17.7.5);

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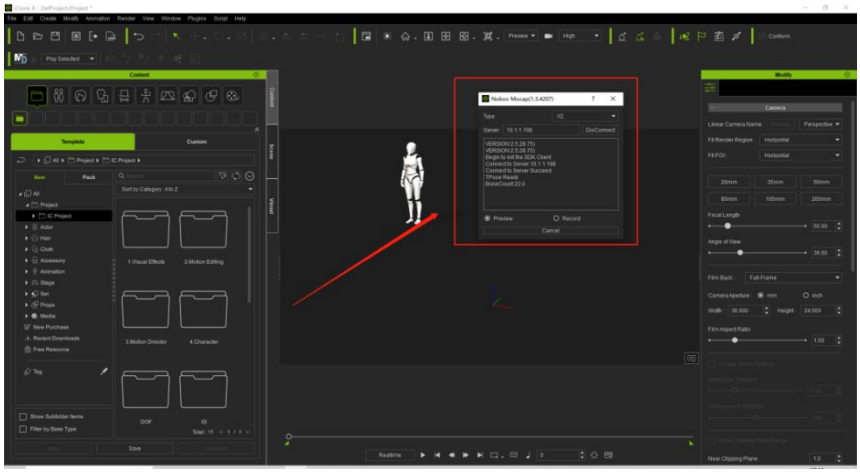
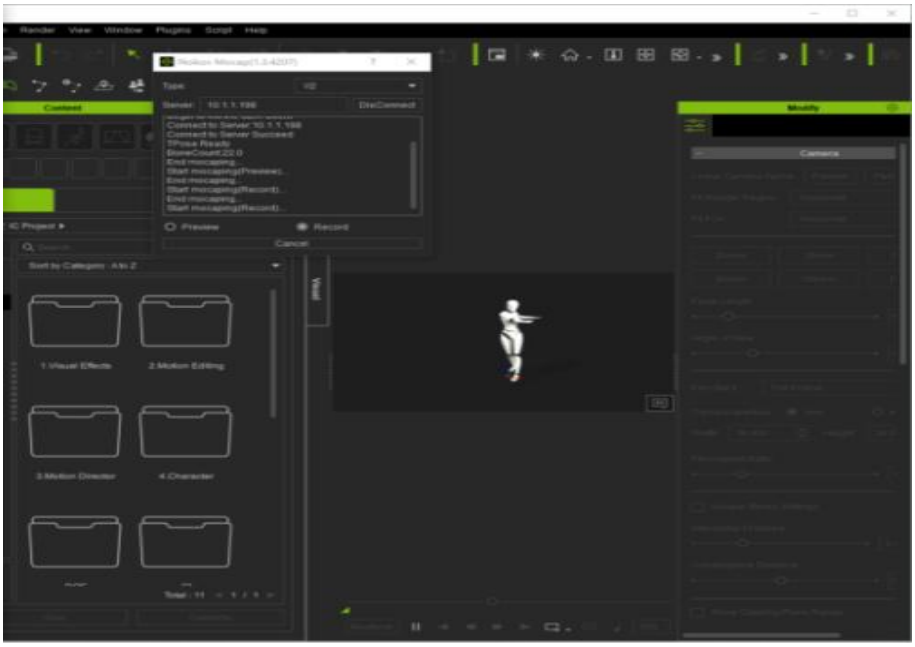


17.7.5

(6) You can select Preview/Record as needed and click Start;

(7) Note: When clicking on Connect to obtain connection information and clicking on Start to run the IClone plugin, please ensure that the human body is in the 3D view during dynamic capture;

(8) At this point, play the capture data and drive the model in IClone in Live (17.7.6).



17.7.6

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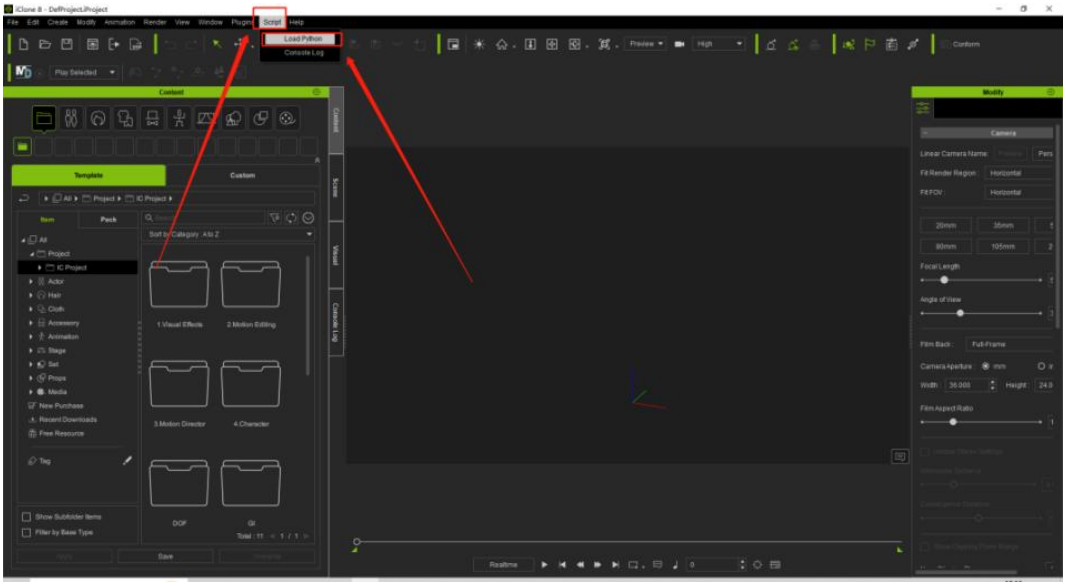
■ **Run plugin - Method 2**

(1) The second method does not require copying the "PluginIClone" folder to OpenPlugin. Start the IClone software, click on the menu bar "Script ->Load Python" (17.7.7), select "main. py" in the "PluginIClone" plugin folder, and click to open it;



17.7.7

(2) Next, refer to steps 2-7 in the previous section "Running plugins - Method 1" to drive the model in IClone.

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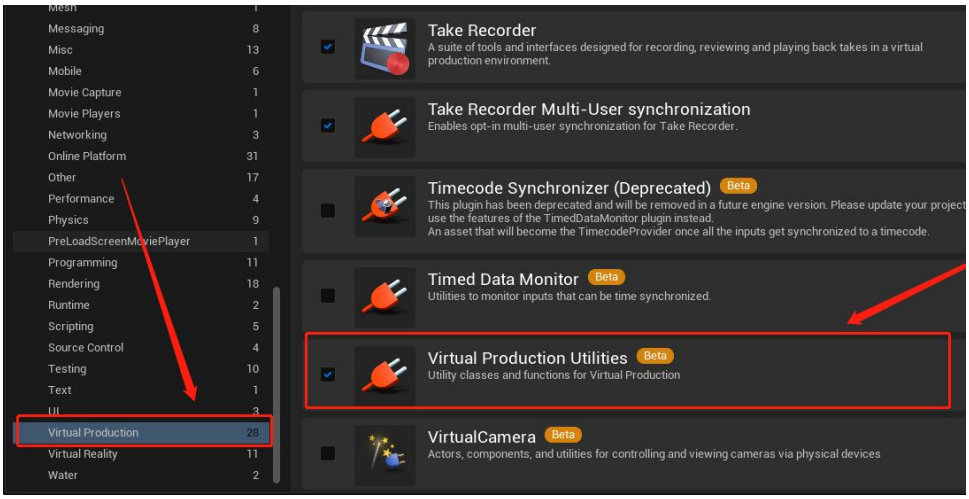
8. Application of TimeCode in UE

■ Plugin installation and software settings

(1) Taking UE5.0 version as an example, introduce the application of TimeCode. Copy the UE plugin to the " UE_5.0 Engine Plugins" directory, please consult the technical engineer for the plugin version;

(2) Create a new UE project, open the UE software, open the plugin settings in the editor, search for MotionCapture in the search box, check the "NokovLiveLink" plugin, search for "Virtual Production", check "Virtual Production Utilities" (17.8.1), check all the above two options, and restart the UE.



17.8.1

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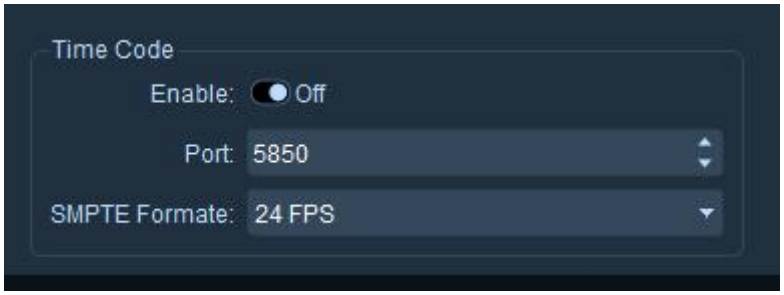
(3) Play the software in XINGYING software, quickly create a rigid body from an unnamed point, open the data broadcast panel on the toolbar above the software, and check the "Enable" checkbox under the TimeCode module (such as 17.8.2). Do not modify the port number and frame rate on the right, and keep the default 5850 port and 24Fps.



17.8.2

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(4) After turning on TimeCode, play the XINGYING software and the TimeCode field will be displayed in the lower left corner of the 3D view. The meanings of the fields are: hour, minute, second, frame, subframe. The jump of the subframe number represents the ratio between the TimeCode frame rate and the two frame rates set by the software;

■ **LiveLink connection and settings**

(1) Ensure that the XINGYING software has enabled SDK broadcasting, with the default broadcasting address of 10.1.1.198. Click on "Window Virtual Production LiveLink" in UE, click on the source in the LiveLink window, select Nokov LiveLink, and click OK to see that the data source has been connected;

(2) Click on "Window Virtual Production Time Code Provider", and the time code displayed in the "Time Code Provider" window defaults to the same time as the computer system;

(3) Select "NokovLiveLink" in the topic list below the LiveLink window, check "TimeCode Provider" to replace it with the TimeCode of the data source, expand "Frame Rate" on the right side of the LiveLink window, and set FPS to the same frame rate as XINGYING software, maintaining consistency (17.8.3).

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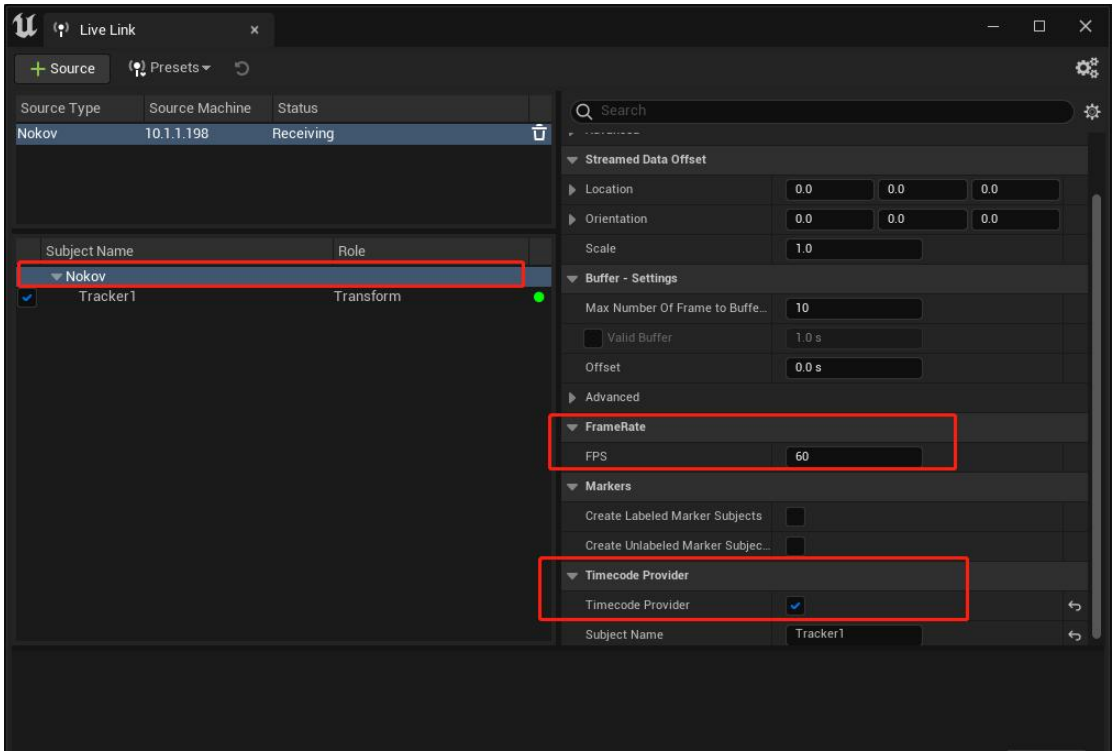

17.8.3

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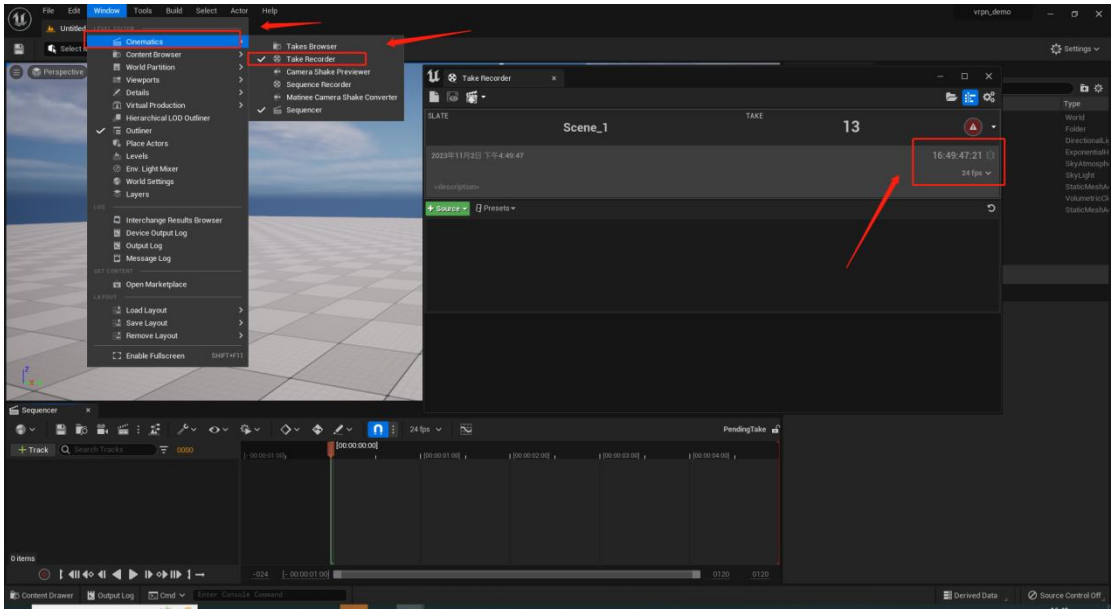
■ UE and XINGYING time code synchronization

(1) Open the "Time Code Provider" window, and the displayed time code will be consistent with the data source, that is, consistent with the XINGYING software TimeCode time code;

(2) Click on "Window Cutoff Animation Camera Trial Recorder", and the time code displayed in the recorder window is synchronized with the time code in XINGYING software (17.8.4), provided that the data source needs to be connected in the LiveLink window and the "TimeCode Provider" checkbox is checked. When using a recorder to record data, the time code in XINGYING software will be recorded;



17.8.4

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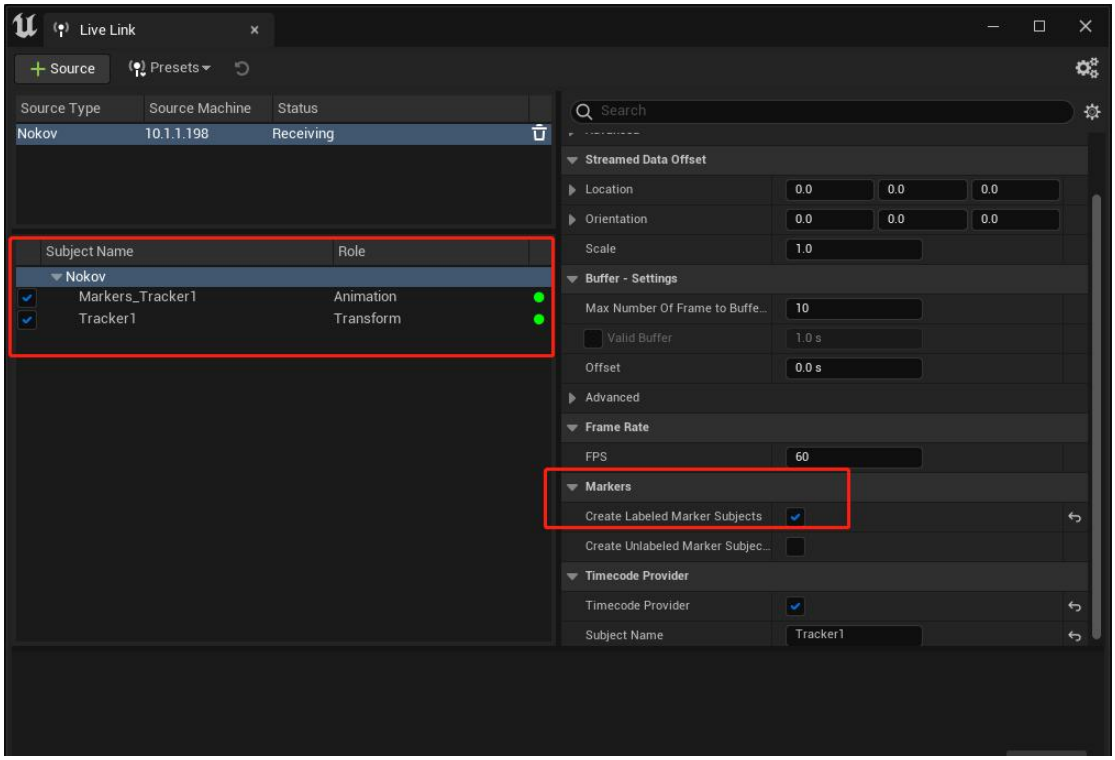
■ Named point creation

(1) Click on the data source in the LiveLink window and select the "Create Labeled Marker Subjects" option on the right to create a named point. After successful creation, a topic name of "Markers_xxx" will be automatically created in the left topic list (17.8.5);



17.8.5

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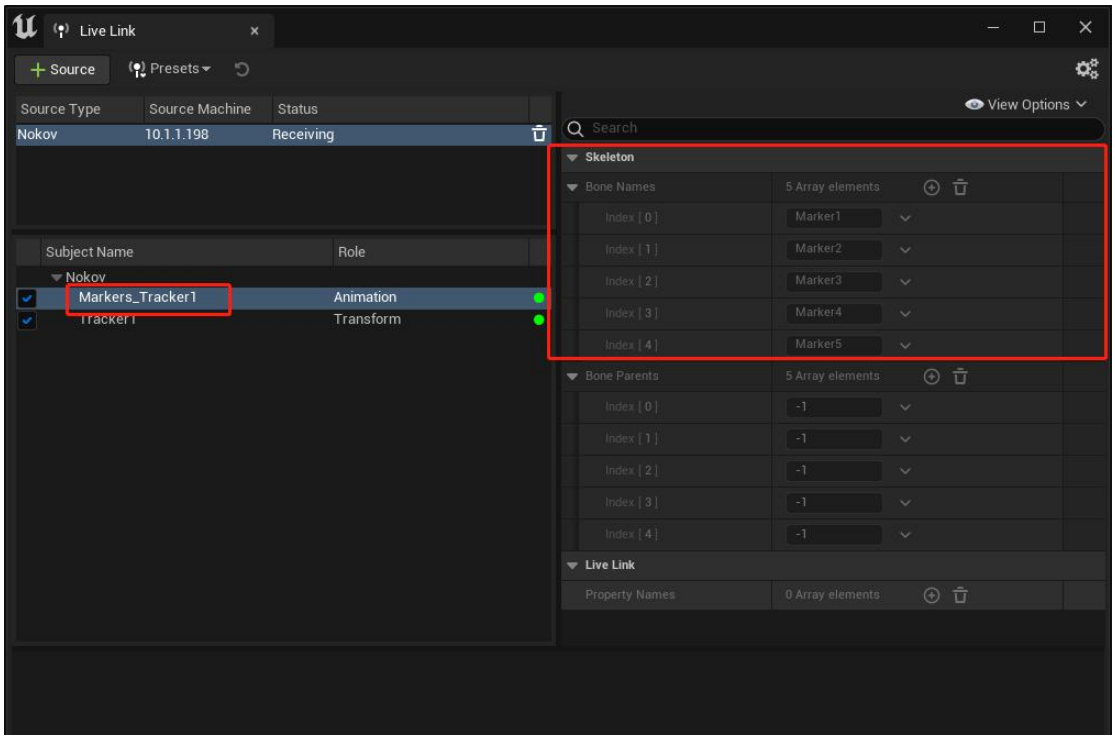
(2) Select the theme name of the created named point, select "Show Static Data" from the "View Options" drop-down in the upper right corner of the window, expand "skeleton Naming", and list the names of all named points in the current Market (17.8.6);



17.8.6

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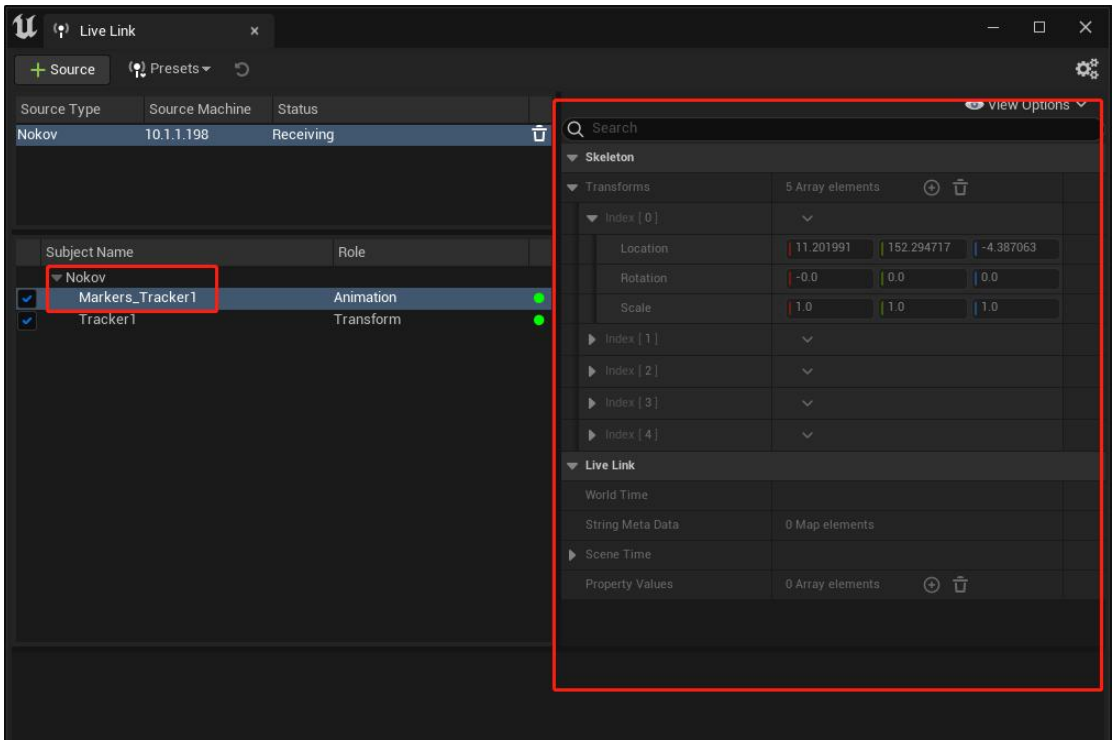
(3) Select "Display Frame Data" from the "View Options" dropdown, expand "Skeleton Transform Index", and you can see the position coordinate data of each named point in real time. Expand "Scene Time" to observe the frame number, time code, and time code frame rate in real time (17.8.7);



17.8.7

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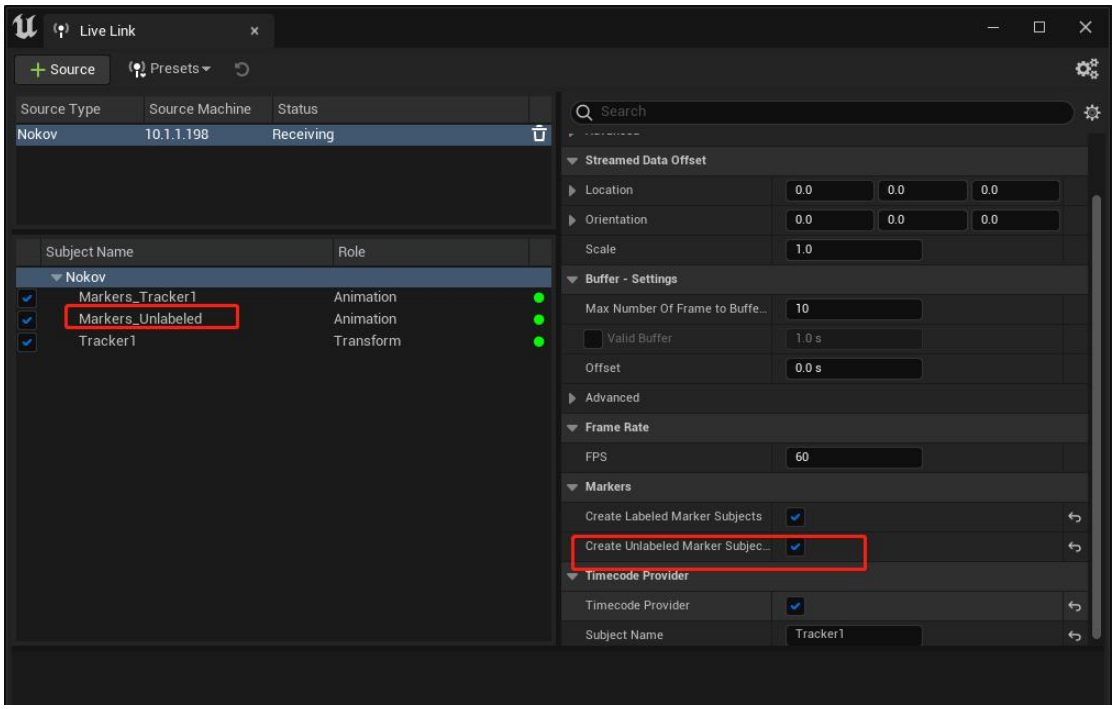
■ Unnamed point creation

(1) Click on the data source in the LiveLink window and select the "Create Unlabeled Marker Subjects" option on the right to create a named point. After successful creation, a topic name of "Markers_Unlabeled" will be automatically created in the left topic list (17.8.8);



17.8.8

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(2) After creating unnamed points, 100 unnamed point names will be automatically created, which can be seen in "View Options - Display Static Data - Skeleton - skeleton Naming"; Expand "View Type Display Frame Data Skeleton Transform Index" to display the position coordinate data of unnamed points. If there are no unnamed points in XINGYING software, the value of the unnamed points here is 0. When unnamed points appear in XINGYING software, the value of the unnamed points here will be filled with the position coordinate data.

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XVIII. UDP Capture Broadcast/Trigger

■ **XINGYING supports UDP protocol broadcast commands to control the start and stop of recording. It also supports broadcasting and sending recorded events.**

1. Remote control

(1) Enable the switch (18.1.1) in the "Capture-Remote" section of the Data Catting Pane to activate the remote control function. The port is the listening port for XINGYING to receive control commands, with a default value of 7060. If this port is occupied by other programs in the system, please allocate other suitable ports for XINGYING to use. If you need to set this port, please cancel the remote control function first, and then enable remote control after completing the modifications.

18.1.1

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(2) After enabling remote control, a camera needs to be connected. After the connection is completed, remote commands can be used to control the recording.

(3) The remote control commands currently supported by XINGYING are in XML file format:

- Start notification
- Stop notification

■ **Start notification**

- The following example shows the start notification. Please note that the broadcast must be suitable for a UDP packet.
- The indentation in the following example is for clarity: the actual data packet is not indented. The blank space between the tags has been removed.

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<CaptureStart>
<Name VALUE="Remotetake01"/>
<SessionName VALUE="SessionName" />
<Notes VALUE="Take notes if any"/>
< Delay VALUE="Reserved" />
<Description VALUE="" />
<DatabasePath VALUE="F:/shared/"/>
<TimeCode VALUE="00:00:00:00"/>
<PacketID VALUE="0"/>
</CaptureStart>
```

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Illustrate:

Value	Description
Name	The name of the file to be recorded
SessionName	Reserved field
Notes	Reserved field
Description	Reserved field
Delay	Reserved field
DatabasePath (*)	Recording file path
TimeCode	Reserved field
PacketID	Reserved field

Attention:

- If the current working environment is loaded with rigid body/human body templates, the parameter DatabasePath needs to be consistent with the current working directory of XINGYING, otherwise the recorded files cannot be directly loaded in XINGYING's Edit.

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- If you need an independent recording file path, you can also copy the used rigid body/body template (. mars) file to the set recording folder after recording, so that it can be loaded normally in XINGYING's Edit.
- For recording unnamed marker data, simply set the parameter DatabasePath to a valid path.

■ **Stop notification**

- The following example shows a stop notification. Please note that the broadcast must be suitable for a UDP packet.
- The indentation in the following example is for clarity: the actual packet is not indented. The blank space between the tags has been removed.

```
<?xml version="1.0" encoding="utf-8"?>
<CaptureStop>
<Name VALUE="Remotetake01" />
<Notes VALUE="Take notes go here if any." />
<Assets VALUE="skel1, skel2, sword" />
<TimeCode VALUE="00:00:00:00" />
<HostName VALUE="optional host name" />
<ProcessID VALUE="optional process id" />
</CaptureStop>
```

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Illustrate:

Value	Description
Name	The name of the file that needs to stop recording
Notes	Reserved field
Assets	Reserved field
TimeCode	Reserved field
PacketID	Reserved field

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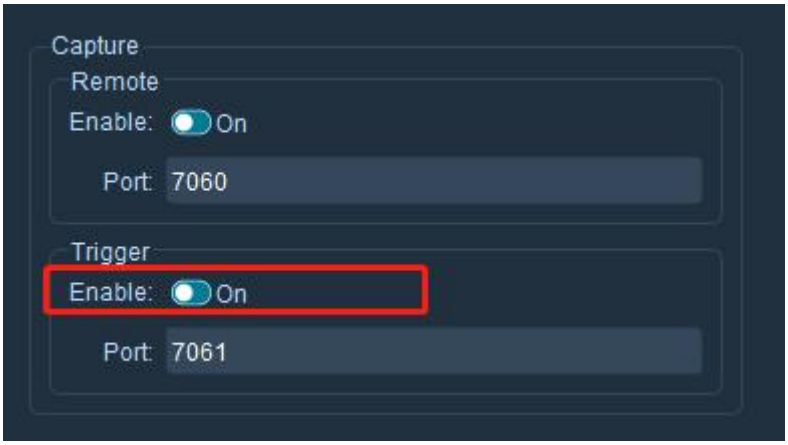
2. Remote trigger

(1) Enable the switch (18.2.1) in the "Capture -Trigger" section of the data broadcast panel to activate the remote trigger function. The port is the broadcast port where XINGYING sends control commands, with a default value of 7061. If the port monitored by third-party software or tools is another port, please assign the correct port to XINGYING for use. If you need to set this port, please cancel the remote triggering function first, and then enable remote triggering after the modifications are completed.



18.2.1

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(2) After enabling remote triggering, a camera needs to be connected. After the connection is completed, it can be triggered by turning on/off recording.

(3) Currently, the trigger control command sent by XINGYING is in XML file format:

- Start triggering
- Stop triggering

■ **Start triggering**

- The following example shows the start trigger. Please note that the broadcast must be suitable for a UDP packet.
- The indentation in the following example is for clarity: the actual packet is not indented. The blank space between the tags has been removed.

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<CaptureStart>
<Name VALUE="RemoteTriggerTest_take0116" />
<DatabasePath VALUE="F:\20230712\test1" />
<Notes VALUE="This is Beijing NOKOV Science & Technology Co., Ltd Motion Capture Start Msg" />
<Description VALUE="NULL" />
<Delay VALUE="33" />
<PacketID VALUE="10028" />
</CaptureStart>
```

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Illustrate:

Value	Description
Name	Recorded file name
SessionName	Reserved field
Notes	Reserved field
Description	Reserved field
Delay	Reserved field
DatabasePath	Recorded file path
PacketID	Reserved field

■ **Stop triggering**

- The following example shows the stop trigger. Please note that the broadcast must be suitable for a UDP packet.
- The indentation in the following example is for clarity: the actual packet is not indented. The blank space between the tags has been removed.

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<CaptureStop RESULT="SUCCESS">
<Name VALUE="RemoteTriggerTest_take0114" />
<DatabasePath VALUE="F:\20230712\test1" />
<Notes VALUE="This is Beijing NOKOV Science & Technology Co., Ltd Motion Capture
Stop Msg" />
<Description VALUE="NULL" />
<Delay VALUE="33" />
<PacketID VALUE="10025" />
</CaptureStop>
```

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Illustrate:

Value	Description
Name	Recorded file name
SessionName	Reserved field
Notes	Reserved field
Description	Reserved field
Delay	Reserved field
DatabasePath	Recorded file path
PacketID	Reserved field

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Beijing NOKOV Science & Technology Co.,Ltd
info@nokov.com +86-10-64922321
Beijing (Headquarter): Room 820, China Minmetals Tower, Chaoyang District, Beijing
Shanghai Subsidiary: Room B201, Shangpinduhui, No.268 Tongxie Road, Changning District, Shanghai
WuHan Branch: B3-601, Wuda Airlines Phase 2, Donghu High-tech Economic Development, Wuhan, Hubei
Shenzhen Branch: A2102, Cloud Technology Building, Nanshan District, Shenzhen