

TachinGlove Flexible Tactile Data Acquisition Gloves User Manual

Table of Contents

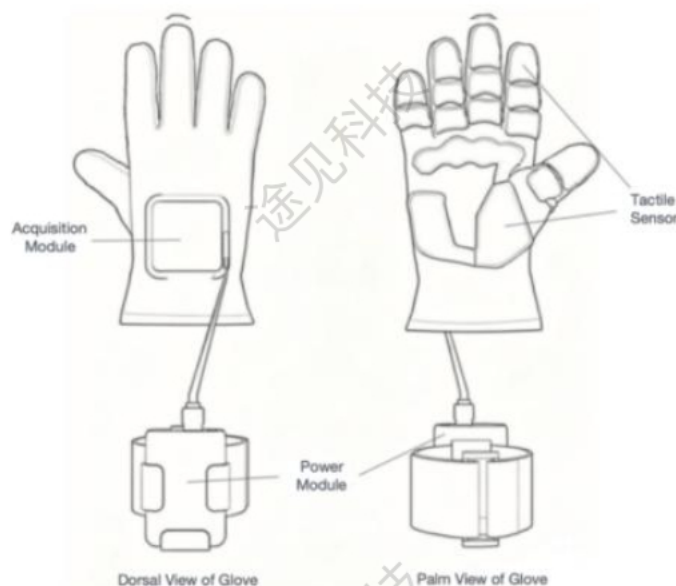
1 Product Introduction	2
2 Product Composition	3
3 Pre-use Preparation	3
4 Glove Wearing Method	4
5 Device Network Configuration and Connection	5
5.1 USB Connection Method	5
5.2 Wi-Fi Connection Method	6
5.3 Setting up NTP Server (for Time Synchronization)	8
5.3.1 Using Public NTP Server	8
5.3.2 Using Local NTP Server	9
6 Host Computer Software Installation and Detailed Operation Instructions	12
6.1 Software Installation	12
6.2 Software Startup 软件启动	13
6.3 Functional Modules	14
6.3.1 Function Mode Selection	14
6.3.2 Connection Method Configuration	15
6.3.3 Data Acquisition and Configuration	17
6.3.4 Visualization Configuration	20
7 Precautions	24
Contact Us	26

1 Product Introduction

The TachinGlove Flexible Tactile Data Acquisition Glove is a smart wearable acquisition device designed for full-hand tactile signal acquisition and data recording. The product integrates high-density, distributed, ultra-thin flexible electronic skin sensing units, which can acquire multimodal tactile signals such as normal force and tangential force, and record the distribution changes and characteristics of contact forces in areas like fingers and palms during operations such as grasping, pressing, and sliding. The product adopts a hand-biomimetic high-density array layout, covering main tactile interaction areas such as the five fingers and the palm; its flexible structure can adapt to hand bending, grasping, and routine movements, supporting data acquisition under natural operating states and restoring the natural working state of humans; the product features a low-noise design in the empty-grasping state, which can reduce false trigger signals and invalid data interference under non-contact states, improving the stability and usability of the acquired data, and ensuring data purity.

The product supports Wi-Fi wireless communication and battery power, completely throwing off wired constraints to achieve flexible acquisition anytime and anywhere, suitable for mobile acquisition and multi-scenario deployment needs. The product can be applied to scenarios such as embodied intelligence training, robot teleoperation, rehabilitation assessment, and industrial operation data acquisition, providing high-precision, highly reliable full-hand tactile signal acquisition and data recording solutions for related systems.

2 Product Composition



Accessories: Gloves * 2 (Left and Right hand), Battery * 2, Battery Holder * 2, Disposable Protective Gloves * 2, Data Cable * 2, U-KEY*1.

3 Pre-use Preparation

- (1) Confirm that the gloves and batteries are intact, undamaged, and clean.
- (2) Confirm that the battery level is sufficient or the gloves can properly connect to the computer via the data cable.
- (3) Prepare a PC and install the host computer software and drivers, ensuring that the operating system is a Windows version.
- (4) Check the acquisition environment: ensure that the acquisition environment is clean and tidy to avoid water ingress and dirt.

4 Glove Wearing Method

- (1) Before putting on the data acquisition glove, you may first wear disposable rubber gloves or thin nylon gloves to isolate the impact of hand sweat on the device.
- (2) Gently slide the glove on from the fingers toward the wrist. Avoid forceful pulling or twisting to prevent damaging the sensors.
- (3) Ensure your fingers are naturally extended and the palm sensor fits snugly against your palm.
- (4) It is recommended to wear the glove continuously for no more than 1 – 2 hours, taking a 10-minute break in between to ensure healthy blood circulation.
- (5) When removing the glove, do not pull forcefully on individual fingers to avoid causing sensor damage. It is recommended to grip with four fingers simultaneously and slide it off smoothly.



5 Device Network Configuration and Connection

TachinGlove supports Wi-Fi wireless communication and USB Type-C wired communication. The wireless mode requires device network configuration first to ensure that the gloves can connect to the host computer software on the PC side.

5.1 USB Connection Method

- (1) Before use, the glove and PC must be connected using a USB cable.
- (2) If it is used for the first time, you need to run zadig-2.8.exe to install the USB driver. Select "List all devices" under "Options", then find "EZ-USB" in the drop-down menu, and click "Replace Driver" (regardless of what the original driver shown for EZ-USB is, just replace it with WinUSB).

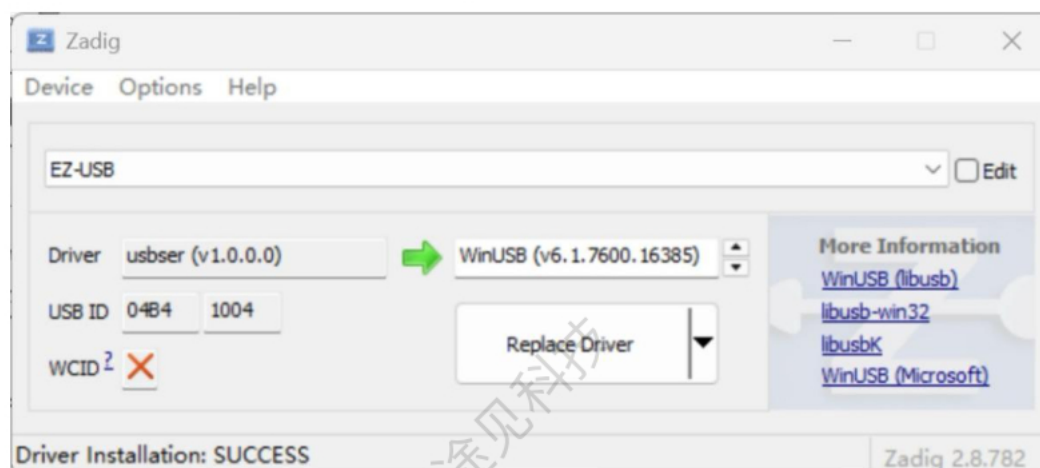


Figure 1 Driver installation during the first use of the USB version.

Please note:

- (1) Before using zadig, the glove must be connected via a USB cable first, and the corresponding driver will be automatically selected by default; if a problem occurs, please manually select the correct device from the list.
- (2) Please operate with caution; accidental misoperation may modify the drivers of

other devices.

(3) In some special scenarios, USB and other interfaces may be used simultaneously. Since the USB itself has a power supply function, do not use other interfaces for simultaneous power supply.

5.2 Wi-Fi Connection Method

Note: The gloves only support 2.4GHz Wi-Fi and do not support 5GHz Wi-Fi at this time.

- (1) When using for the first time, you need to configure the Wi-Fi connection for the gloves and obtain the corresponding IP address.
- (2) After powering on the gloves, search for the corresponding hotspot in the wireless list of the computer or mobile phone, fill in the correct password, and wait for a successful connection. Hotspot example: Tachin_XXXXXXXXXXXX
Password: Tachin_123.

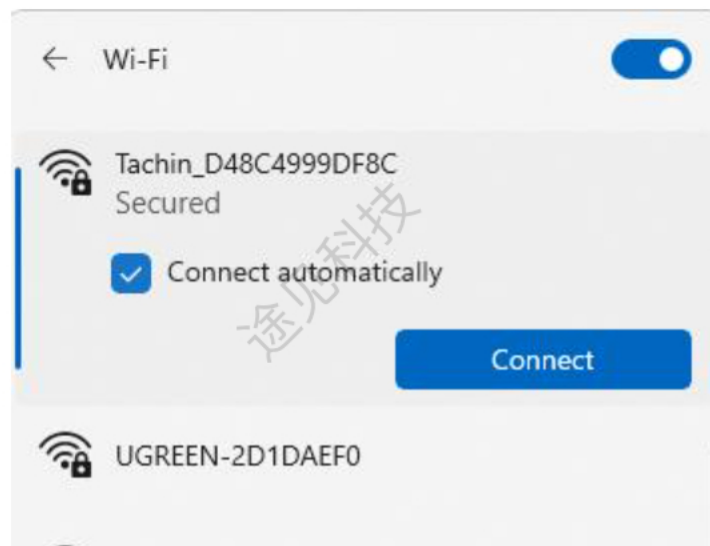


Figure 2 Example of device hotspot for the Wi-Fi version.

- (3) Open the website <http://192.168.4.1/> in the browser of the device (computer or mobile phone) connected to the glove's hotspot, select the wireless network

you want to connect to, enter the corresponding password, and click the "Save & Connect" button at the bottom to submit. After waiting for a period, it will jump back to the original interface and display the IP address of the hardware device within the current wireless network segment.

The figure displays two side-by-side screenshots of the 'WiFi & NTP Configuration' interface. The left screenshot shows an 'Error' status with red indicator lights for SSID, Signal, IP, and Device Time. The right screenshot shows a successful connection with a green indicator light for SSID and specific values for Signal (-50 dBm), IP (172.16.32.164), and Device Time (Not synced). Both interfaces include fields for WiFi SSID, WiFi Password, NTP Server IP, and a 'Save & Connect' button.

Figure 3 Example of wireless network connection settings for the Wi-Fi version device.

(4) Once the Wi-Fi connection is successful, this IP address will be the device IP address of the host computer.

The figure shows the 'Device Configuration & Software Settings' interface. The 'Software Settings' tab is active. The 'Connection Type' is set to 'Wifi', 'Card Type' is 'Wifi32', and 'Wi-Fi' is '8C8C2954DBB0'. The 'Device IP' field is highlighted with a red border.

(5) If you need to enable the hardware timestamp function, select the local IP address as the NTP server address on the wireless network connection settings page and fill it in. Before filling it in, ensure that the current machine has enabled the NTP server and related functions. After filling in the NTP server address,

reconnect the computer to the corresponding wireless network, disconnect and restart the glove device, and observe whether the Device Time is correctly displayed. If displayed correctly, it means the board time has been successfully synchronized.

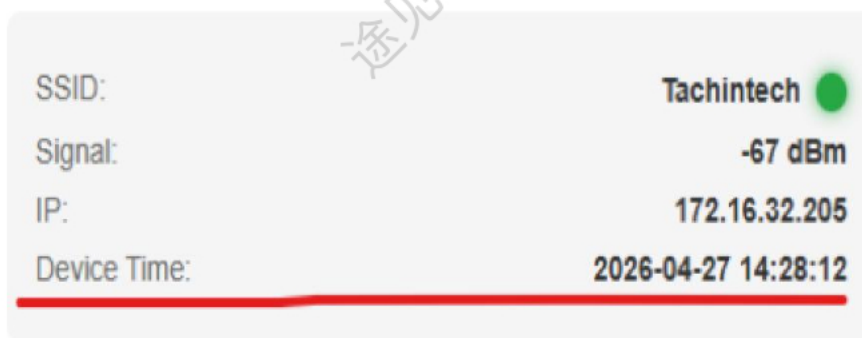


Figure 4 Successfully using an NTP server to set the hardware timestamp.

5.3 Setting up NTP Server (for Time Synchronization)

The NTP server can use both public network and local machine methods. The local setup method is recommended, as it can reduce the time synchronization error between multiple devices.

5.3.1 Using Public NTP Server

For public network servers, pay attention to opening UDP port 123 in the firewall.

ntp1.aliyun.com	Alibaba Cloud Public NTP
ntp2.aliyun.com	Alibaba Cloud Public NTP
ntp3.aliyun.com	Alibaba Cloud Public NTP

ntp1.ntsc.ac.cn	National Time Service Center
ntp2.ntsc.ac.cn	National Time Service Center
ntp3.ntsc.ac.cn	National Time Service Center
ntp1.cstnet.cn	China Science and Technology Network
ntp2.cstnet.cn	China Science and Technology Network

5.3.2 Using Local NTP Server

- (1) Use the shortcut key Win + R, enter regedit in the Run window, and open the Registry Editor.
- (2) Expand the items in order:
\\HKEY_LOCAL_MACHINE\\SYSTEM\\CurrentControlSet\\Services\\W32Time\\TimeProviders\\NtpServer, and set Enabled to 1 to turn on the NTP service.

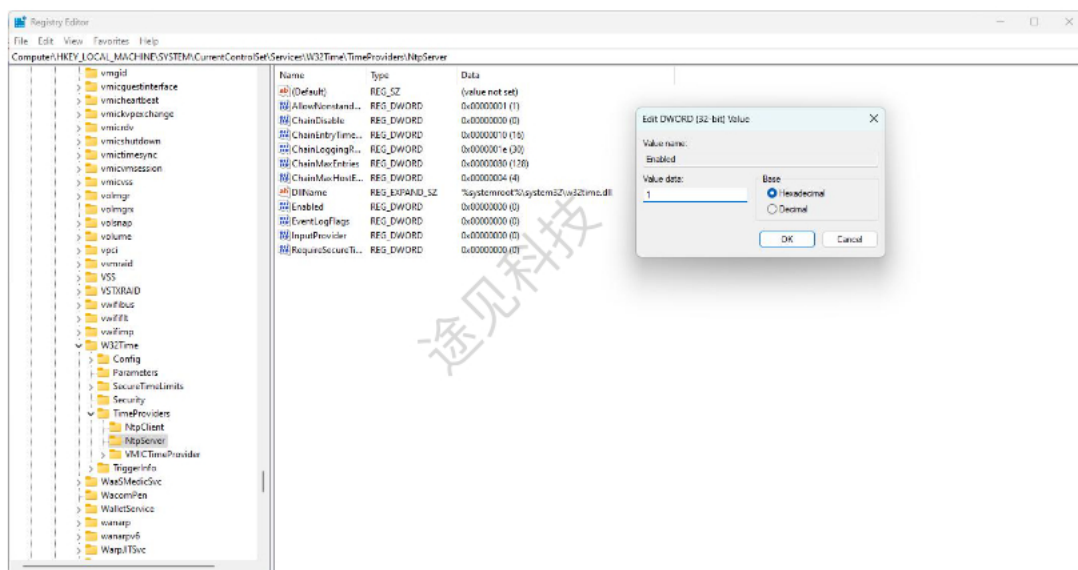


Figure 5 Schematic diagram of opening the NTP server.

(3) Expand the items in order:

\HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\Config, and set the value of AnnounceFlags to 5 (the system default is a).

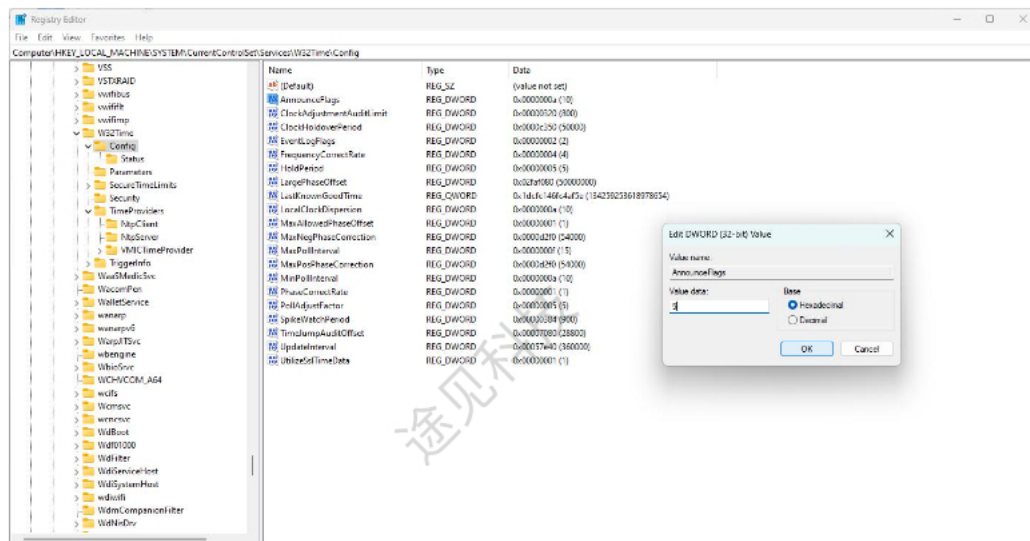


Figure 6 Schematic diagram of setting AnnounceFlags.

(4) Use the shortcut key Win + R, enter services.msc in the Run window to open Services. Find "Windows Time" in the service items, double-click to open it, and set the [Startup type] to Automatic. After setting it to automatic, click OK, right-click, and restart this service. At this point, the service is successfully started.

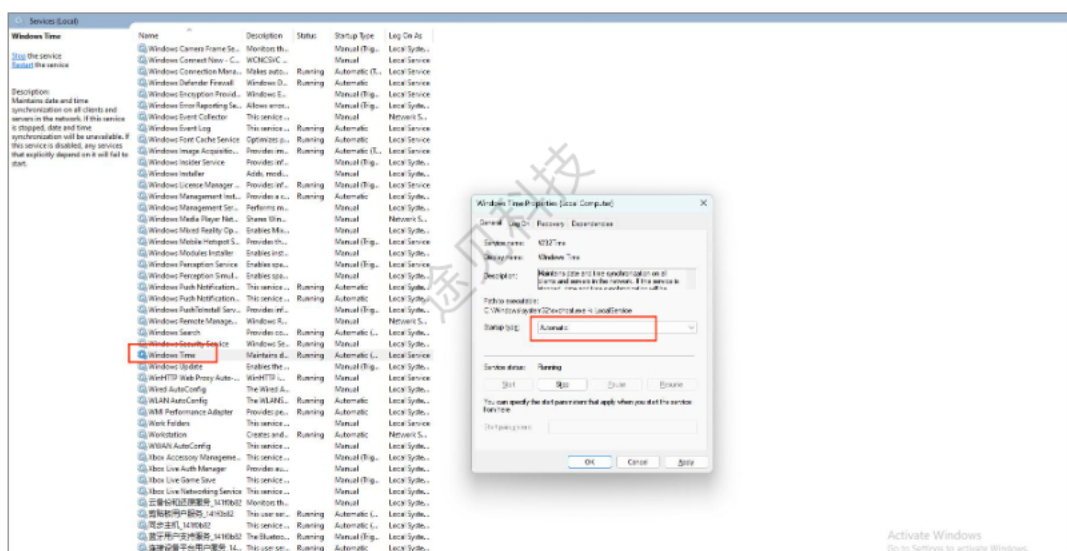
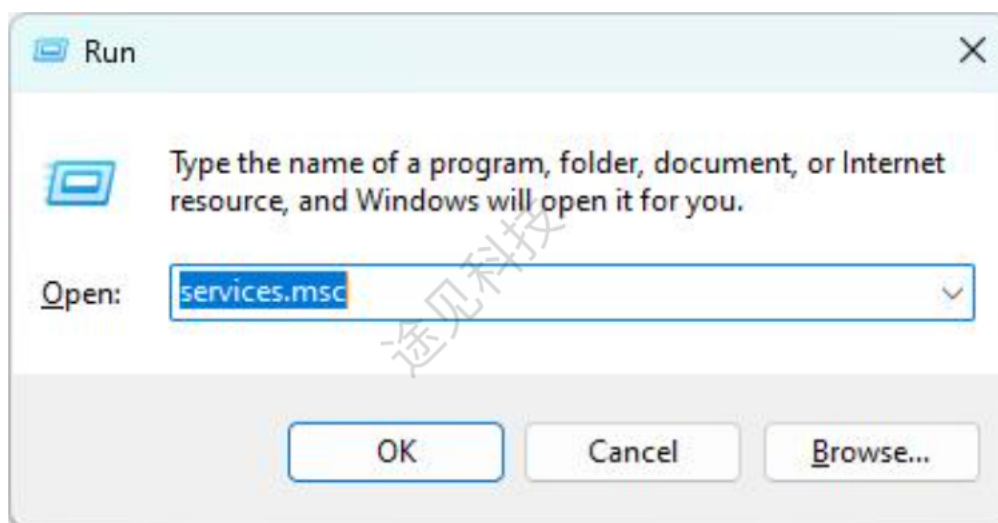


Figure 7 Starting Windows Time.

(5) Enter `w32tm /stripchart /computer:127.0.0.1` in the cmd/Powershell window.

If there is an echo, the service is normal.

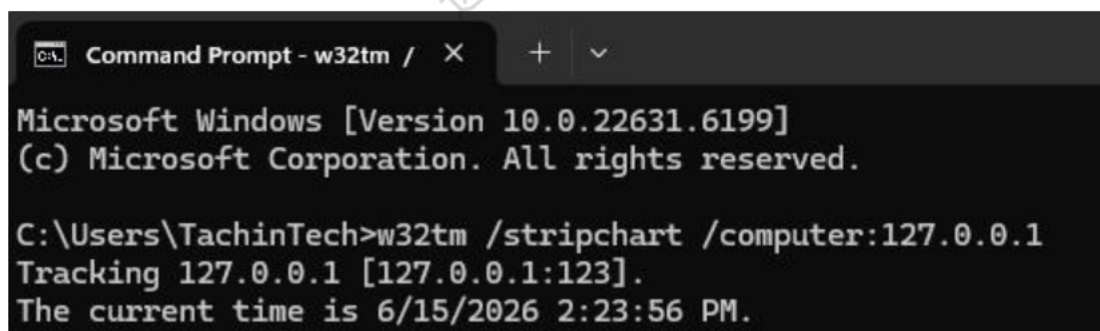


Figure 8 Checking whether the service is normal.

(6) If the device board consistently fails to establish time synchronization with the local NTP server correctly, please try turning off the local firewall.

6 Host Computer Software Installation and Detailed Operation Instructions

6.1 Software Installation

- (1) Double-click the "电子皮肤采集程序-0.x.x-win-x64.exe" (Electronic Skin Acquisition Program) installer, and the installation window will pop up to complete the installation operation.
- (2) You can choose the installation directory and installation user under the installation options.

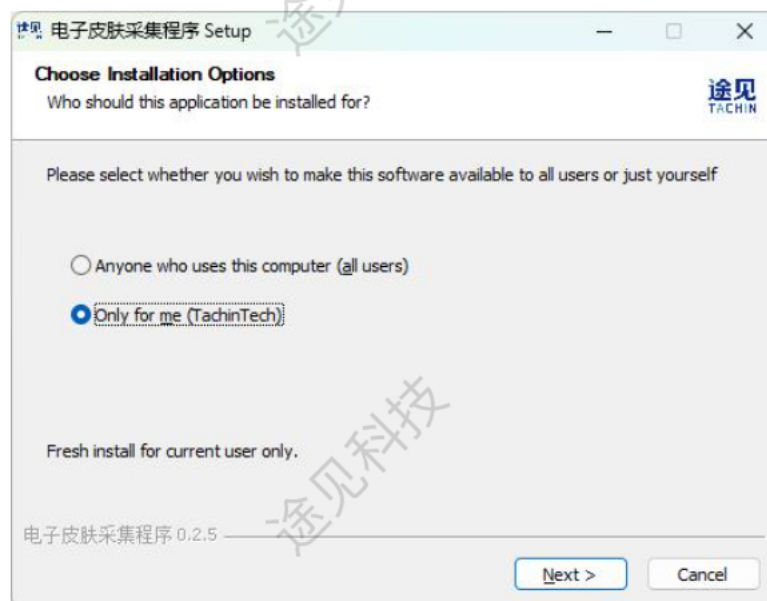


Figure 9 User installation options.

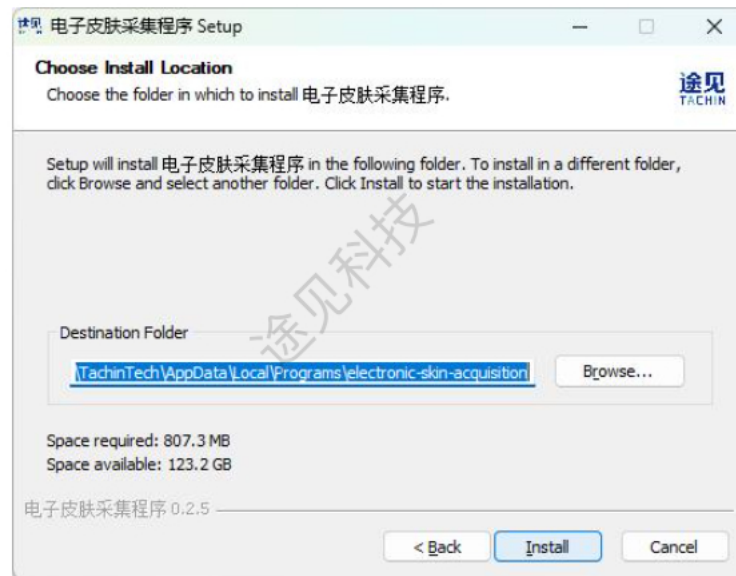


Figure 10 Installation directory options.

6.2 Software Startup

Before starting the software, please insert the U-KEY delivered with the gloves into the PC for software authentication, so that the software can be used normally.

- (1) The installed software can be started through the application list or the desktop shortcut icon.



Figure 11 Software startup method.

- The first time the software is started, it will take a long time due to operations like decompression and compilation; please wait a moment.
- If the main interface of the software does not respond for a long time during loading, you can try to observe whether a backend window resembling a command-line terminal is correctly created and running. If there is an error or the backend window does not pop up correctly, you can try to exit and restart the software.

(2) Main interface program of the software.

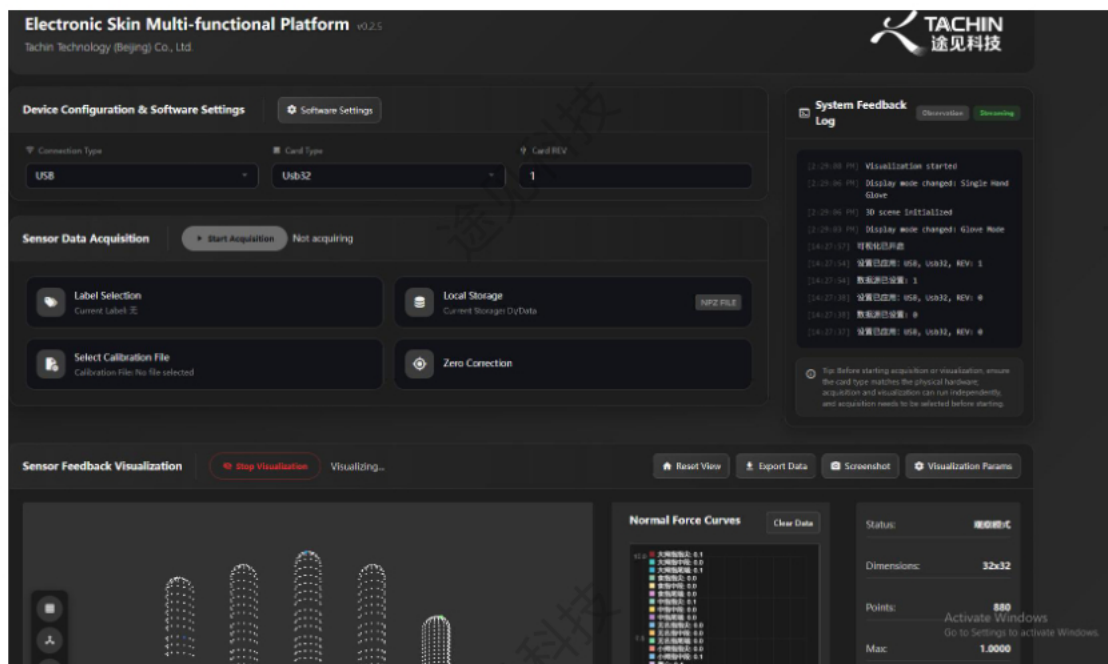


Figure 12 Schematic diagram of the host computer interface.

6.3 Functional Modules

6.3.1 Function Mode Selection

(1) Different function modes can be selected and switched at the bottom of the main program interface. The corresponding function mode must be selected after

the program starts for the first time.

(2) Single-hand glove mode only supports connecting a single glove device at the same time, which can be connected via USB wired or Wi-Fi wireless methods.

(3) Self-developed glove mode supports connecting left and right gloves simultaneously to receive data, and supports an optional headband camera device.

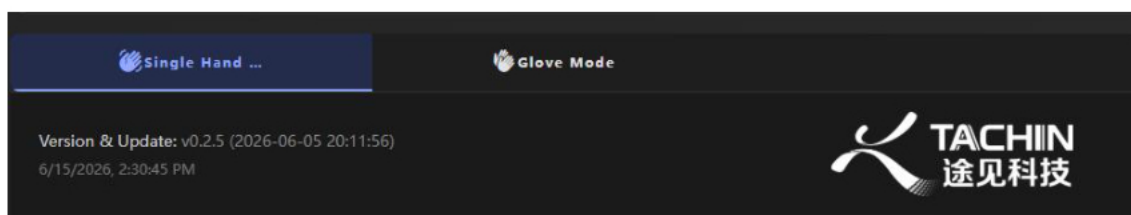


Figure 13 Function mode selection.

6.3.2 Connection Method Configuration

(1) Select the corresponding connection method in the configuration panel according to the connection method corresponding to the acquisition card.

(2) Select the corresponding model according to the type of acquisition card; Usb32 represents 3232, Usb64 represents 6464, and so on. This glove project selects two connection types: Usb32 and Wifi32.

(3) In USB mode, you need to select the acquisition card REV number. The REV number is generally a non-negative integer starting from 0. If a corresponding REV number error prompt is thrown, you can modify it sequentially and try to reconnect. This glove project defaults the left-hand glove to 0 and the right-hand glove to 1. If the device is not connected (including not connected or not recognized by Windows) or the REV number is set incorrectly, there will be a corresponding prompt.

If the driver is not updated as described previously, there will be a corresponding prompt to install using zadig, at which point the driver should be updated to

"EZ-USB".

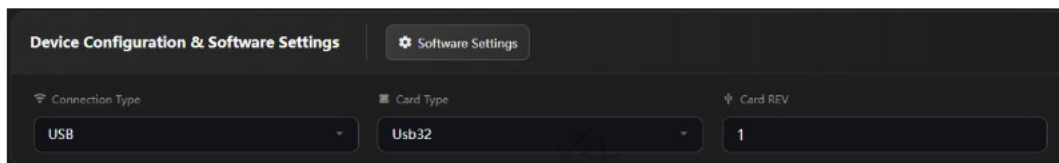


Figure 14 Schematic diagram of USB connection method configuration.

(4) In Wi-Fi mode, you need to select the device IP address and port number. If using this glove device for the first time in the current network environment, please refer to the first part for corresponding settings to obtain the corresponding IP address. The port number for this project is currently fixed at 3333. If the IP address and port number are set incorrectly, a timeout prompt will appear after trying acquisition or visualization connection.

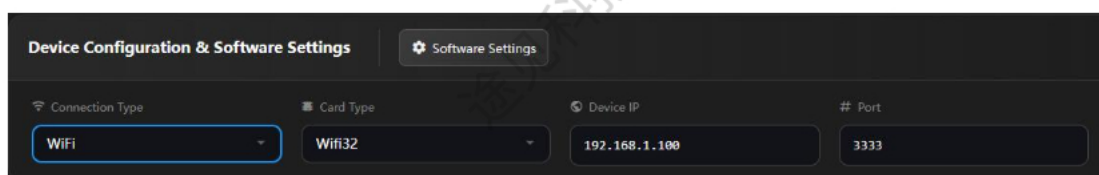


Figure 15 Schematic diagram of Wi-Fi connection method configuration.

(5) In the self-developed glove function mode, the connection methods of multiple devices need to be configured. The specific configuration process is similar to that of the single-hand glove, and configurations can be made for different devices such as the left and right hands. If the self-contained camera headband section provided by the project is required, IP configuration must also be performed here to transmit data via RTSP stream. The default port is 8554.

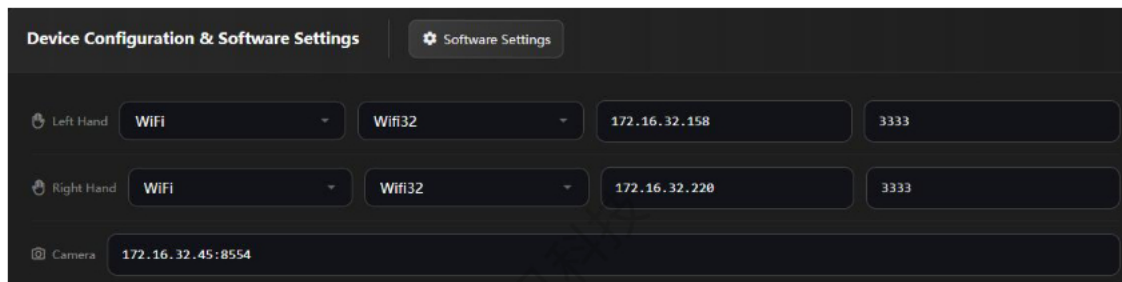


Figure 16 Schematic diagram of single-set device connection method configuration for self-developed gloves.

6.3.3 Data Acquisition and Configuration

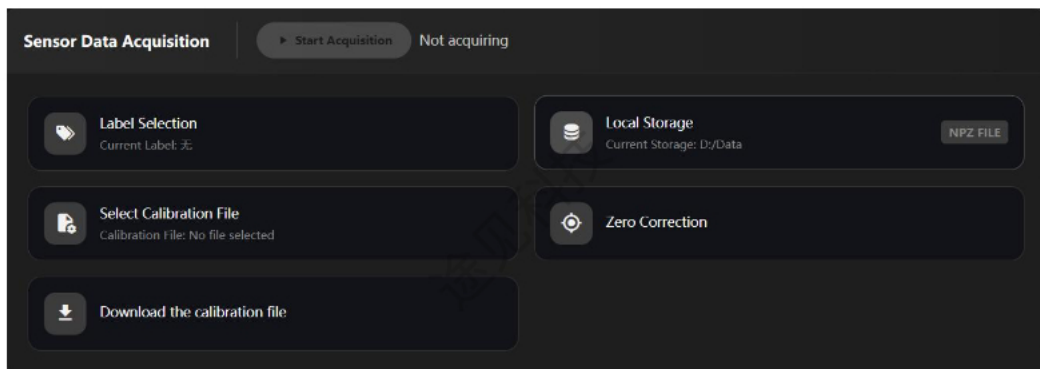


Figure 17 Schematic diagram of data acquisition and configuration.

(1) "Local Storage" is a required option for data collection, used to configure the data storage method and saving path. Currently, the glove project data can be stored in either NPZ or CSV format, which you can select based on your requirements.

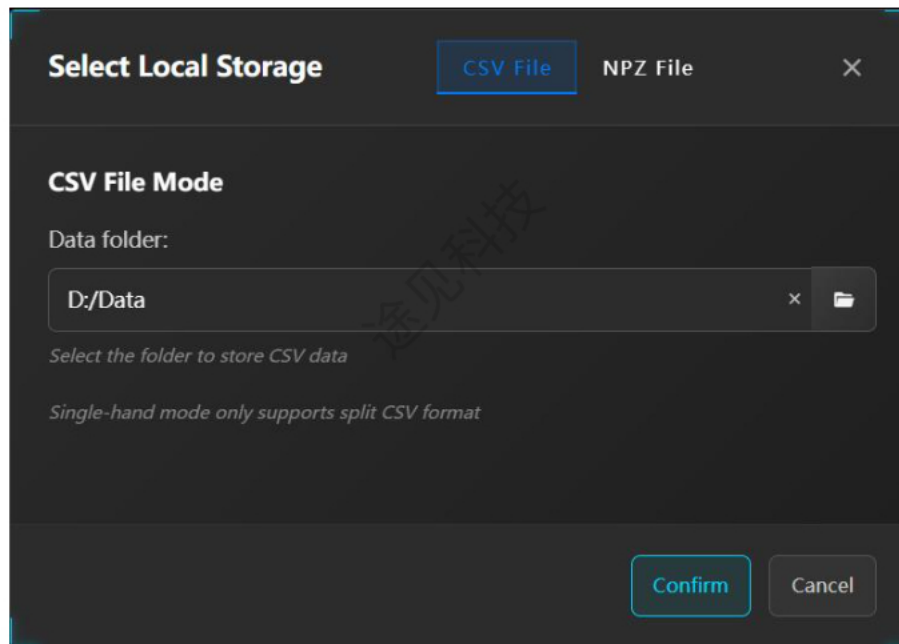


Figure 18 Data storage settings panel in NPZ format.

(2) "Select Calibration File" is an optional configuration, allowing you to select different calibration files for the sensors to make corresponding corrections. Select the file in the panel. In the calibration mode, you can choose between two calibration modes: single-file (single glove) and multi-file (both gloves). The latter can simultaneously set different calibration files for the left and right hands. If not selected, the default calibration file will be used.

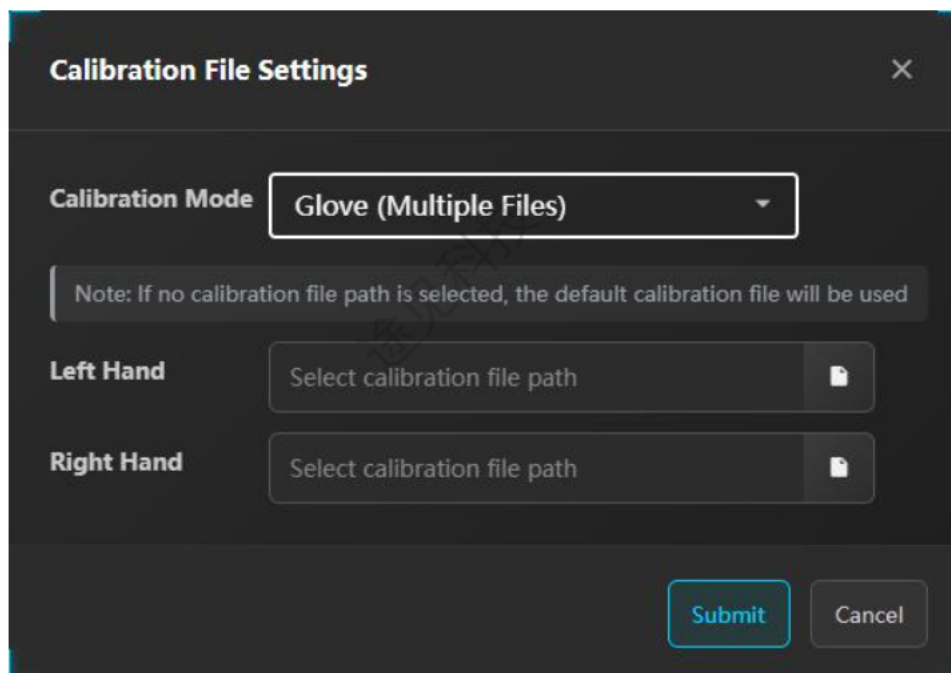


Figure 19 Data storage settings panel in NPZ format.

(3) "Zero-point Correction" is an optional configuration. It can be turned on during data acquisition or visualization to eliminate interference factors such as zero-point noise.

(4) Download Calibration File: Users can download the calibration file by directly entering the glove ID number, which can be found on the label located on the inner wrist of the glove.

(5) Click the "Start Acquisition" button to begin acquisition. If the status on the right shows "Acquiring", it means the data is being correctly acquired. Click the "Complete Acquisition" status button again to end the acquisition.

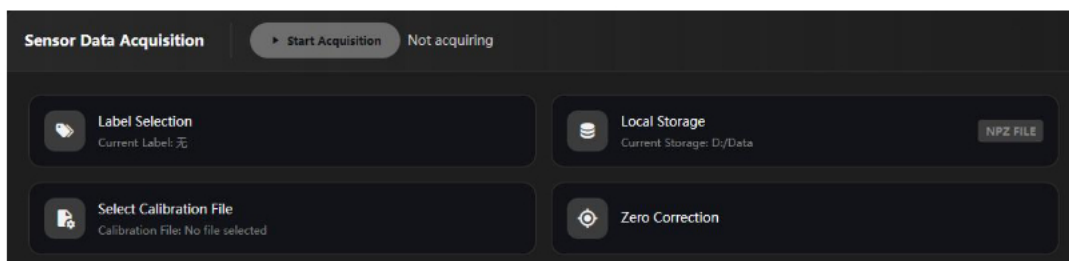


Figure 20 Schematic diagram of data acquisition status.

6.3.4 Visualization Configuration

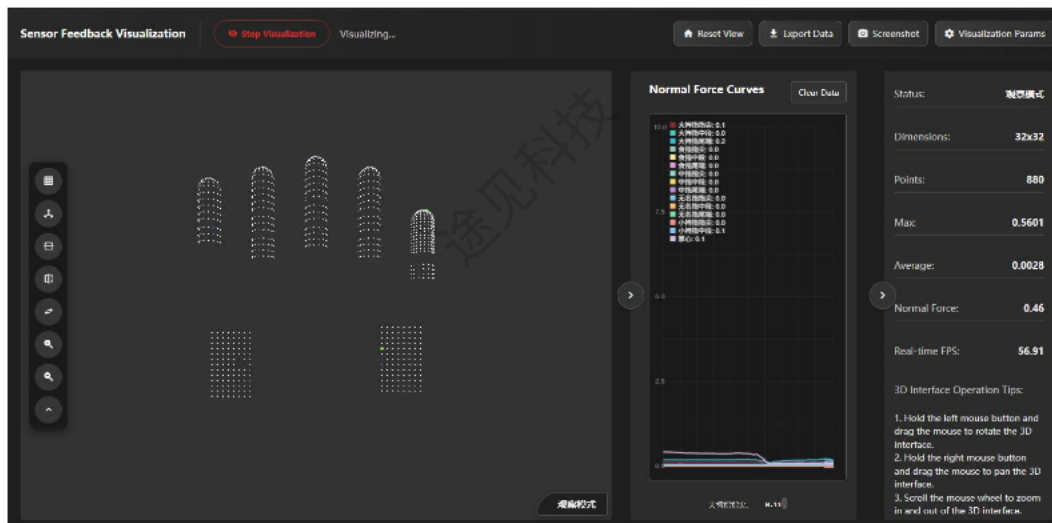


Figure 21 Schematic diagram of single-hand glove data visualization panel.

- (1) Click the "Start Visualization" button to begin visualization.
- (2) Visualization and data acquisition can be clicked to run individually, or they can be turned on and run simultaneously.
- (3) Single-hand glove mode: The leftmost main panel is a 3D point cloud display, which can reflect the pressure of each point through color, and can also reflect the tangential force direction of each point through the arrow direction. The operation panel on the left of the main panel can adjust part of the visualization effects of the point cloud in the current 3D space. The visualization parameter settings at the top right can correspondingly set display parameters, such as frame rate, left/right hand, etc.

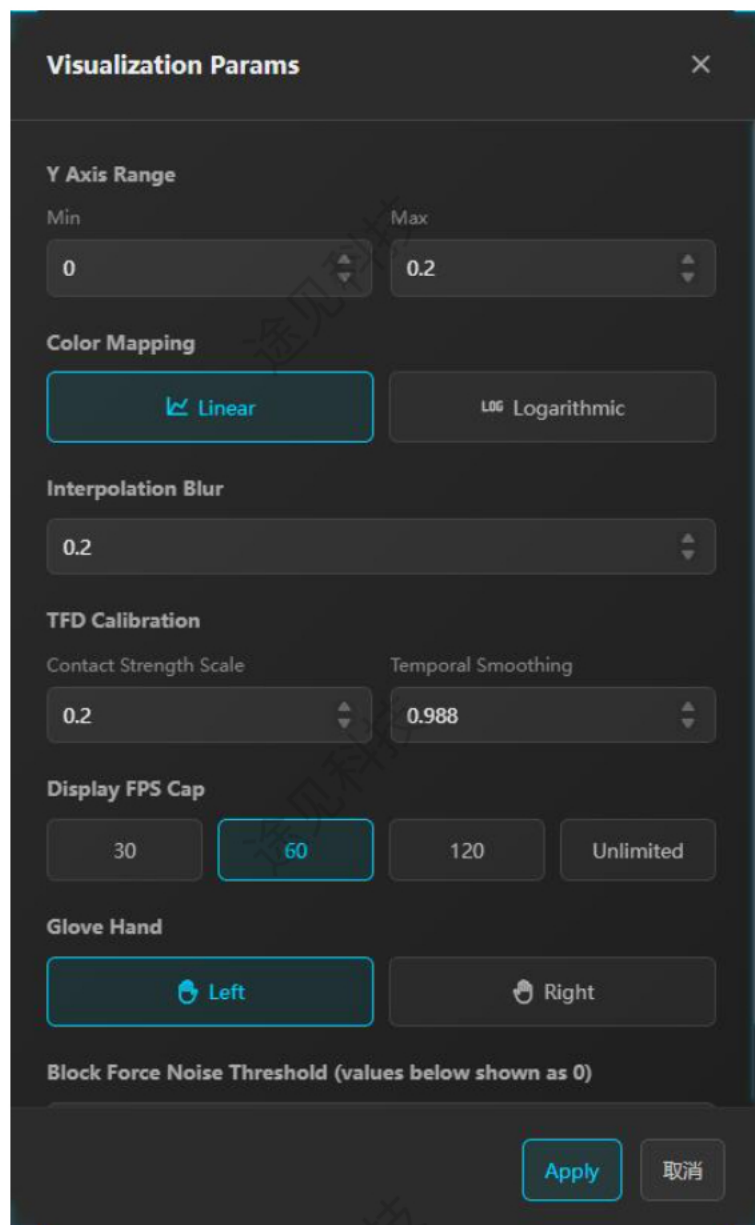


Figure 22 Single-hand glove visualization parameter settings.

(4) Self-developed glove mode: The left and right columns are the visualization panels for the left-hand and right-hand devices respectively. The upper side is the heatmap display of the 3D point cloud, and the lower side is the real-time display of the normal force curve for each partition. In the upper right corner, you can set the types of data panels to show or hide (heatmap, normal force curve, and video data) through the "+" and "-" icons.

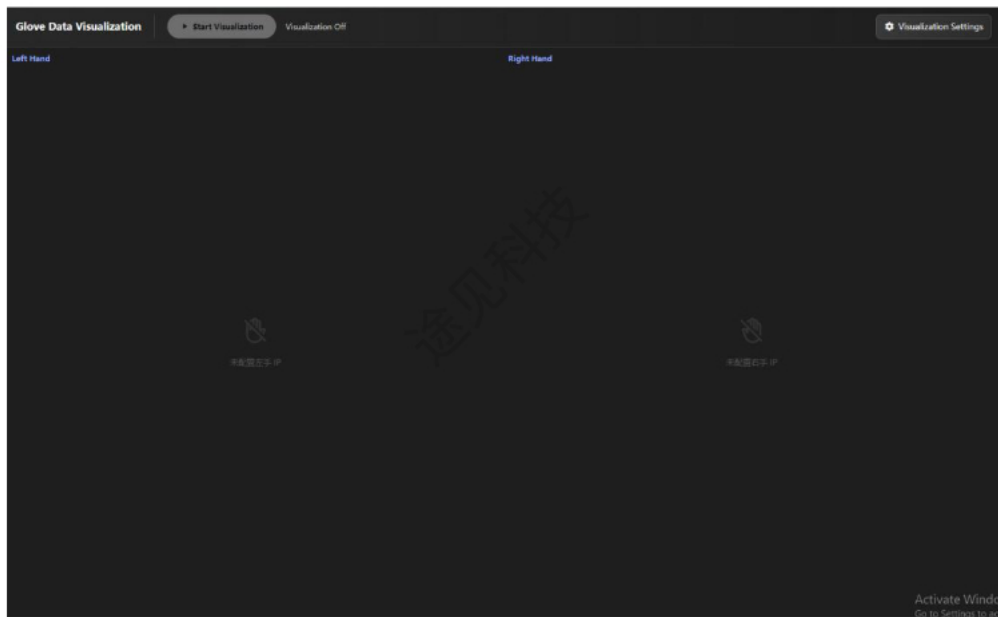


Figure 22 (Repeated) Schematic diagram of self-developed glove visualization panel.

(5) The middle panel shows the current normal force curves and normal force magnitudes for each partition. The right panel shows the real-time display of various data information. Both panels can be expanded or hidden.

(6) Clicking the "Visualization Parameters" configuration button at the top right of the panel or the gear icon (visualization settings) to the right of the "Start Visualization" button will pop up the corresponding panel to adjust the visualization effects of the raw data. After adjustment, click Apply to save and apply the corresponding changes in real time.

- Y-axis Range: Represents the sensitivity range of the current visualization. The smaller the upper and lower limit ranges, the more sensitive it is.
- Linear and Logarithmic Mapping Modes: Represent the correspondence between data visualization and color range.
- Interpolation Blur Coefficient: Represents the applied Gaussian blur coefficient.
- Max Display Frame Rate: Can set the fixed maximum frame rate for rendering in the current visualization main panel 3D space.

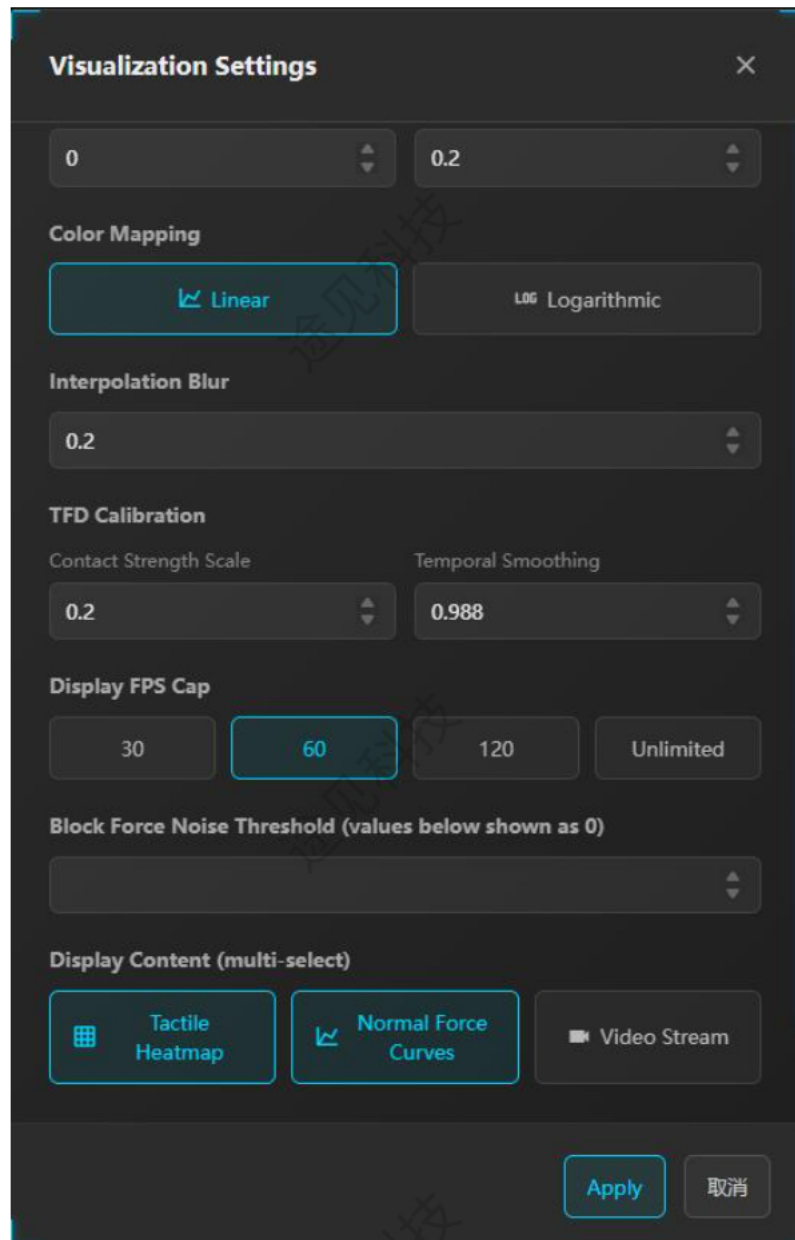


Figure 23 Schematic diagram of visualization parameter configuration panel.

(7) The toolbar panel on the left of the 3D main panel can adjust parameters such as camera perspective, rendering position, and orientation in the 3D coordinate system. Among them, the three options "Flip Vertically", "Flip Horizontally", and "Swap XY Axes" can adjust the rendered image to achieve operations like axis symmetry or rotation.

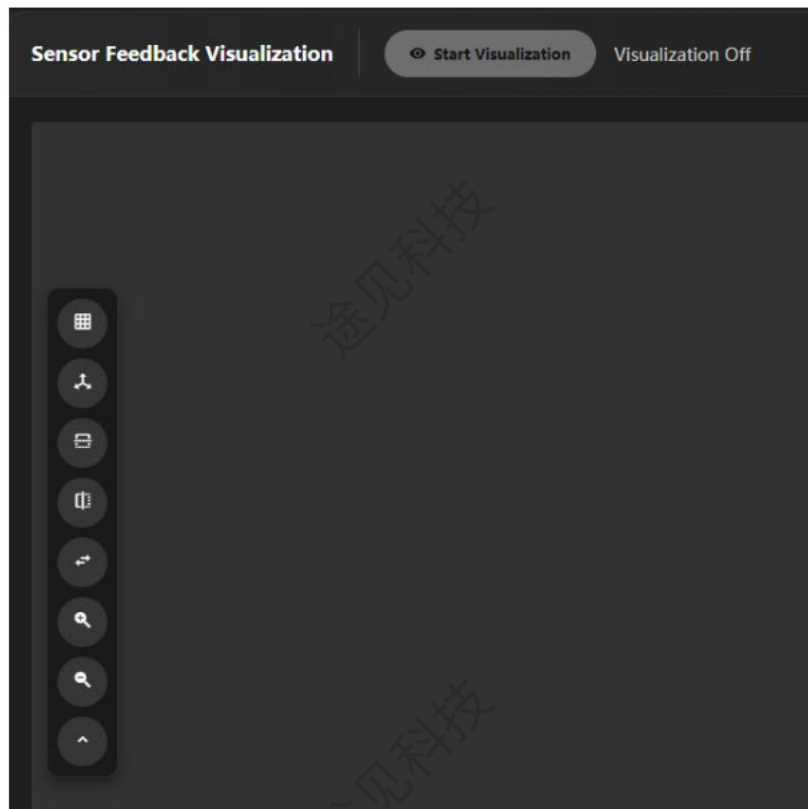


Figure 24 Schematic diagram of 3D main panel toolbar.

7 Precautions

- Device Protection
 - The device is a precision electronic device; avoid collision, dropping, and squeezing.
 - Avoid contact with water, oil, and corrosive liquids to prevent device damage or sensor failure.
 - Avoid using it in environments with high temperature, low temperature, high humidity, or heavy dust.
- Glove Use
 - When wearing tactile gloves, avoid pulling them forcefully.
 - Avoid sharp objects scratching the glove surface to prevent sensors from falling off or being damaged.

- The wearing time should not be too long (recommended to rest for 10 minutes every 1-2 hours) to avoid compressing the hands and affecting blood circulation.
- Data Acquisition
 - Ensure that the acquisition area is well-lit and the background is simple.
 - Avoid direct strong light shining into the camera lens, and avoid the hands being blocked.
 - Otherwise, it will affect motion capture accuracy and tactile data acquisition effects.
- Charging and Maintenance
 - The matching charging cable must be used; avoid using non-original charging equipment.
 - Avoid touching the device during charging to prevent short circuits or overheating.
 - Lithium batteries need to be charged regularly (recommended to charge at least once a month) to avoid long-term low battery levels leading to battery damage.
- Software and Maintenance
 - PC-side software needs to be updated regularly to ensure compatibility with the device.
 - When the device malfunctions, do not disassemble and repair it yourself; you should contact after-sales service personnel for handling.
 - After data acquisition is complete, turn off the device power in a timely manner, organize the device components, and place them in a dry, ventilated environment for storage.

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