

PhotonLabeling

User Manual

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Content

1 Operating Environment	3
2 Software Installation	3
3 Software Uninstallation.....	3
4 Software Functional Modules	4
4.1 Function Overview.....	4
4.2 Input Data.....	5
4.3 Software Input Data	5
4.4 Software Function.....	6
4.4.1 Menu.....	6
4.4.2 Toolbar.....	10
4.4.3 Quick Settings.....	12
4.4.4 View Interaction Window	14
4.4.5 Data Information Window.....	15
4.4.6 Labeling Data Window.....	16
4.4.7 Operation Log Window	19
4.4.8 Point Information Display Function	21
4.4.9 Point Selection and Labeling Function.....	22
4.4.10 Rectangular Selection and Labeling Function.....	23
4.4.11 Elliptical Selection and Labeling Function.....	23
4.4.12 Line Selection and Labeling Function.....	24
4.4.13 Scatter Size Adjustment Function	25

1 Operating Environment

This software supports operation on Windows 7 or higher versions of the operating system. In terms of hardware requirements, a processor supporting 64-bit architecture (at least a dual-core CPU) is recommended, with a minimum of 4 GB RAM (8 GB or higher recommended), and ensure at least 1 GB of available hard disk space.

2 Software Installation

This software has packaged all dependent environments, eliminating the need for users to install any additional dependencies. Users only need to download the compressed package (such as .zip or .tar.gz) suitable for their operating system from the release page and then extract it to a specified directory. After extraction, users can directly run the executable file (such as PhotonLabeling.exe) in the extracted folder to start the software and begin using it without any additional configuration or installation.

3 Software Uninstallation

If users no longer need to use this software, they can uninstall it by deleting the folder where the software is located. Simply manually delete the downloaded and extracted software folder, which contains all the software files and data. Additionally, if the software generated configuration files or temporary data files during use, users can choose to manually delete these files. Since all dependent environments are packaged within the software, there is no need to clean up any system environments or additionally installed dependency libraries during the uninstallation process.

4 Software Functional Modules

4.1 Function Overview

This software is primarily used for the labeling and visualization of point cloud data, supporting users in performing interactive data operations through a graphical interface. The core functions of the software include data import and export, selection and labeling of point cloud data, and visual display of the data. Users can perform operations such as point selection, rectangular selection, elliptical selection, and line selection using the mouse to label point cloud data, facilitating subsequent data analysis and processing. The software also supports interactive functions such as zooming and panning, allowing users to flexibly adjust the view to examine data in different ranges. Furthermore, the software provides an operation log and data table to assist users in recording the operation process and viewing data labels in real time. Through simple and intuitive operations, users can quickly complete data labeling tasks, improving work efficiency.

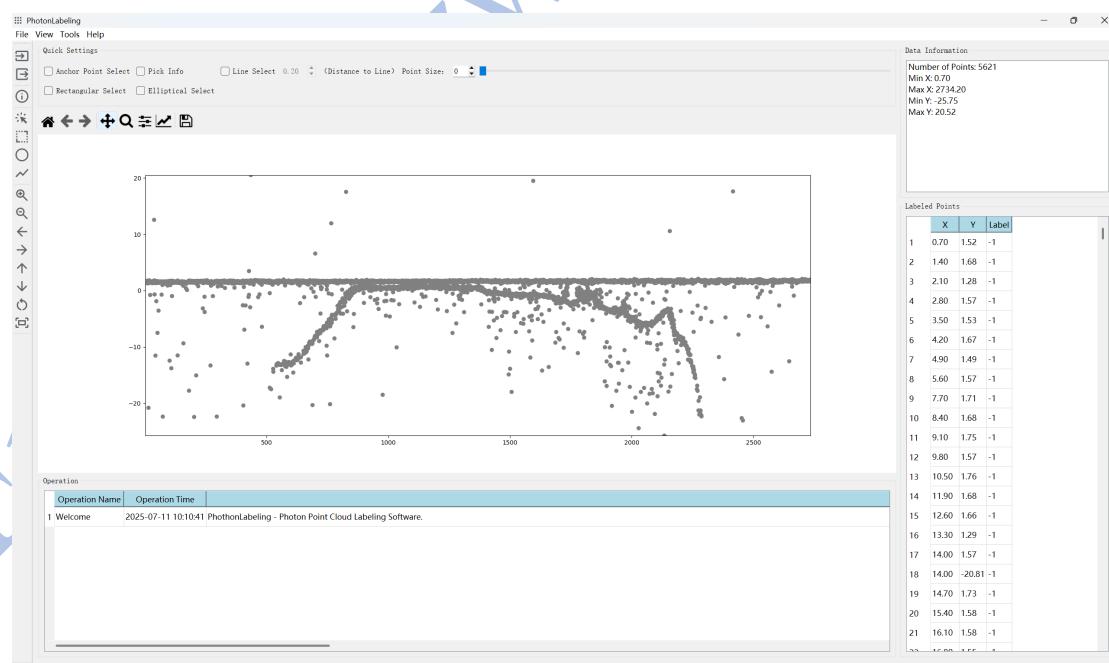


Figure 1 Main Interface of the Software

4.2 Input Data

This software supports importing point cloud data via CSV format files. The first column of the CSV file represents the X coordinate, and the second column represents the Y coordinate. When importing data, users can select specific columns from the CSV file to serve as the X and Y coordinates, and the software will automatically read and display the data. Each row in the data represents the coordinates of a point, allowing users to interactively label these points through the visualization interface for further data analysis. The software supports importing CSV files with existing labels and will display these labels accordingly.

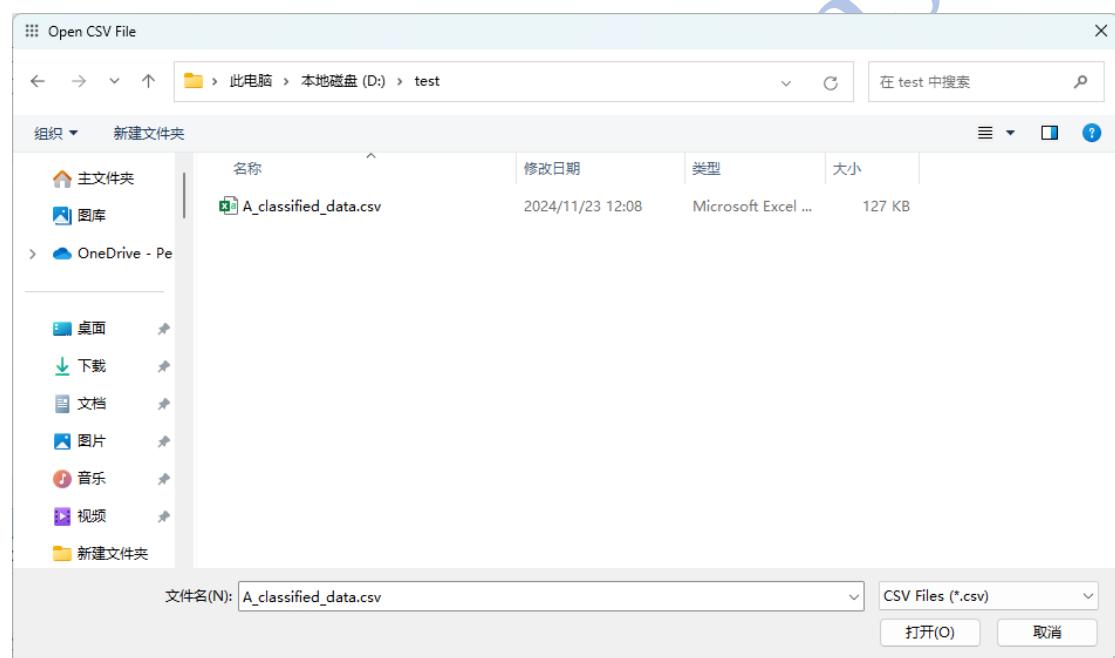


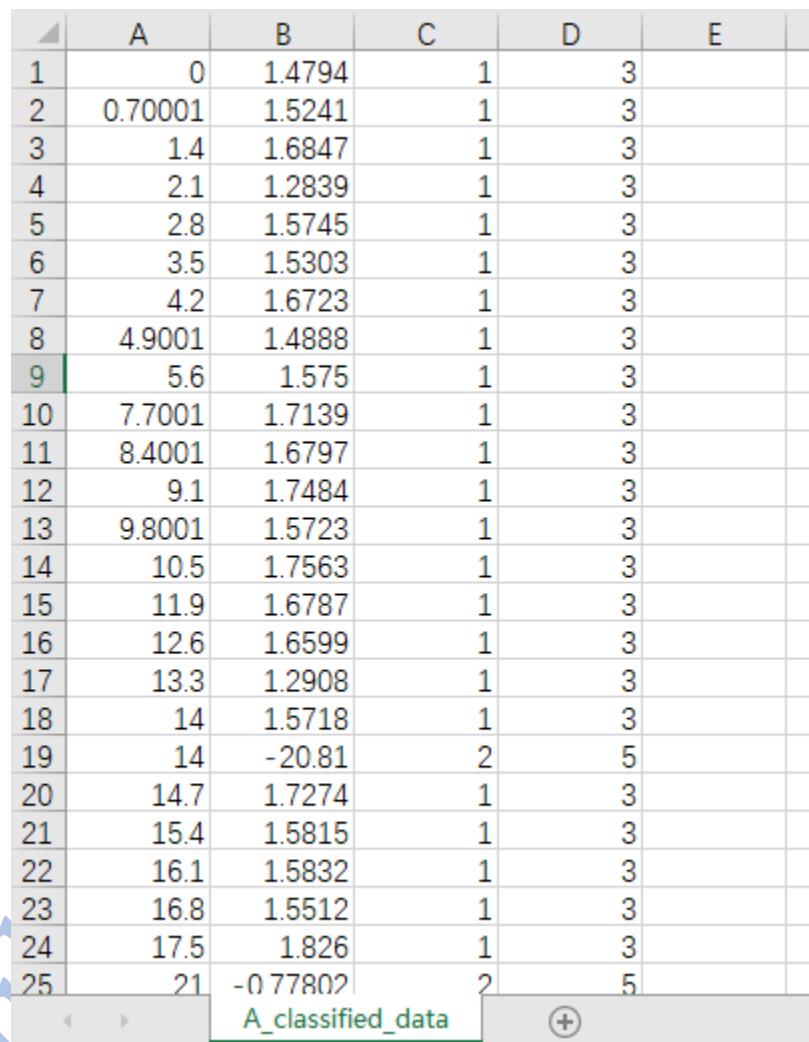
Figure 2 Software Data Opening and Input

4.3 Software Input Data

This software supports importing data via CSV format files. The input data typically includes two-dimensional coordinates, with the first column representing the X coordinate, the second column the Y coordinate, and additional columns potentially containing supplementary attribute information (such as labels, timestamps, etc.). Users can select specific columns as the X and Y coordinates as needed, and the software will visualize the data accordingly.

The format of the software's input data is as follows:

- (1) First column of the template: X coordinate data;
- (2) Second column of the template: Y coordinate data;
- (3) Third column of the template: Label attribute 1;
- (4) Fourth column of the template: Label attribute 2.



	A	B	C	D	E
1	0	1.4794	1	3	
2	0.70001	1.5241	1	3	
3	1.4	1.6847	1	3	
4	2.1	1.2839	1	3	
5	2.8	1.5745	1	3	
6	3.5	1.5303	1	3	
7	4.2	1.6723	1	3	
8	4.9001	1.4888	1	3	
9	5.6	1.575	1	3	
10	7.7001	1.7139	1	3	
11	8.4001	1.6797	1	3	
12	9.1	1.7484	1	3	
13	9.8001	1.5723	1	3	
14	10.5	1.7563	1	3	
15	11.9	1.6787	1	3	
16	12.6	1.6599	1	3	
17	13.3	1.2908	1	3	
18	14	1.5718	1	3	
19	14	-20.81	2	5	
20	14.7	1.7274	1	3	
21	15.4	1.5815	1	3	
22	16.1	1.5832	1	3	
23	16.8	1.5512	1	3	
24	17.5	1.826	1	3	
25	21	-0.77802	2	5	

Figure 3 Input Data Format

4.4 Software Function

4.4.1 Menu

The software's menu is designed to be concise and intuitive, primarily categorized as follows:

1. **File Menu (File):**

◦ **Open Data (Open):** Imports CSV file data. Users can select the data file and specify which columns to use as X and Y coordinates.

◦ **Save Data (Save):** Saves labeled point cloud data as a CSV file, including X/Y coordinates and label information.

2. View Menu (View):

◦ **Info:** Displays detailed information (e.g., coordinates, labels) of the currently selected point(s) with interactive viewing capabilities.

3. Tools Menu (Tools)

◦ **Zoom In:** Magnifies the view for detailed inspection.

◦ **Zoom Out:** Reduces magnification to view a broader data range.

◦ **Move Left/Right/Up/Down:** Navigates the viewport to explore different data regions.

◦ **Click Select:** Allows single-point selection by clicking on the point cloud.

◦ **Box Select:** Enables rectangular area selection for data filtering or labeling.

◦ **Oval Select:** Enables elliptical area selection for irregular-shaped regions.

◦ **Line Select:** Selects points along a drawn line, useful for path-based data selection.

4. Help Menu (Help):

◦ **About:** Provides basic software information (version, developer contact) to assist users in understanding the software's background and support resources.

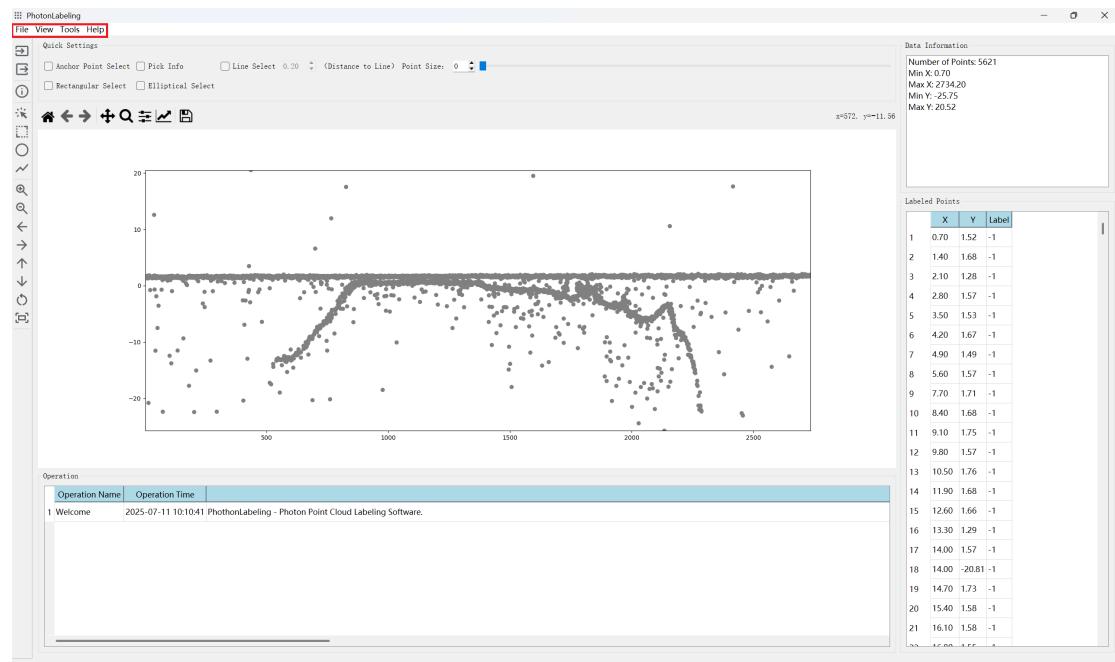


Figure 4 Software Menu (as shown in the red box)

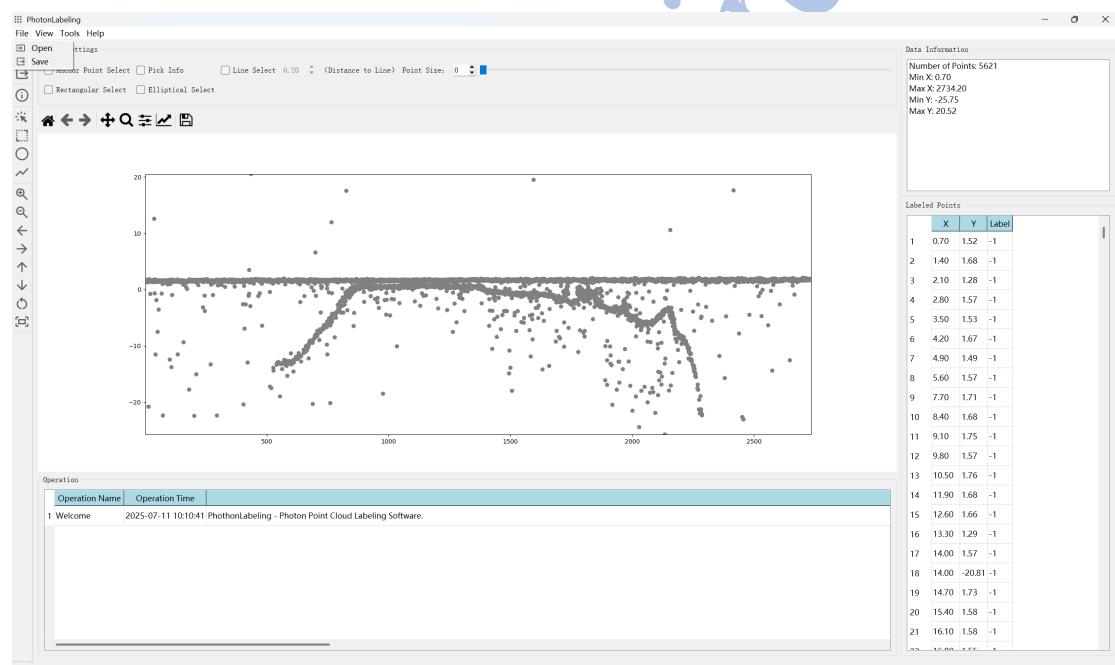


Figure 5 Software "File" Menu

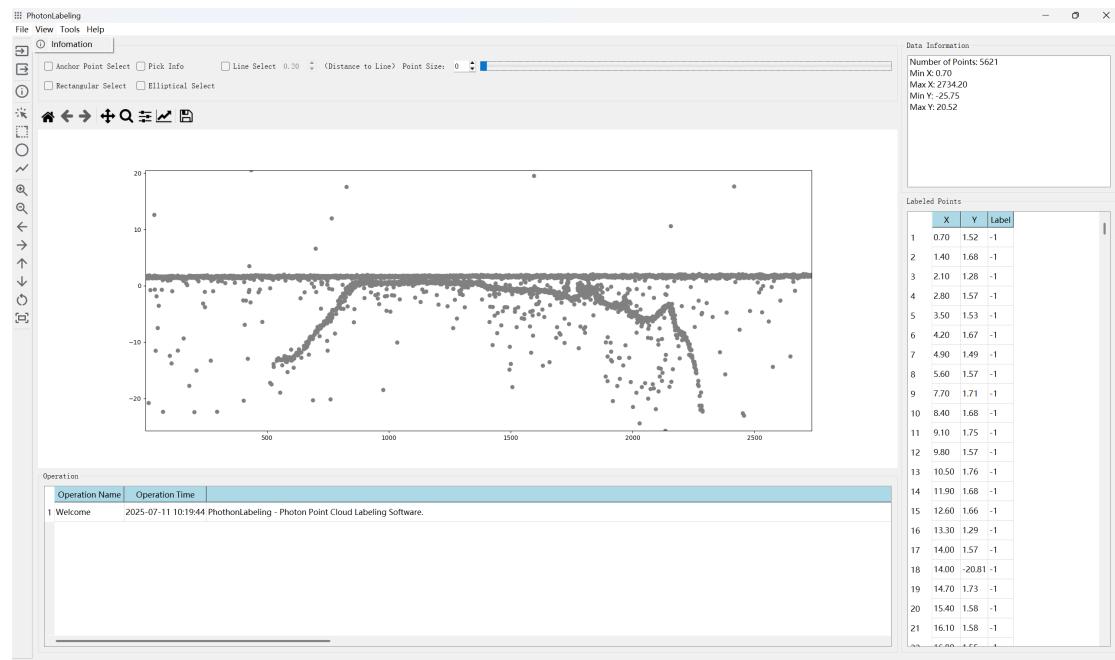


Figure 6 Software "View" Menu

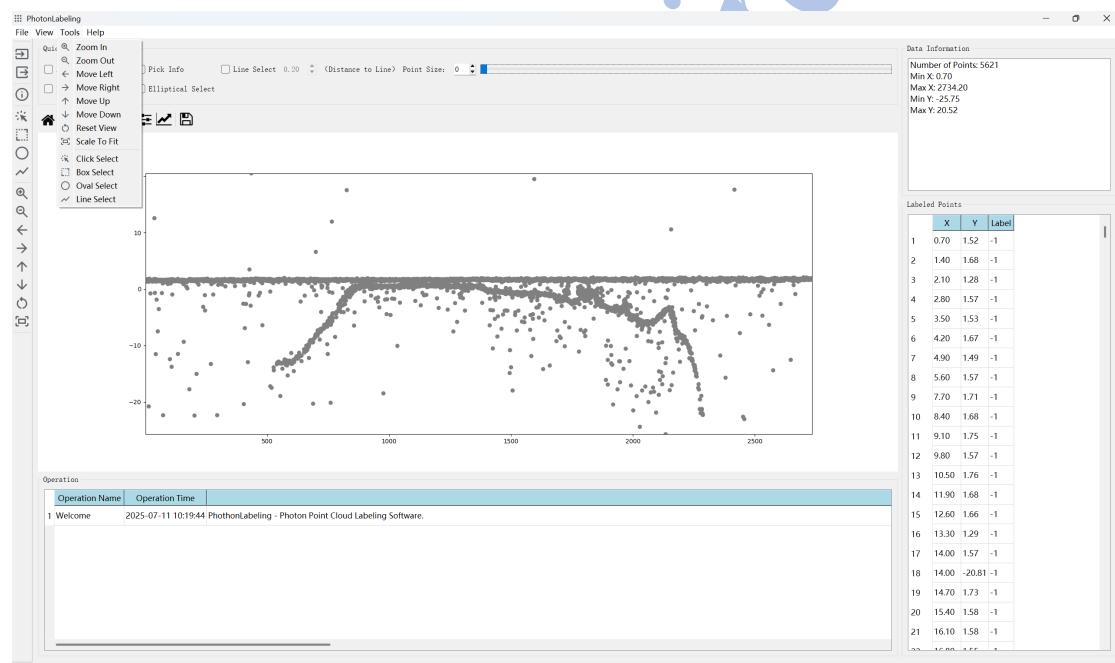


Figure 7 Software "Tools" Menu

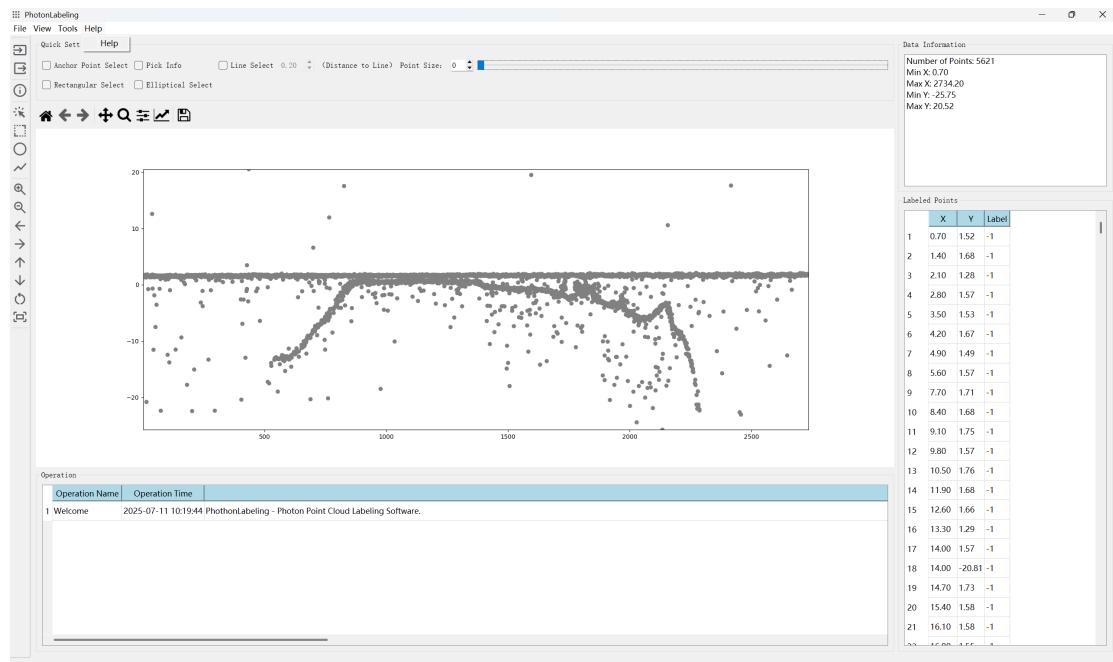


Figure 8 Software "Help" Menu

4.4.2 Toolbar

The software toolbar provides convenient shortcut buttons for quick access to frequently used functions, enhancing operational efficiency. The toolbar includes the following categories of commonly used function buttons:

1. **Zoom In Button:**
 - This button magnifies the current view, allowing users to inspect data details. Clicking it reduces the displayed range, focusing on the central area of the data.
2. **Zoom Out Button:**
 - This button reduces magnification to show a broader data region. Clicking it expands the display range for an overview of the entire dataset.
3. **Move Left Button:**
 - Clicking this button shifts the viewport leftward to explore the left-hand data region.
4. **Move Right Button:**
 - This button shifts the viewport rightward to display the right-hand data region.

5. Move Up Button:

- Clicking this button shifts the viewport upward to view the upper data region.

6. Move Down Button:

- This button shifts the viewport downward to access the lower data region.

7. Anchor Point Select Button:

- Activates point-selection mode, enabling users to click individual points for labeling or data manipulation.

8. Rectangle Select Button:

- Enables rectangular selection. Users can drag the mouse to define a rectangular area, quickly selecting all points within.

9. Elliptical Select Button:

- Activates elliptical selection for irregularly shaped regions. Users can drag to define an elliptical area for data selection.

10. Line Select Button:

- Enables selection of points along a drawn line, useful for path-based data filtering. Points within a predefined proximity to the line are selected.

Each toolbar button corresponds to a core software function, allowing users to switch between operational modes swiftly, thereby streamlining workflows and improving productivity.

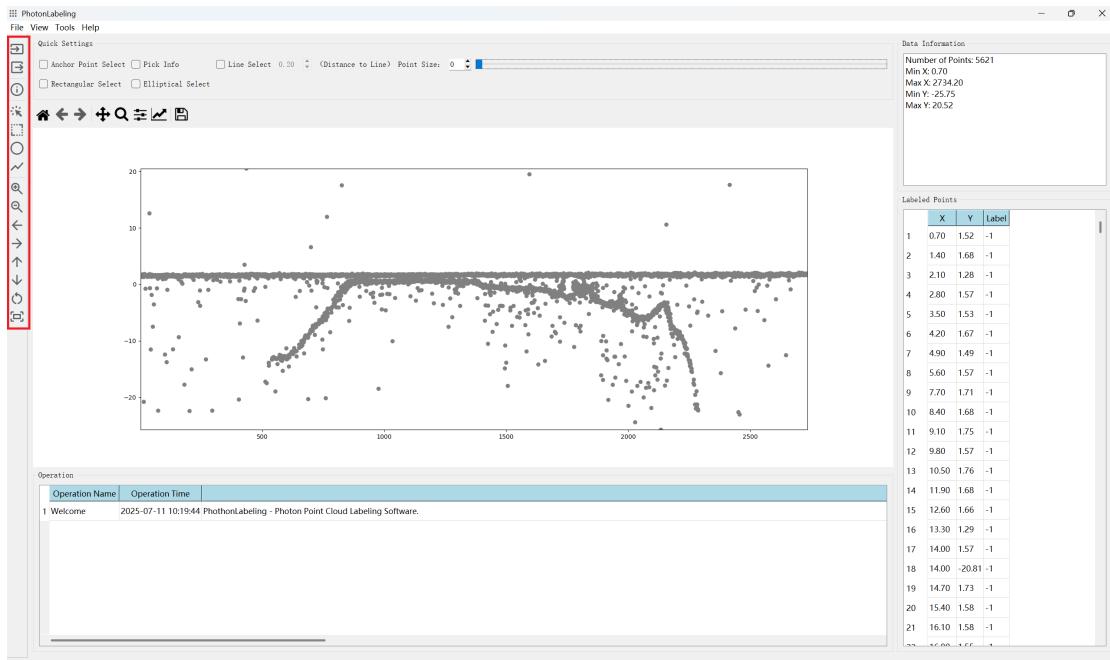


Figure 9 Software Toolbar (as shown in the red box)

4.4.3 Quick Settings

The software's Quick Settings area provides rapid access buttons and options for commonly used functions, enabling users to operate and configure the software more efficiently. Key functions include:

1. Anchor Point Select:

- Enables direct point selection and labeling by clicking on data points. Ideal for precise, single-point operations.

2. Rectangle Select:

- Activates rectangular area selection. Drag the mouse to define a rectangle, quickly selecting all points within for bulk labeling or filtering.

3. Elliptical Select:

- Allows selection of irregularly shaped regions via elliptical bounding boxes. Drag to draw an ellipse and select enclosed points.

4. Line Select:

- Enables path-based selection by drawing a line. Points within a configurable proximity to the line are automatically selected, useful for linear features (e.g., roads).

5. Pick Info:

- Toggles detailed information (e.g., coordinates, labels) when clicking points. Displays numeric data in real-time upon selection.

6. Distance to Line:

- Sets a distance threshold for line selection. Points closer to the drawn line than the threshold are selected. Adjust the threshold via a rotary control.

7. Point Size:

- Dynamically adjusts the visual size of data points for improved clarity. Sliding left/right decreases/increases point diameter.

The Quick Settings area centralizes essential controls, allowing users to swiftly switch between selection modes and parameters. This flexibility streamlines workflows, enhancing efficiency for tasks like targeted selection, region-based filtering, and real-time visualization adjustments.

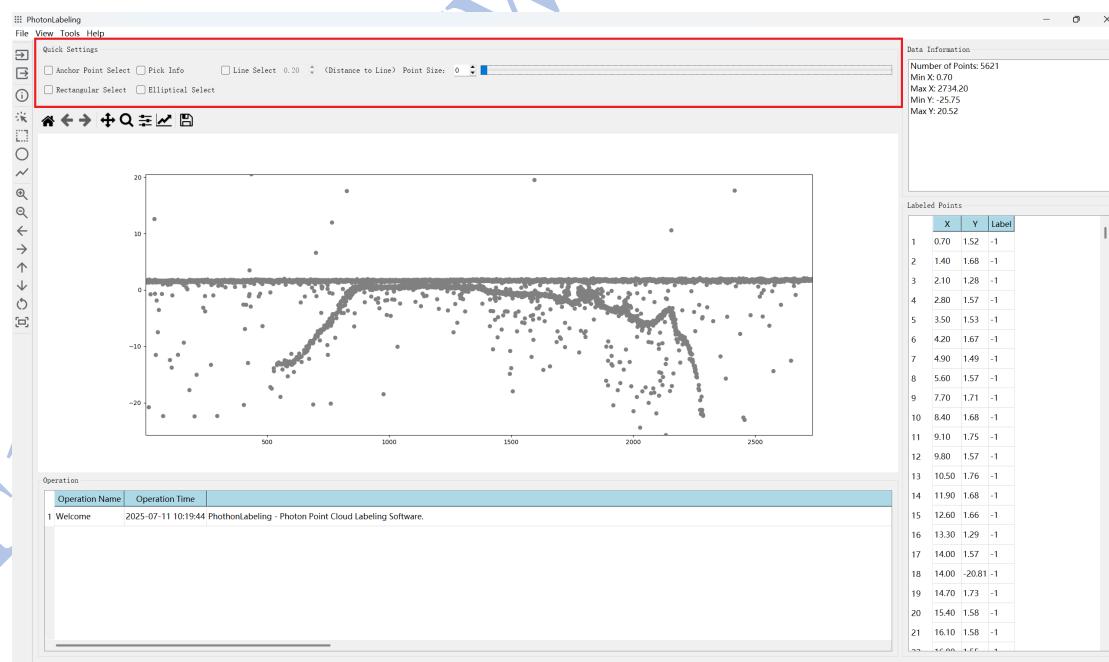


Figure 10 Software Quick Settings (as shown in the red box)

4.4.4 View Interaction Window

The View Interaction Window serves as the core visualization area of the software, enabling users to intuitively view, manipulate, and analyze imported data. Beyond basic data display, it integrates multiple interactive functions to facilitate efficient data selection, labeling, and analysis. Key features include:

1. Data Visualization:

- Displays imported point cloud data as a scatter plot, allowing users to observe data distribution and grasp the overall structure at a glance.

2. Interactive Zoom (Zoom In/Zoom Out):

- Users can zoom in/out using the mouse wheel or toolbar buttons to examine fine details or a broader data range, ensuring flexible focus on specific regions or global overviews.

3. Panning (Pan):

- By holding the left mouse button and dragging, users can pan the view to navigate across large datasets, enabling seamless exploration of different data segments.

4. Point Selection and Labeling:

- Supports multiple selection modes: single-point click, rectangular/elliptical area drag, and line-based selection. Selected points can be labeled or modified, catering to diverse selection needs.

5. Dynamic Updates:

- The view refreshes in real time with user operations, such as adjustments to point size, selected regions, or label updates, ensuring users always see the latest results.

6. Auxiliary Annotation and Information Display:

- Detailed point information (e.g., coordinates, labels) is displayed when a point is selected, providing immediate access to attributes critical for accurate labeling and analysis.

7. Drawing Auxiliary Lines and Regions:

- Users can draw lines, rectangles, or ellipses directly on the view to assist selection. For example, a drawn line can filter points within a set proximity, or a rectangle can isolate a specific data cluster.

8. Chart Adjustment and Customization:

- Allows customization of display parameters, including axis labels, titles, and axis ranges. This flexibility ensures the visualization aligns with specific analytical requirements.

As the primary interface for user-software interaction, the View Interaction Window combines rich functionality with intuitive operation, simplifying visualized analysis, selection, and labeling of data. Through this window, users can flexibly manipulate data, complete tasks efficiently, and conduct in-depth data analysis.

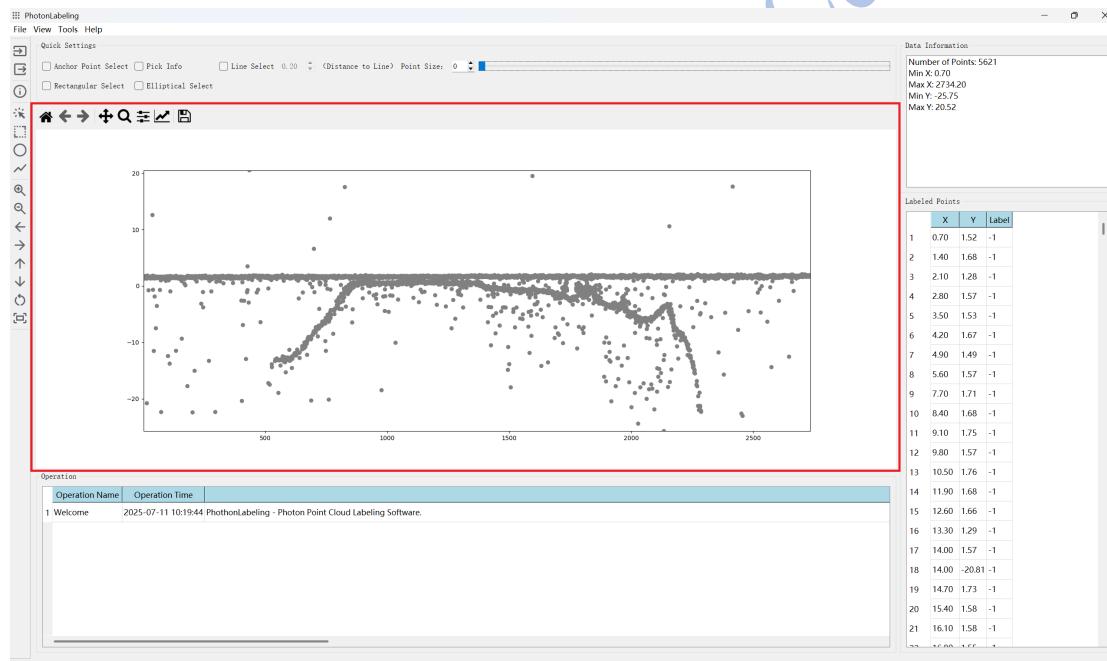


Figure 11 Software View Interaction Window (as shown in the red box)

4.4.5 Data Information Window

The Data Information Window displays summary information of imported data, helping users quickly grasp the basic characteristics of the dataset. It primarily shows overall dataset information and key statistical data, facilitating preliminary analysis of data distribution and ranges. The functions of the Data Information Window include:

1. Data Volume Display:

○ Shows the total number of points in the imported dataset. This information helps users understand the scale of the dataset, supporting further processing and analysis.

2. X Data Range:

○ Displays the minimum and maximum values of X-axis coordinates, enabling users to understand the distribution range of data along the X-axis. This is valuable for analyzing data distribution and locating points in specific regions.

3. Y Data Range:

○ Shows the minimum and maximum values of Y-axis coordinates, allowing users to grasp the distribution range of data along the Y-axis. Similar to the X-axis range, this aids in analyzing the spatial distribution and scope of the data.

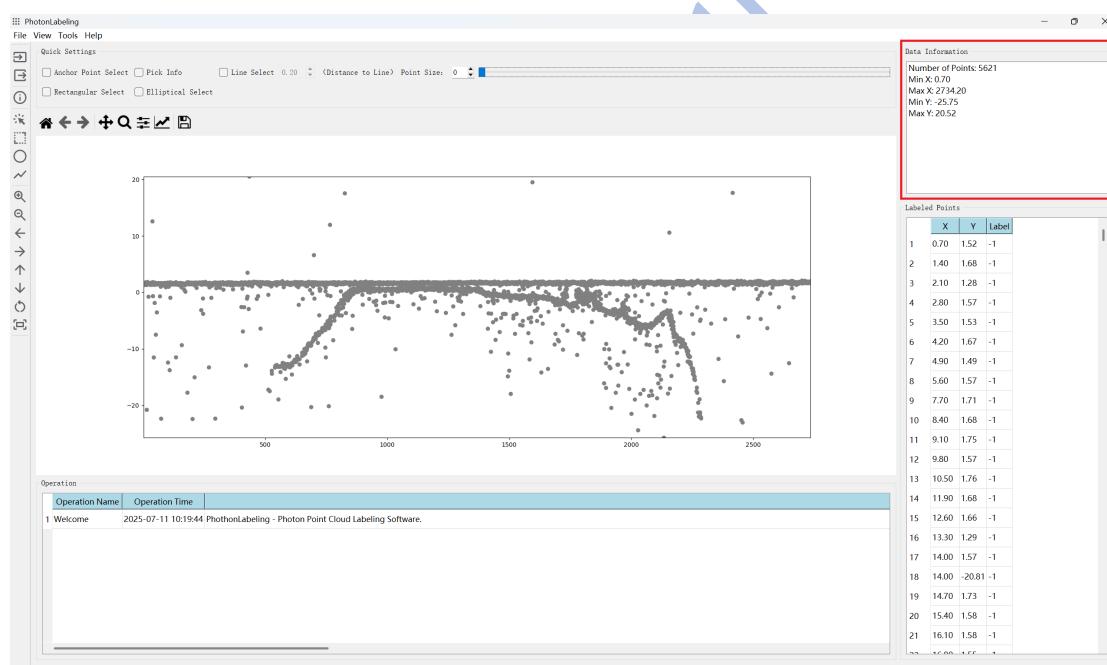


Figure 12 Software Data Information Window (as shown in the red box)

4.4.6 Labeling Data Window

The Labeling Data Window (table Widget Label) is one of the core functions for displaying and managing labels of data points in this software. It provides a table view where users can view, edit, and manipulate labels of data points. This window aims to

help users effectively mark and classify data, and it updates in real-time synchronization with the View Interaction Window. Its main functions include:

1. Data Label Display:

- The Labeling Data Window presents label information of each data point in the form of a table. Each row represents a data point, and the table includes the X, Y coordinates and label value (if labeled) of the point. This allows users to quickly check the labels of data points and make necessary edits.

2. Label Editing:

- Users can directly modify the labels of data points in the table. By double-clicking a label cell, users can input a new label value. Batch editing is supported, enabling users to modify labels of multiple data points simultaneously.

3. Real-Time Synchronization Update:

- When users label data points in the View Interaction Window, the Labeling Data Window will update to display the new label information in real-time. Conversely, when users modify labels in the table, the corresponding data points in the View Interaction Window will also update immediately, ensuring label consistency.

4. Data Filtering and Sorting:

- The Labeling Data Window supports sorting and filtering of the label column, allowing users to easily find data points with specific labels. For example, users can filter out all data points with a specific label value, or sort labels in alphabetical or numerical order.

5. Label Statistical Information:

- The software can display the count statistics of each label in the Labeling Data Window, helping users understand the distribution of each label. Users can intuitively see the number of data points labeled with different labels, assisting in data analysis and inspection.

6. Batch Label Operations:

- This window supports batch label operations. Users can select multiple data points and assign the same label to them at once, which improves work efficiency when processing large amounts of data.

7. Data Modification Prompt:

- In the Labeling Data Window, when the label value is changed, the system can prompt the user whether to save the changes, providing a certain level of security against misoperations.

8. Data Export:

- The Labeling Data Window supports exporting data in the table (including X, Y coordinates and label information) to CSV files or other formats. Users can export the labeled data for further analysis or storage.

9. Intuitive Operation:

- This window offers an intuitive way of label management, allowing users to easily edit and update labels during operation, thus ensuring the efficiency of data processing.

The Labeling Data Window (tableWidgetLabel) displays and manages data label information in the form of a table. Combined with other interactive functions, it greatly facilitates the annotation, editing, and management of data. It provides users with a flexible and efficient label management platform, ensuring that users can conveniently process and classify data while efficiently synchronizing and updating data in the View Window.

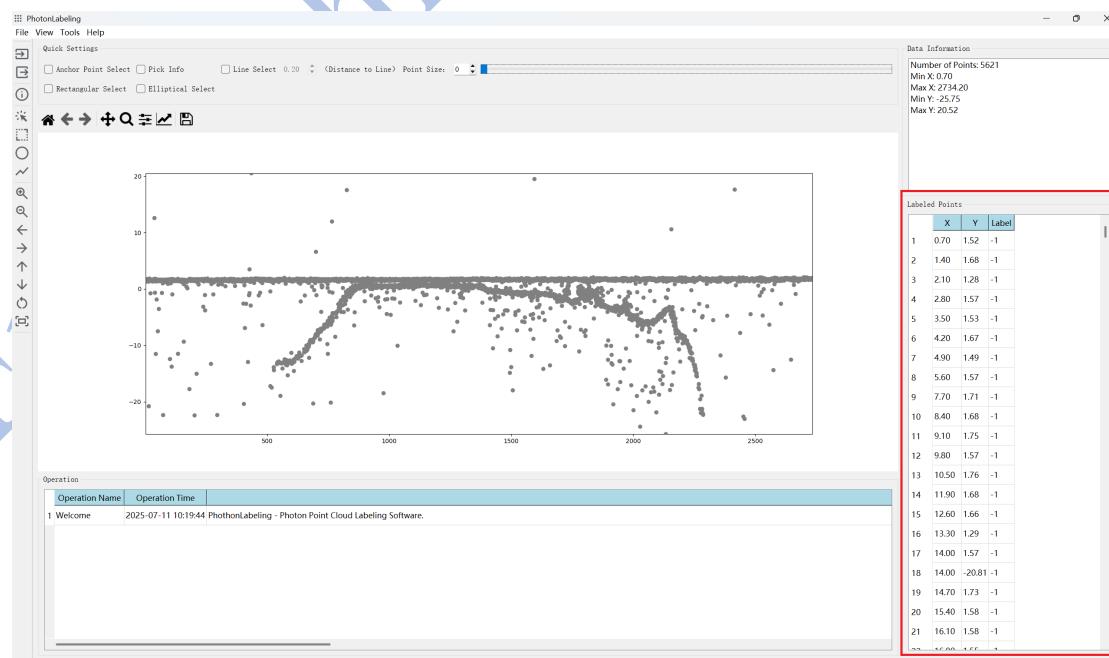


Figure 13 Software Labeling Data Window (as shown in the red box)

4.4.7 Operation Log Window

The Operation Log Window (tableWidgetRun) is one of the important functions in this software for recording and displaying users' operation history. It records the user's operation process in real-time in the form of a table, providing users with clear operation records and feedback. This window helps users track every step of the operation in the software, facilitating the review and management of work progress. Its main functions include:

1. Display of Operation Logs:

- The Operation Log Window presents each operation performed by the user in a table format, including operation type, operation time, and operation details. Each row represents an operation record, and users can view all operation history through this table.

2. Real-Time Recording of User Operations:

- Whenever the user performs an operation (such as label modification, data selection, view zooming, etc.), the Operation Log Window will automatically record the operation and display the specific content of the operation. All operation information is updated in real-time to ensure that users can view the latest operation records.

3. Operation Categories and Descriptions:

- The operation log not only records the content of each operation but also provides a brief description for each operation category. For example, when the user modifies the label of a data point, the log will record the "label modification" operation and specify the details of the modification (such as label value, modified points, etc.) in the description.

4. Operation Timestamps:

- Each operation log contains a timestamp, recording the exact time of the user's operation. This provides a time basis for operation tracking and problem tracing, helping users analyze and find problems in the operation process.

5. Recording of Batch Operations:

○ If the user performs batch operations (such as batch modifying labels or batch deleting data points), the Operation Log Window will record the operation and clearly display the details of the batch operation. This helps users understand the overall operations they have performed, not just the modification of individual data points.

6. Backtracking and Querying of Operation Logs:

○ Users can backtrack previous operations through the Operation Log Window and query the time and content of a specific operation. This is very helpful for users to find specific operation steps in the complex data processing process.

7. Log Clearing and Management:

○ The Operation Log Window provides a clearing function, allowing users to delete some or all log records to keep the log window clean and effective. This function helps manage logs after completing work.

8. Exporting Operation Logs:

○ Users can export operation logs to CSV files or other formats for subsequent analysis or backup. The exported logs include information such as operation type, timestamp, and description, facilitating users' data auditing or archiving.

9. Visual Feedback and Warnings:

○ During certain key operations (such as batch deletion, data modification, etc.), the Operation Log Window can provide visual feedback or warnings to remind users whether a specific operation has been completed. This helps avoid misoperations or incomplete operations.

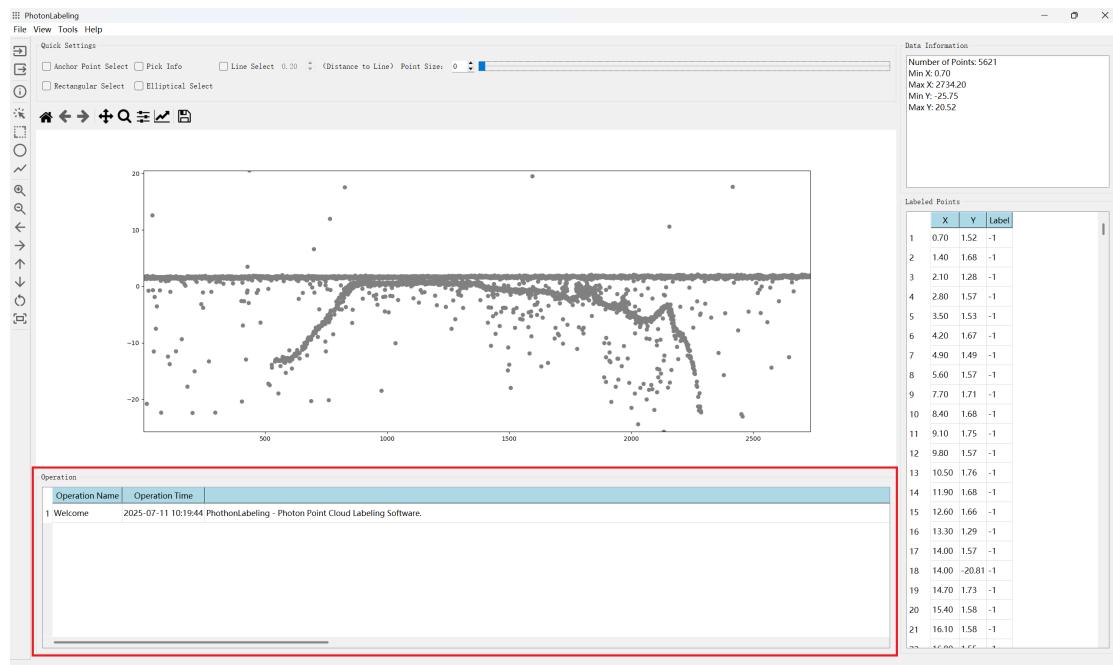


Figure 14 Software Operation Log Window (as shown in the red box)

4.4.8 Point Information Display Function

The point information display function allows users to view detailed information of a data point by clicking on it. In the visual graph, users can select any data point, and the software will pop up an information box showing the point's coordinate values and other relevant information. This function facilitates data annotation, data analysis, and result verification, enabling users to quickly grasp the specific location of each data point. It enhances the interactivity and accuracy of data analysis, helping users view and process data more intuitively.

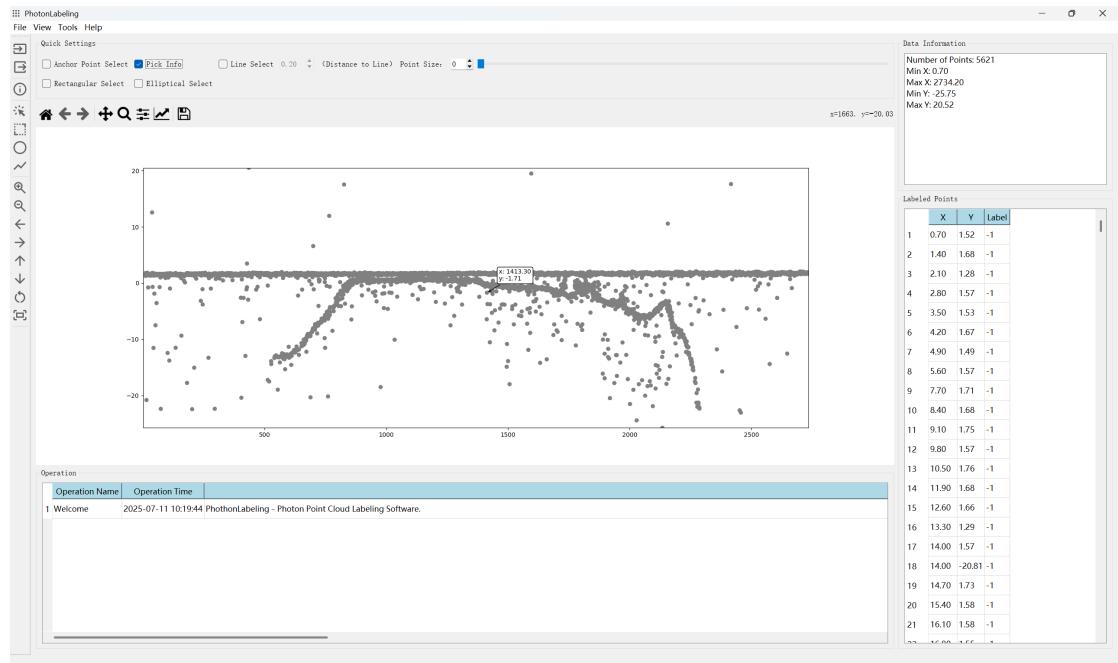


Figure 15 Software Point Information Display Function

4.4.9 Point Selection and Labeling Function

With the point selection and labeling function, users can directly interact with data points on the data visualization interface, select data points of interest, and assign labels to them.

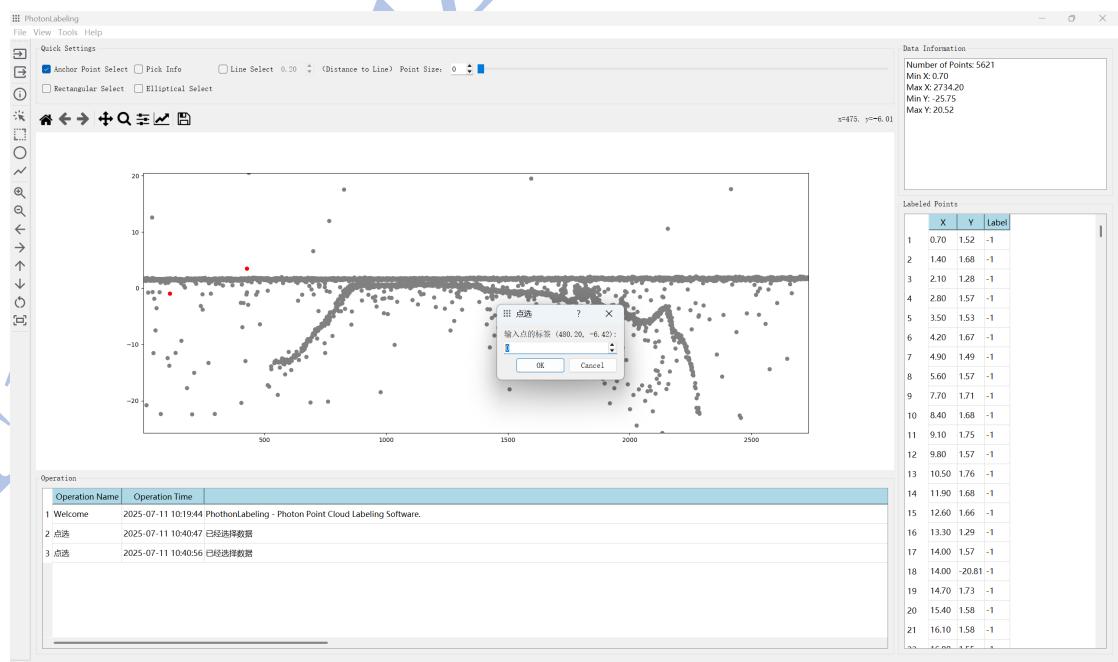


Figure 16 Software Point Selection and Labeling Function

4.4.10 Rectangular Selection and Labeling Function

The rectangular selection and labeling function allows users to select multiple data points by drawing a rectangular frame on the visualization graph and assign the same label to these selected data points. Users can drag the mouse to draw a rectangular area, and all points within this area will be automatically selected and labeled. The labels of the selected data points will be updated in real-time and reflected in the software's labeling data table, ensuring data synchronization and consistency.

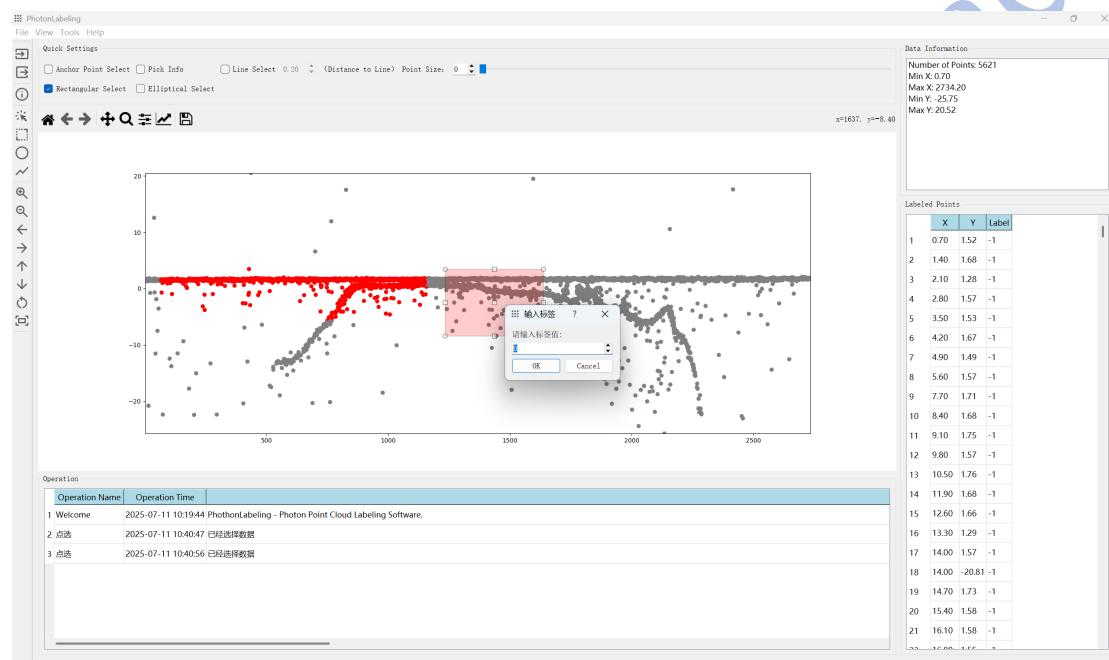


Figure 17 Software's Rectangular Selection and Labeling Function

4.4.11 Elliptical Selection and Labeling Function

The elliptical selection and labeling function allows users to select data points by drawing an elliptical area and assign the same label to these selected points. Users can define the starting and ending points of the ellipse in the graph with the mouse, and all data points within this elliptical area will be automatically selected and labeled. This function is particularly suitable for scenarios where data within specific shapes or regions need to be labeled, enabling efficient batch processing of data point annotations. The labels of the selected data points will be updated in real-time and reflected in the software's labeling data table, ensuring data consistency and synchronization.

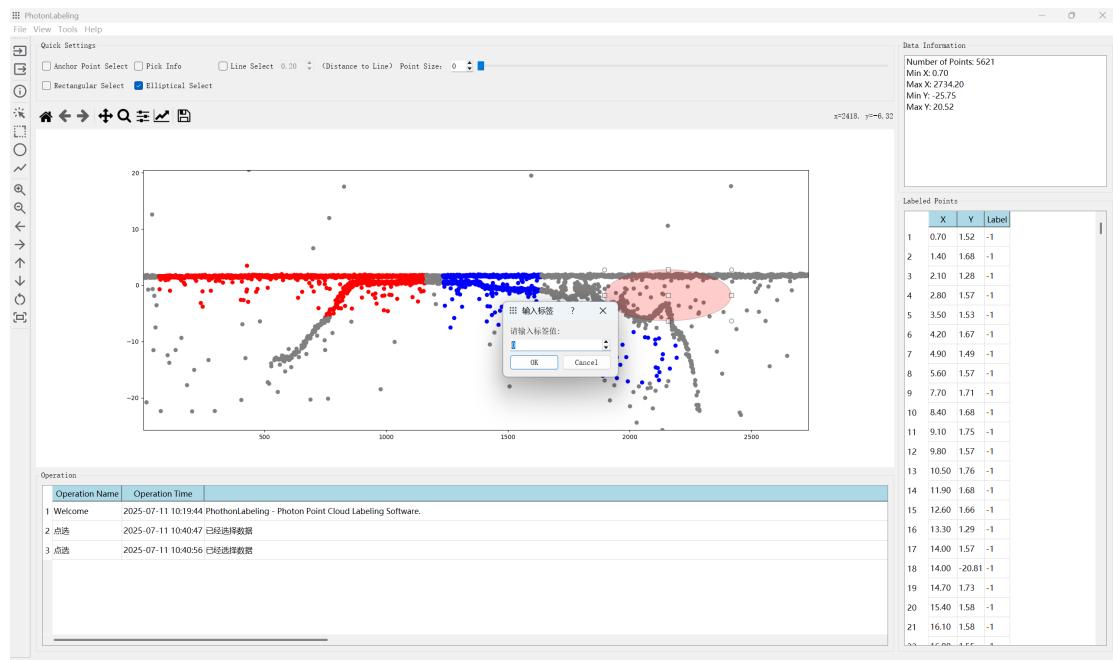


Figure 18 Software's Elliptical Selection and Labeling Function

4.4.12 Line Selection and Labeling Function

The line selection and labeling function allows users to select data points close to a line by drawing a straight line in the graph and assign the same label to these points. Users can specify the start and end points of the line by clicking the mouse. The software will calculate the distance from each data point to this line, and select and label the points whose distance to the line is within the set threshold range. This function is suitable for scenarios where data needs to be labeled based on a specific straight line, especially when processing data distributed along a straight line. After labeling, the data points will be distinguishable in the visualization graph, and their labels will be updated in real-time and synchronized to the software's labeling data table, ensuring data accuracy and consistency.

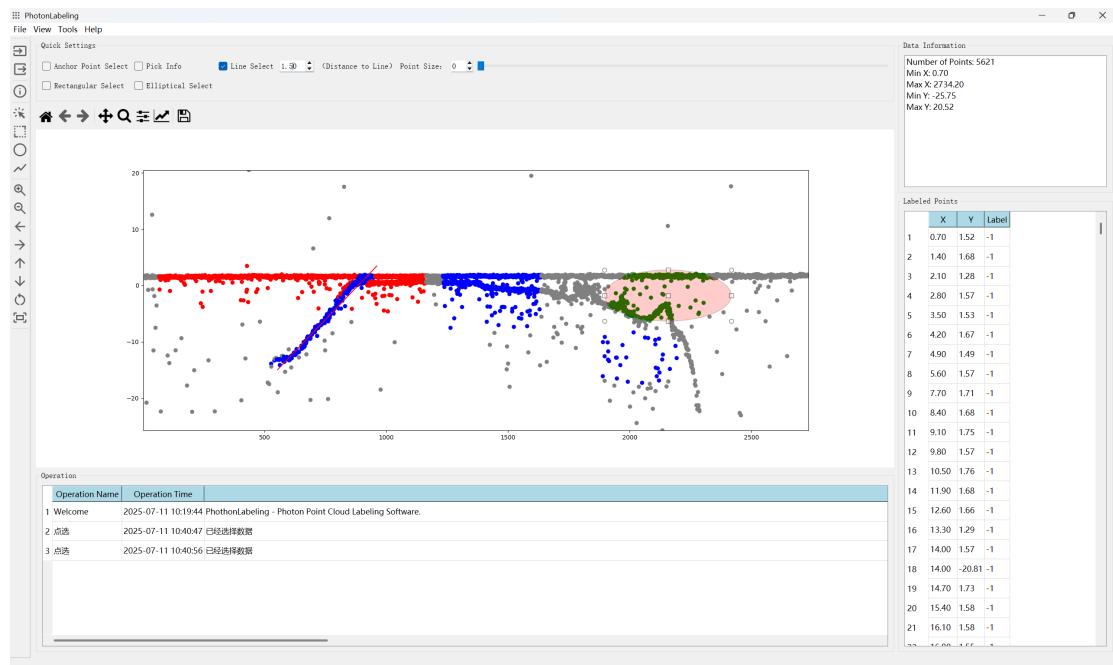


Figure 19 Software's Line Selection and Labeling Function

4.4.13 Scatter Size Adjustment Function

The scatter size adjustment function allows users to dynamically adjust the size of data points in the visualization graph via a slider. Users can use the slider on the interface to modify the point size, making it easier to observe and distinguish the distribution of data points. This function is particularly useful in scenarios with a large number of data points or when there is a need to highlight data points within a specific range. As the slider is adjusted, the size of the scatter points changes in real-time and is immediately reflected in the graph, helping users optimize the display effect of the chart according to their needs. This function enhances the visualization effect of the graph, enabling users to process and analyze data more flexibly.

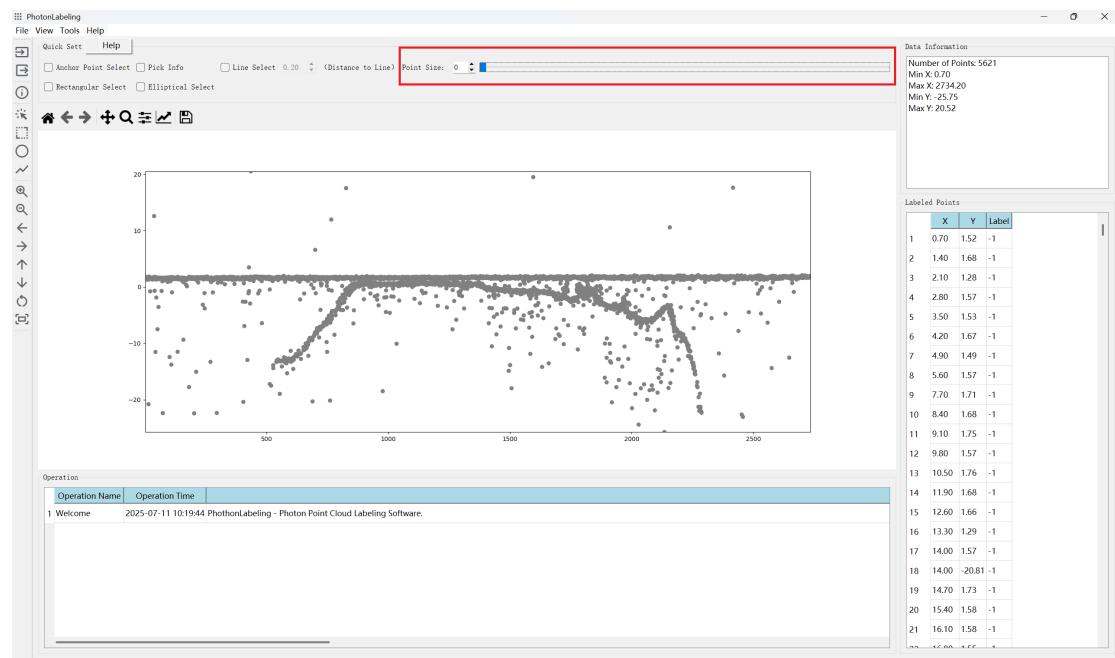


Figure 20 Software's Scatter Size Adjustment Function (as shown in the red box)