GSYS2.2 manual

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Contents

1 What is GSYS2.2?

GSYS2.2 is the newest version of the digitizing system, GSYS, which is used in Japan Charged-Particle Nuclear Reaction Data Group (JCPRG). This is a software to achive numerical data from images of graphs.

Main features of GSYS2.2 is listed below.

- Cross-platform window application which only requires Java Runtime Environment.
- Intuitive and light GUI.
- Supports PNG, GIF, and JPEG image formats.
- Flexible input and output that are compatible with many data formats.
- Feedback function which enables to reuse former data easily.
- Easy set-up of X-axis and Y-axis with automatic axis detection.

The details of each function are explained in the sections below. More information about GSYS is available in previous manuals.[1, 2]

Please use this system at your own risk.

It is not allowed to use this system for any kind of business purpose.

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2 How to use GSYS2.2

GSYS2.2 requires Java 1.4 or later. Please download and install Java runtime environment from the website of Sun Microsystems. (http://java.com/) Then download an executable file "Gsys2.2.X.jar" (X is a version number) from the website of JCPRG. (http://www.jcprg.org/) Now you are ready to start GSYS2.2. If you want to uninstall GSYS2.2 from your computer, just remove the file "Gsys2.2.X.jar".

GSYS2.2 makes a property file "gsys2.properties" in order to save user's properties. You can also remove this file if you don't need it.

> Note: Sometimes GSYS2.2 doesn't work properly because of the property file ("gsys2.properties"). If you find that GSYS2.2 is not working properly, remove "gsys2.properties", and then restart GSYS2.2.

2.1 Starting-up the system

Let's start GSYS2.2. If you use Windows OS, double-click the file, "Gsys2.2.X.jar". In the case of Unix-like systems such as FreeBSD and Linux, type "**`java -jar Gsys2.2.X.jar`**". When GSYS2.2 starts, you would see the window shown in figure 1.

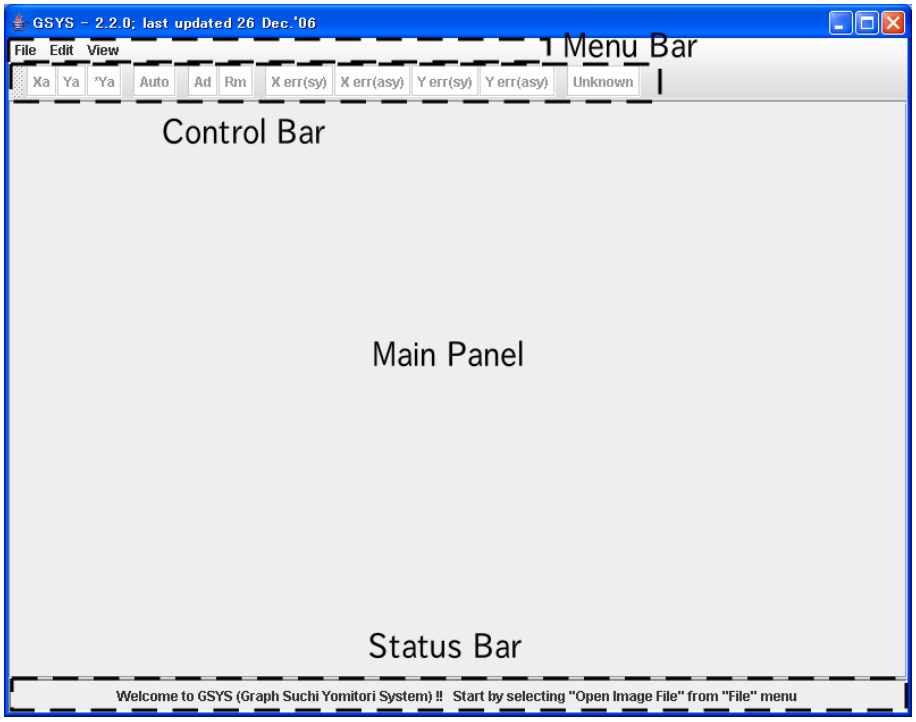

Figure 1: Startup window of GSYS2.2. You can select "Load Image File" in "File" menu, "Properties" in "Edit" menu, and "Show status bar" in "View" menu.

The window of GSYS2.2 contains four main components: menu bar, control bar, main panel, and status bar. Menu bar provides menus to operate GSYS2.2. Control bar contains functions required to read data, such as setting axes, data points, and error bars. An image loaded from a file is displayed on the main panel. You digitize data on this

panel. In the status bar, a description of a button focused by a mouse, the position of a mouse, and the coordinates of a selected point are displayed.

GSYS2.2 can be operated using a keyboard, but in this document, how to operate with the menu bar and the control bar by a mouse is explained. Keyboard shortcuts are shown in Table 1 at Appendix A.1.

2.2 Loading the image file

Select "Load Image File" from the "File" menu in the menu bar. Select an image file (PNG, GIF, or JPEG) from a file dialog in a new window. If the image file is successfully loaded, the image is displayed on the main panel as shown in figure 2. The sample image used in this document was made from experimental data published in Phys. Rev. **104** (1956) 123, Phys. Rev. **109** (1958) 850, Phys. Rev. **129** (1960) 2252.

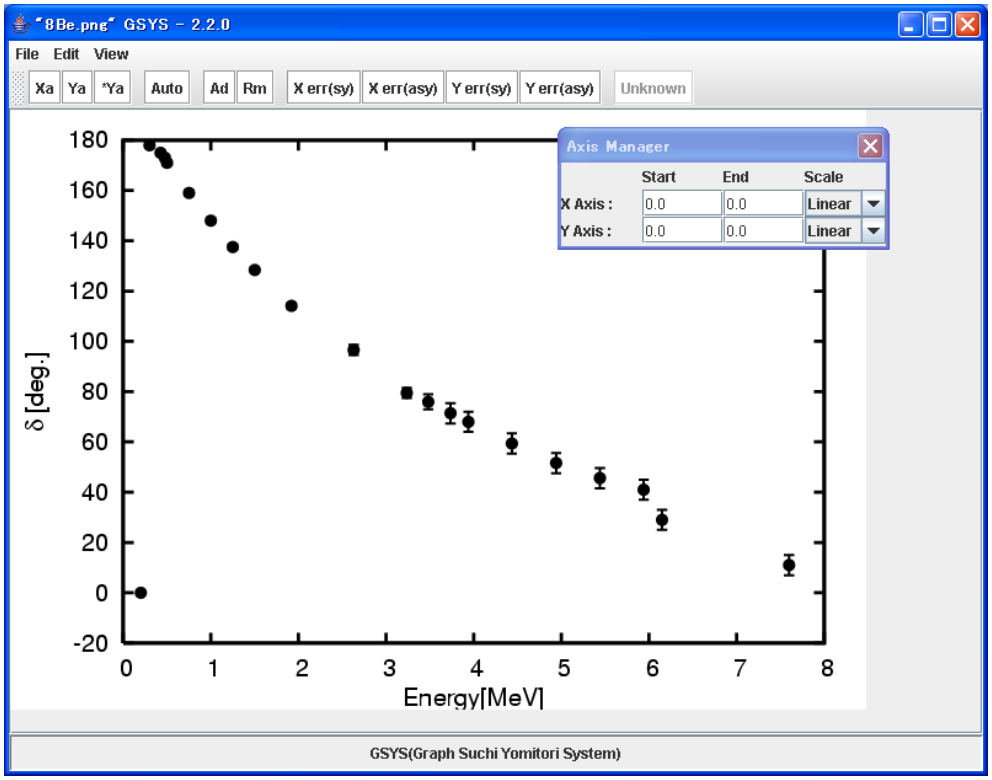

Figure 2: Window after an image loaded. The image is displayed on the main panel and an axis manager is displayed in a new window.

> Note: In order to read-in the data precisely, enlarge the image so that fine tuning of data points is possible. To enlarge the size of the main panel, expand the window of GSYS2.2. The main panel expands and shrinks automatically to fit the size of the window of GSYS2.2. If you want to expand the main panel more, remove the check from "Show status bar" in the "View" menu, and remove the status bar from the window of GSYS2.2. It is also possible to move the control bar by dragging a handle (shaded area) at the left of the control bar. If you want to zoom in and out, select "Zoom in" or "Zoom out" in the "View" menu. Select "Resize" to recover its original size.

2.3 Setting the position and the type of axes

Next, set starting and ending points of X and Y axes respectively. In GSYS2.2, automatic axis detection function is implemented.

Setting the axis with automatic axis detection

Press Auto button to enter the automatic axis detection mode. Auto button turns red. Enclose X or Y axis by dragging on the image on the main panel as shown in figure 3. If the automatic axis detection succeeds, you will see a dialog to choose starting point of the axis as shown in figure 4. In the dialog, detected axis is shown as a blue line, and detected divisions of the axis are shown as a green line. The divisions are given alphabetical names. Choose the appropriate starting point from the list box on the right, and click OK button. (The label of this button depends on your system language.) If you want to cancel the automatic axis detection, or think that the detection is not accurate, click cancel button.

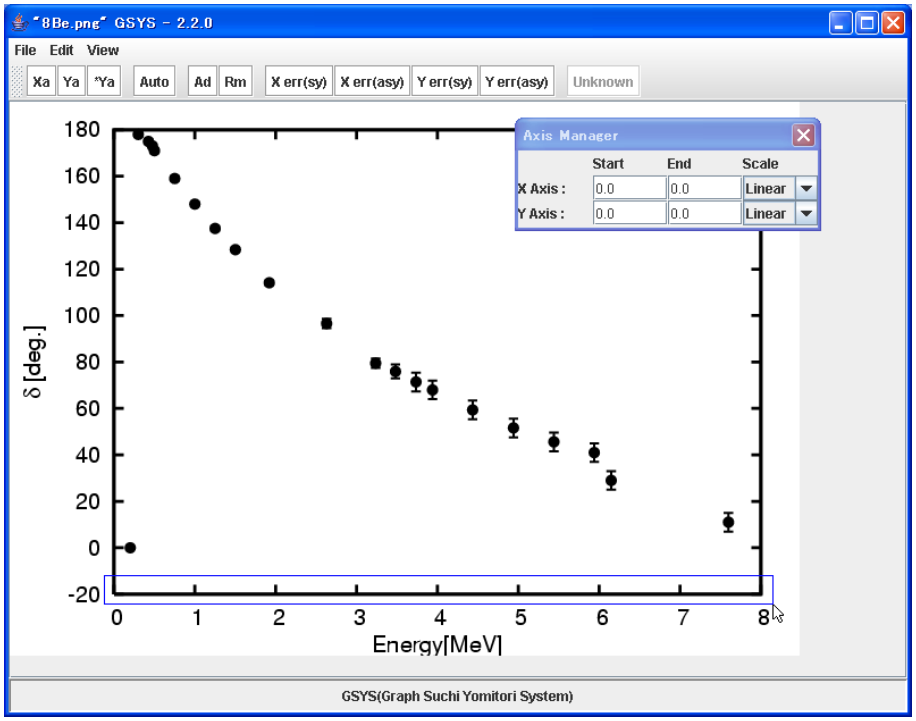

Figure 3: Window to select a starting point of an automatically detected axis.

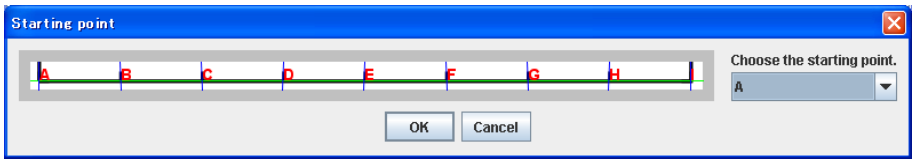

Figure 4: Window to select a starting point of an automatically detected axis.

Next, you will see a dialog to choose ending point of the axis. Set as well as the starting point. You will see then an axis is set.

> Note: Automatic axis detection function selects X-axis if the enclosed frame is horizontally oriented, otherwise, it selects Y-axis. If one axis is already set, the other is set.
>
> The algorithm of the automatic axis detection works properly only if there are only the axes and the divisions in the frame. If the detection fails, set the frame excluding extras. If the detection still fails, set the axis with an alternative method explained below.

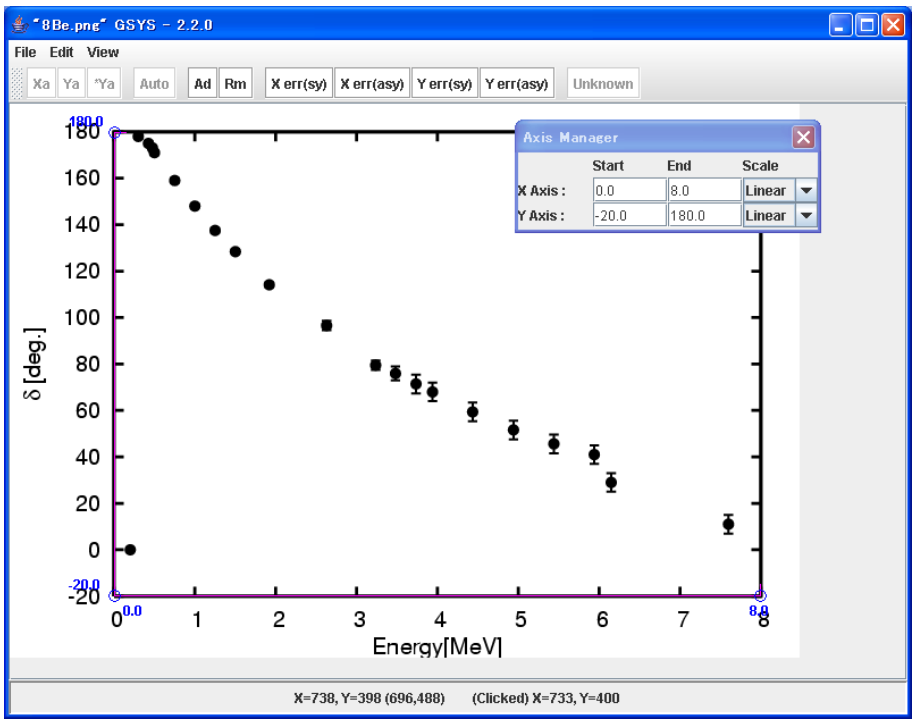

Figure 5: Window after setting positions and value of endpoints of the axes.

Setting an axis with an alternative method

Press Xa button to enter the X-axis setting mode. Xa button turns red. Click starting and ending points in order on the image on the main panel to set X-axis. An X-axis with two endpoints is set on the main panel. Similarly, press Ya button to set Y-axis. Click the starting and ending point in order. If the starting point of Y-axis is the same as that of X-axis, press Ya* button to skip setting the starting point of Y-axis.

If you want to move starting or ending point of an axis, click the point to move, then move it by a mouse or cursor keys.

> Note: If the X and Y axes are required to be orthogonal to each other, when you move starting or ending points of an axis, the ending point of the other axis automatically moves in order to keep its orthogonality. You can change this orthogonality condition in the property dialog. Detailed description is given in Chapter 4.

The axis manager appears in a new window when you load an image in section 2.2. Set the value of starting and ending points of X and Y axes using "Start" and "End" menus in the axis manager. And select the type of the axis from the options ("Linear" and "Log" (Common Logarithm)) in "Scale" selection box. When you finish setting the axis, you will see a window shown in figure 5.

2.4 Reading the data

You are ready to read data if you finish setting the axis. Press Ad button to enter the data input mode. The button turns red. If you click on the image during the data input mode (When Ad button is red), a red data point is added on the image. You can add another point by clicking another place. Continue to click the image until all the data points are added. This mode is canceled by clicking the Ad button again. When you finish adding the data points, you will see a window shown in figure 6.

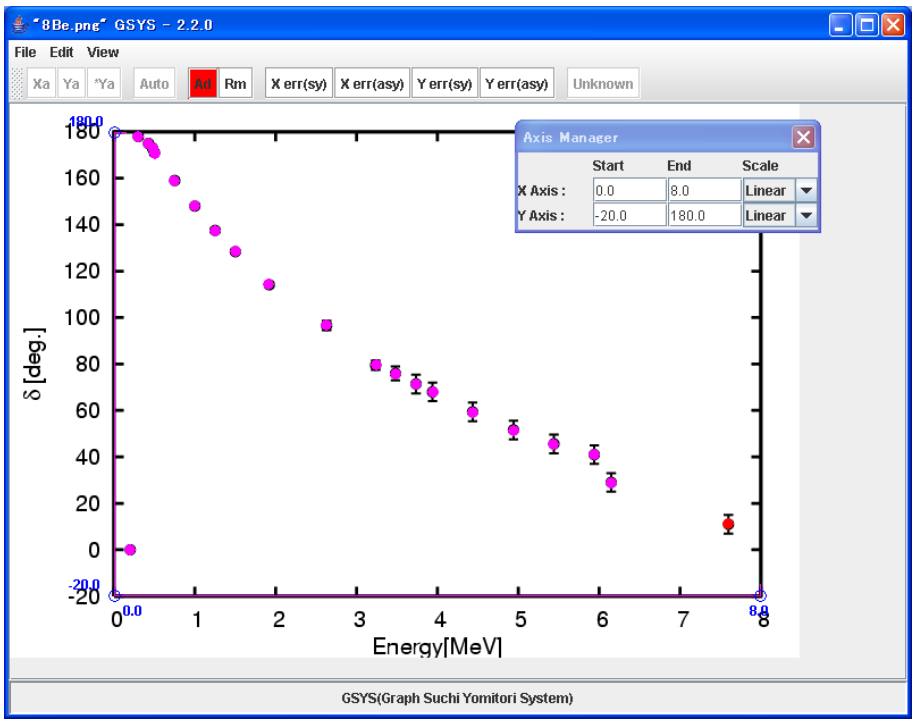

Figure 6: Window after reading the data points.

2.5 Reading the error information

This section gives how to read error information. First, click a data point which has an error bar on the graph. (The selected data point turns red.) To set a symmetric error for X value, press Xerr(Sy) button, and click one endpoint of the error bar. To set asymmetric error to X axis, press Xerr(Asy) button, and click both endpoints. If you treat a data which has error for only one direction, click the one endpoint and press Xerr(Asy) again.

The same operation can be done for error for Y value of a data.

After setting the error for the first point, the error input button, which is pressed before, turns pink. This implies that you are still in the error input mode. Select the next point to set a next error bar. When the point is specified, the button turns red again, and you can set error bar in the same way as mentioned above. Repeat operations until you finish setting error bars for all the data. To cancel error input mode, press the error input button again. After inputting errors, you will see a window shown in figure 7.

> Note: In NRDF data format, an error bar which sticks out from the graph should be set an "UNKNOWN" flag. First, set errors using Xerr(Asy) or Yerr(Asy). When you treat an NRDF format file, the unknown button is selectable. After pressing the button, click the endpoint of the error bar. An arrow is displayed at the end of the error bar, and "UNKNOWN" flag is set for the data. (The output becomes `UNKNOWN` rather than numerical value.) Please refer to chapter 5 to know about NRDF format.

2.6 Modifying and removing the data

This section explains how to modify and remove the data.

Modifying the position of data points, error bars, and endpoints of axes

In order to modify a data, select the data point which you want to move by clicking it. Selected data turns red. Then move it by a mouse or cursor keys to the correct position. You can modify error bars, and endpoints of axes in the

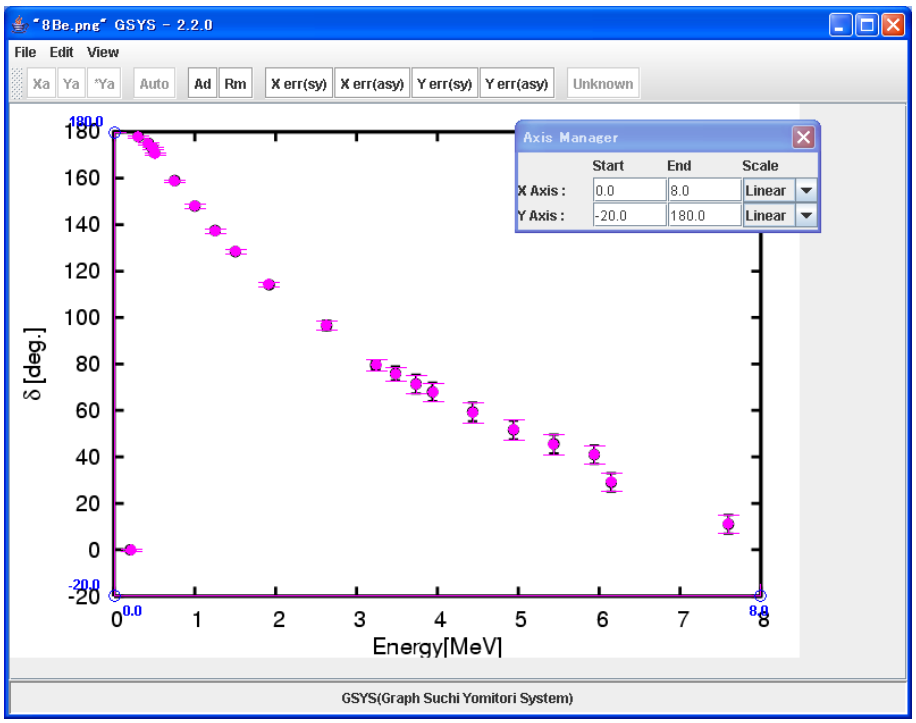

Figure 7: Window after setting error bars.

same way.

Removing data points, error bars, and axes

In order to remove a data point, select the data point to remove. Then press Rm button to remove it. The data is removed. To remove an error bar, click the endpoint of the error bar to select the error bar to remove. The selected endpoint is enclosed by a red circle, then press the Rm button. To remove an axis, click an endpoint of the axis to select the axis to remove. The selected endpoint is enclosed by a red circle, then press the Rm button.

Removing all the data points and axis

In order to remove all the data, select "Clear" in the "Edit" menu.

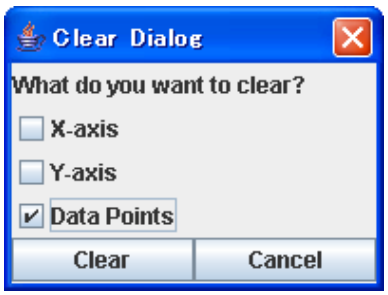

Figure 8: Window to select what to clear.

A dialog with check boxes labelled "X-axis", "Y-axis", "Data Points" is displayed as shown in figure 8. Check componets you want to remove, and press Clear button. If you want to cancel to clear, press Cancel button.

2.7 Outputting the numerical data

When you finish reading data, select "Output Numerical Data" from the "File" menu. Output dialog opens in a new window as shown in figure 9. This window contains a control panel to configure output data, and text area in which numerical data is displayed.

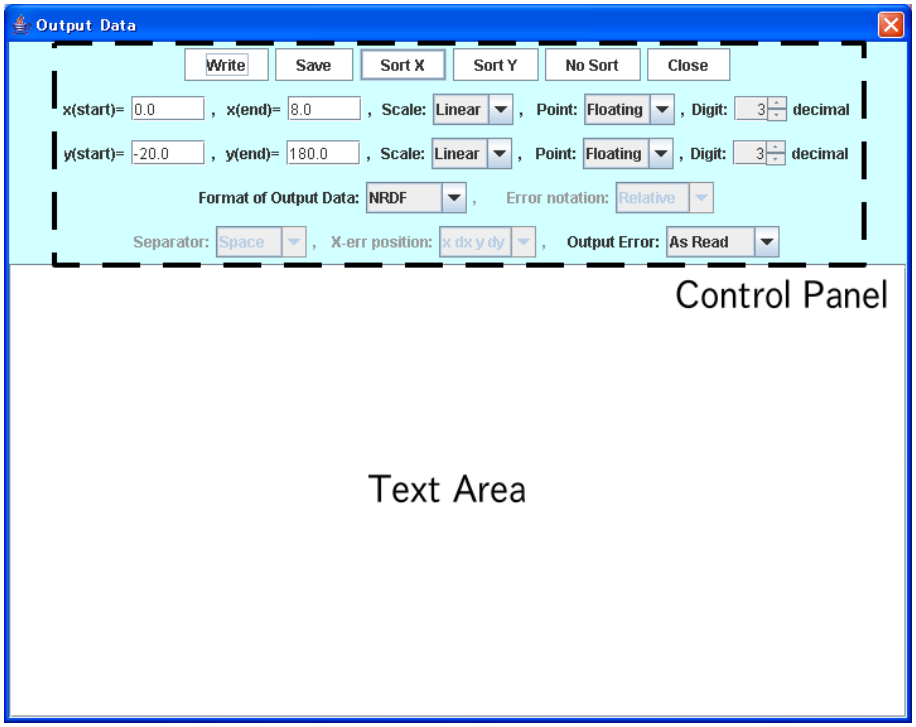

Figure 9: Window for outputting numerical data

First, configure output on the control panel as follows.

- Input the value of starting and ending points of X and Y axes in "x(start)=", "x(end)=", "y(start)=", and "y(end)=", respectively.
- Select the type of X and Y axes from "Linear" and "Log" (Common Logarithm) in "Scale" selection box.

The default values for the box are the same as the input values of section 2.3. Please check the values again here. Besides, set the type of output from the options ("Floating" number and "Fixed" number), and the number of digit after the decimal point by changing "digit".

Next, select the output format to use. Please refer to chapter 5 to know about data format treated in GSYS2.2. When you use the Standard Format, set "Error notation", "Separator", and "X-err position" as follows.

- "Error notation" specifies the settings for error output.

  Relative : Output the value of the difference between the value of the data point and the endpoints of the error bar.

  Absolute : Output the value of the endpoints of the error bars.

- "Separator" specifies the field separator from the options (comma and white space).
- "X-err position" specifies the position of the error of the X-direction.

  "x dx y dy" : Output X-error value after the value of X.

  "x y dx dy" : Output X-error value after the value of Y.

At last, select the type of output from the options in "Output". "As Read" is selected by default, and fields are output depending on the presence of the error bars. If you want to omit particular error, or specify output format, please select from options below.

"No Error"	:	Don't output error.
"X Error"	:	Output error for only X-direction.
"Y Error"	:	Output error for only Y-direction.
"X & Y Error"	:	Output error for X and Y direction.

If you finish all the configuration, press Write button. Numerical data is displayed in text area.

If you press Sort X or Sort Y button, you can sort data in ascending order by X or Y value, respectively. If you press No sort button, the data is sorted by the order of the data point input. If you are using NRDF format, or EXFOR format, the data is sorted by X value by default.

Press Save button to save the output numerical data into a file. Specify file name in the file dialog in a new window. You can also directly copy & paste to other applications. (Right-click menu is implemented from GSYS2.2.) If you want to close the output window, press Close Button.

3 Feedback function

This chapter explains the feedback function.

3.1 What is the feedback function?

Feedback function is a function to load the numerical data from files and plot them directly on the image on the main panel. This function is implemented in GSYS2.0. Former digitizing processes were one way processes that read the data from an image, then digitize it. Therefore, if there are some mistakes in the data, or the quality of the data is not very good, the user must recompile the data from the beginning to improve the data. The feedback function enables us to compare the numerical data visually with the real data on the graph by plotting the old numerical data on the image (Refer to figure 10). It is also possible to modify the data by moving or adding the data points. GSYS2.2 can read not only the numerical data produced by GSYS, but also general numerical data. Thus, the feedback function enables us to reuse the data easily and check the data accuracy in greater detail.

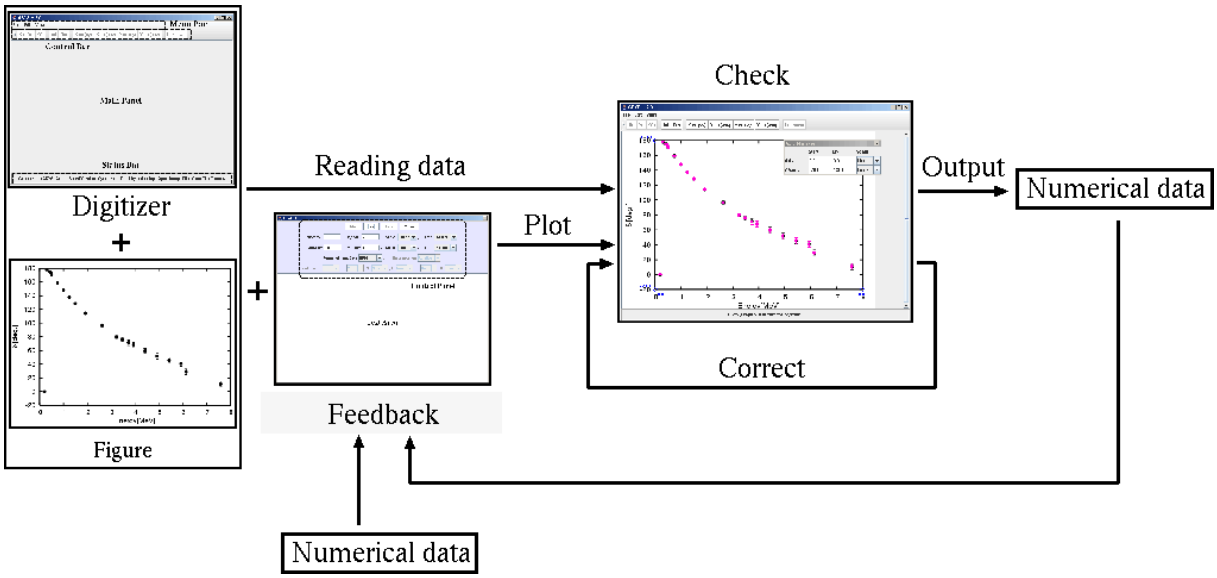

Figure 10: Data reading process and feedback function

3.2 Using feedback function

In order to use the feedback function, select "Input Numerical Data" from the "File" menu. Input window shown in figure 11 opens. This window contains a control panel to configure the settings for inputting the data, and a text area in which input numerical data are displayed.

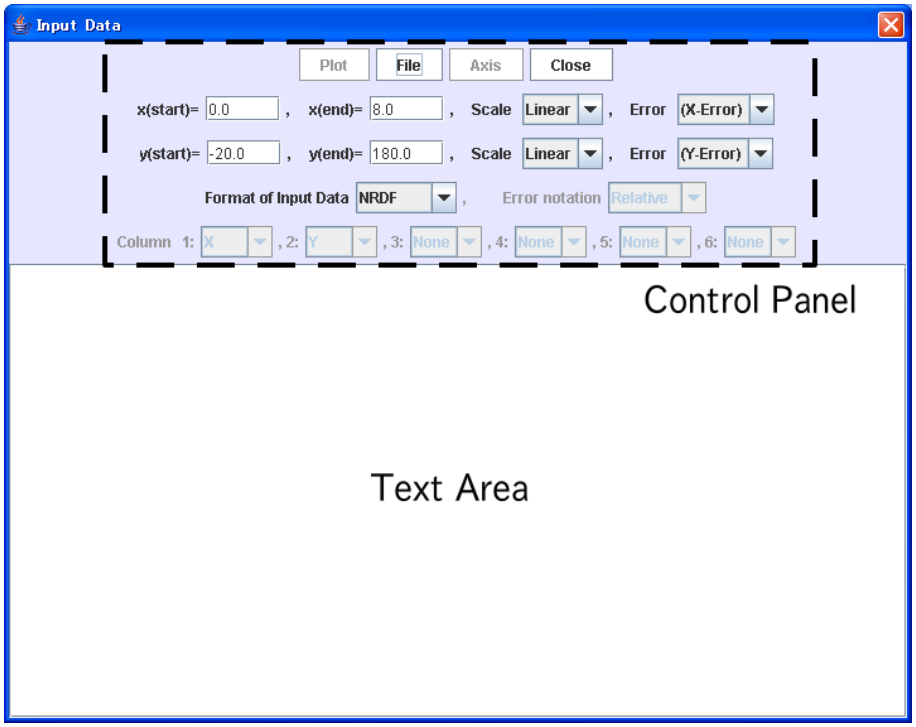

Figure 11: Window for loading the numerical data file

Firstly, select the numerical data to be input. Press File button to open the file dialog and select a file which you need. Contents of the selected file are displayed in the text area. Instead of selecting a file, you can input the numerical values into the text area directly, or copy & paste the values. (Right-click menu is implemented in GSYS2.2.)

Secondly, confirm that the X and Y axes are set on the image. If not, set the axes as explained in section 2.3. If you opened the data which was degitized by GSYS2.2 or GSYS2.0 from the same image file, you can reuse the information of the position of the axis. If axes are not set yet, they are automatically set by using former information. If axes are already set, they are not automatically set, but AXIS button is enabled and you can set former axes by pressing the button.

Thirdly, input the information of the axes. If you load a file generated by GSYS, the information of axes is read from the file header. Confirm the information of the axes.

- Input the values of the starting and ending points for the X and Y axes into "x(start)=", "x(end)=", "y(start)=", and "y(end)=", respectively.
- Select a type of the X and Y axes from the options, "Linear" and "Log"(Common Logarithm) in "Scale" selection box.

Finally, specify the data format. This process depends on a file format. Refer to Chapter 5 to know about file formats treated in GSYS2.2.

- In case of NRDF format or EXFOR format, set "(X-Error)" and "(Y-Error)" in "Error" from the options ("Sym"(Symmetric Error) or "Asym"(Asymmetric Error)). If the data contains no error information, select "No Error".

Note: If you want to use some specific column in the loaded data with NRDF or EXFOR format, load the numerical data as the standard format as mentioned below and then revert it back to the original format.

- For the standard format, specify a display format for each column from the options (”X”(X value), ”Y”(Y value), ”X-err”(Error for X), ”Y-err”(Error for Y), and ”NONE”(no data or not to use)).

Only ”Relative” error (the difference from the real value) is available for NRDF and EXFOR formats, but, ”Absolute” error (the end of the error bar) is also available for standard format. Change ”Error notation” if necessary. If you finish all the settings, press Plot button. The data will be plotted on the image shown in figure 7. To modify the data, follow the explanation in chapter 2.

4 How to customize GSYS2.2

This section explains how to customize GSYS2.2. Select ”Properties” in the ”Edit” menu. You can customize GSYS2.2 using the property dialog in a new window. Since the configuration is saved in a file, ”gsys2.properties”, you can change the configuration by editing that file.

Color & Size

When ”Color & Size” tab is selected, you can see the windows shown in figure 12. The user can select the color of the axes and the data points, and the size of the points from the dialog boxes.

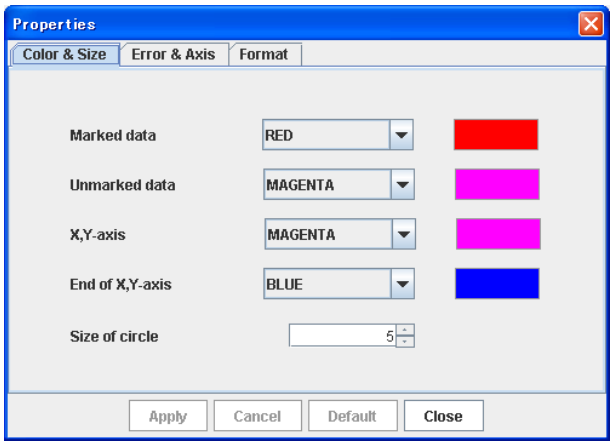

Figure 12: Window of the property dialog when the ”Color & Size” tab is selected.

Marked data	Set the color of marked data.
Unmarked data	Set the color of unmarked data.
X, Y-axis	Set the color of axes.
End of X, Y-axis	Set the color of the starting and ending points of axes.
Size of circle	Set the size of data point circles.

Error & Axis

When ”Error & Axis” tab is selected, you will see the window shown in figure 13. The user can set the error expression, whether to display the value of the starting and ending points of the axes and whether to impose the orthogonality condition for the X and Y axes.

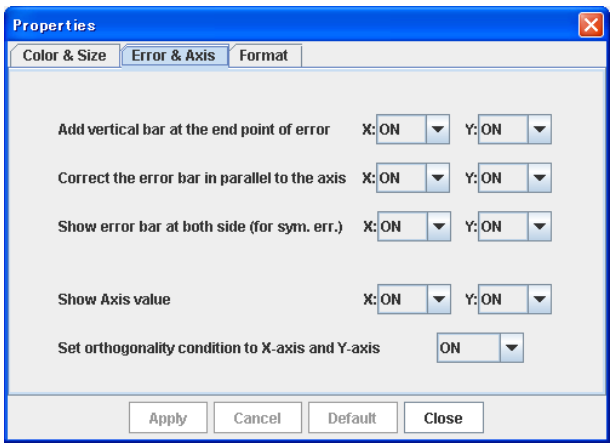

Figure 13: Window of the property dialog when the "Error & Axis" tab is selected.

Add vertical bar at the end point of error	Set whether to display the vertical line at the end of the error bar.
Correct the error bar in parallel to the axis	Set whether to display the X and Y error bars parallel to the X and Y axis.
Show error bar at both side (for sym. error)	Set whether to display the symmetric error bars of the data.
Show Axis value	Set whether to display the value of the ends of axes close to the ends of the axes.
Set orthogonality condition to X-axis and Y-axis	Set whether to make X-axis and Y-axis orthogonal.

Format

In order to change the format for the numerical data, select "Format" tab. You will see the window shown in figure 14, and you can configure the format used for writing the data and the feedback function. Refer to chapter 5 to know more about the data formats.

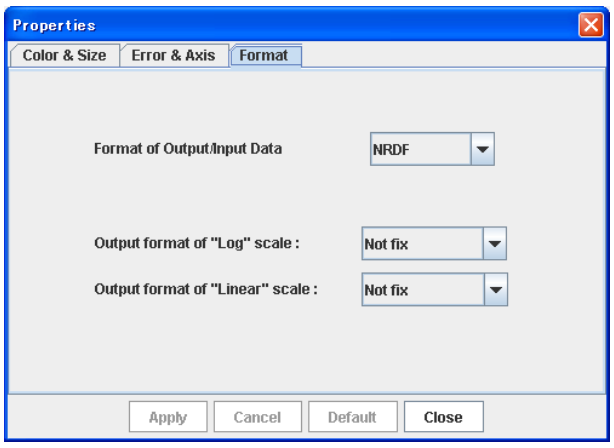

Figure 14: Window of the property dialog when the "Format" tab is selected.

Format of Output/Input Data	Set a format of input and output.
Output format of “Log” scale	Set a type of output for “Log” (Common Logarithm) from floating point number and fixed point number.
Output format of “Linear” scale	Set a type of output for “Linear” from floating point number and fixed point number

5 Data format

There are three formats treated in GSYS2.2. They are used for NRDF, for EXFOR recording, and for general use. They are called NRDF Format, EXFOR Format, and Standard Format, respectively. Refer to chapter 4 to learn how to change the format to treat.

NRDF Format

An example of NRDF Format file is shown below. (this example is the data with symmetric error for X and asymmetric error for Y.)

```
#     x           +-dx          y              +dy-dy
 1.000E+00   +-2.500E-01   8.000E+00    +4.000E+00-2.500E+00
 2.000E+00   +-4.500E-01   4.000E+00   +2.000E+00-NEGLIGIBLE
 3.000E+00   +-5.000E-01   2.000E+00      +5.000E-01-UNKNOWN
 4.000E+00   +-1.000E-01   1.000E-00    +1.000E-01-1.500E-01
```

If the error value is too small to be read by GSYS2.2, ’NEGLIGIBLE’ is output. If the error value is very large so that the error bar sticks out of the graph, ’UNKNOWN’ is output. As for UNKNOWN, it is necessary to set a type of the error output as unknown by unknown button as explained in section 2.5. The error format is +-VALUE (for symmetric error), or +VALUE-VALUE (for asymmetric error). The error values are given as ’relative’ error(the difference from the real value).

EXFOR Format

An example of EXFOR Format file is shown below.

```
#     x           dx          y           dy         -dy
  1.000E+00   2.500E-01   8.000E+00   4.000E+00 -2.500E+00
  2.000E+00   4.500E-01   4.000E+00   2.000E+00
  3.000E+00   5.000E-01   2.000E+00   5.000E-01 -1.854E+00
  4.000E+00   1.000E-01   1.000E-00   1.000E-01 -1.500E-01
```

The columns are separated per 11 characters, and the data with no value is expressed as white spaces. The error value is given as ’relative’ error(the difference from the real value).

Acknowledgements

We wish to thank Dr. Koji Arai for developing the first GSYS and providing source code. We wish to thank Dr. Ayumi Minoguchi, who named the ’feedback function’, and also coopetated on translating this manual into English. We wish to thank the users of GSYS, including Ms. Takako Ashizawa for giving us valuable comments. We also wish to thank the members of ”NRDF-to-EXFOR Working Group (NTX-WG)” for precious comments. Especially, we wish to thank Ms. Hitomi Yoshida and Dr. Naohiko Otuka for strong support from the development to release of GSYS2.2.

A Appendix

A.1 Keyboard shortcuts

The correspondence between keyboard shortcuts and the buttons on the control bar and menus in the menu bar is shown in Table 1.

Table 1: Keyboard shortcuts

Correspondence between buttons in control bar and keyboard shortcuts

Operation	Button	Key
Set X axis.	Xa	x
Set Y axis.	Ya	y
Set an axis by automatic axis detection.	Auto	z
Set ending point of Y-axis when starting point is the same as X axis.	*Ya	Y
Add data points.	Ad	a
Remove marked data point or axis.	Rem	D, Delete, BackSpace
Set symmetric error for X direction.	X err(sy)	F1
Set asymmetric error for X direction.	X err(asy)	F2
Set symmetric error for Y direction.	Y err(sy)	F3
Set asymmetric error for Y direction.	Y err(asy)	F4
Set UNKNOWN flag for the error of a data. (Available for NRDF Format.)	Unknown	u

Correspondence between menus in menu bar and keyboard shortcuts

Operation	Key
Open a window to load an image file.	Ctrl + o
Open a window to load a numerical data file.	Ctrl + i
Open a window to output data.	Ctrl + s
Quit GSYS2.2.	Ctrl + q
Clear data points and axes.	Ctrl + c
Magnify image.	+
Shrink image.	-
Recover original size of image.	0

Correspondence between other operations and keyboard shortcuts

Operation	Key
Set error bar for X-axis (For the asymmetry error, focus on the error which is set first, then focus on the other error if pressed again).	F5
Set error bar for Y-axis (For the asymmetry error, focus on the error which is set first, then focus on the other error if pressed again).	F6
Focus on the next data point.	F7
Focus on the previous data point.	F8

A.2 Changes from GSYS2.0 to GSYS2.2

- Automatic axis detection is implemented. Refer to section 2.3 for details.
- Right click menu in the text area of Input Dialog and Output Dialog is implemented.

- Checkbox style clear dialog is implemented. It provides various selection and clarity.
- Rm button become applicable to axes, while it was only applicable to data points and error bars.
- File name is displayed at title bar when a file is opened from "Open Image" in "File" menu.

A.3 Changes from the first GSYS to GSYS2.0

- Simplified setup process by replacing tar.gz package with a single file which is executable by double click.
- Feedback function to reuse the old numerical data directly on the image. (Refer to Capter 3)
- Instead of AWT, new GUI system 'Swing' was adopted to eliminate the platform dependence. The whole system becomes lighter by this change.
- Thoroughly revised the design, and user interface.
  - Minimum necessary functions remains as buttons on the control bar and menus in the menu bar instead of assigning all the functions to the buttons.
  - It becomes easy to resize the window so that the display can be used effectively.
  - Modified interfaces enables to move the data points directly by clicking and dragging a mouse.
  - The operations for data points and error bars changed to be the same though former GSYS had different operation styles for them. In addition, the direction of an error bar is changed to be parallel to the X or Y axis. For the display of a symmetric error, showing error bars on the top and bottom (left and right) of the point makes it possible to evaluate the accuracy of the symmetric error bars.
- Responded the problems about axes which were found in the rerecording process of NRDF D1501-D1600.
  - Several problems were found: the positions of the ends of the axes depends on the user of the system. This user dependence affects the accuracy of the numerical data crucially. Besides, in the digitizing system, it is difficult to read the data with high accuracy if X-axis and Y-axis are not orthogonal. Therefore, the developer added a guide which makes X-axis and Y-axis be orthogonal to each other in order to reduce the effect of the user dependence about the configuration of the axes.
  - The axis manager is added and makes it possible to check of the values of the ends of the axes twice in order to decrease the mistake for setting the values of the ends of the axes. Besides, the opportunity to check the values of the ends of the axes is increased further by displaying them on the image.
- Improved treatment of file formats.
  - Become able to change a digit number of the output numerical data.
  - Become able to output the fixed point representation.
  - The error in the treatment of NRDF format file is modified. (The position of the output of the error for X; white space is outputted in the asymmetric error which includes `NEGLIGIBLE`, `UNKNOWN`) NEGLIGIBLE is automatically output for the data with no error, and it makes the generation of the numerical data with NRDF format easy.
  - EXFOR Format file becomes available.
- Configuration file enables to save the settings after quitting the system and configure by editing the configuration file.

References

[1] K. Arai, A. Minoguchi, N. Otuka, K. Naito, *GSYS: Development and usage of a software to read-in and digitize the graphical data*, NRDF Annual Report No.18, 2004, p. 78; Progress report 2004 (INDC(JPN)-194/U). (http://www.jcprg.org/gsys/ver1/gsys-e.pdf)

[2] R. Suzuki, *GSYS2 Manual*, NRDF Annual Report No.19, 2005, p. 10. (http://www.jcprg.org/gsys/ver2/gsys2-e.pdf)