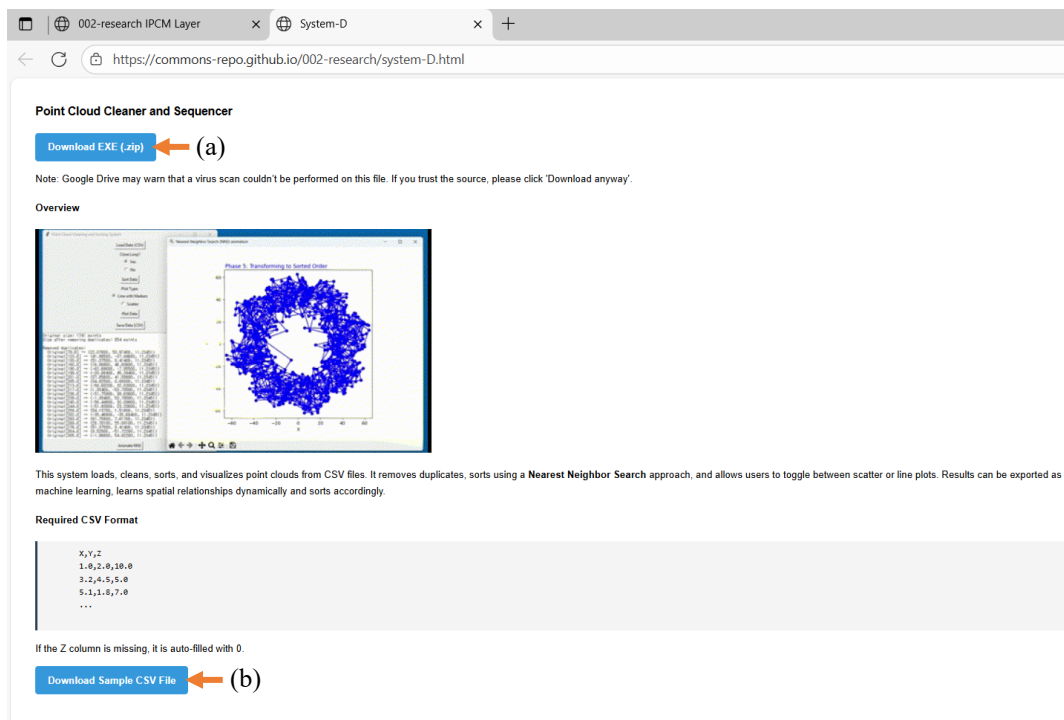How to use System D

(Point Cloud Cleaner and Sequencer)
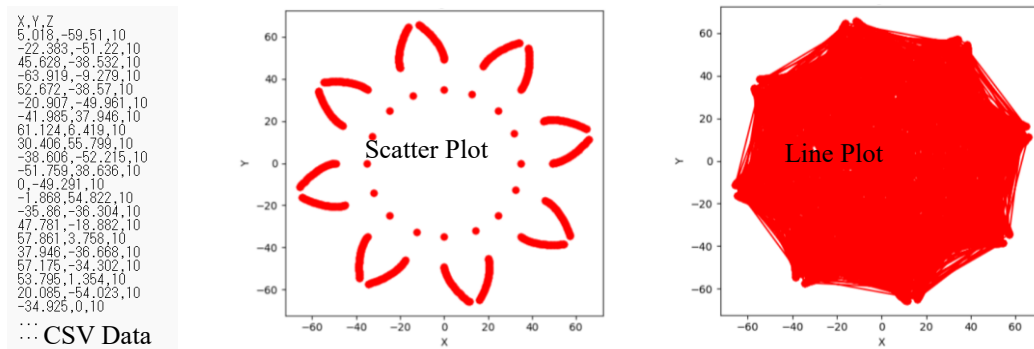
1. (a) Download the system (.exe) from the web portal.

   (b) Download the sample CSV file (sample.csv).

Note:

○ The download for System D is provided as a ZIP archive. Extract the file before running the application. Inside the extracted folder, locate 'Point Cloud Cleaning and Sorting System.exe', which is the executable to launch. Please ensure that Python is installed on your system, as the application uses Python in the backend to perform all processing steps.

○ System D is designed to assist in situations where a given point set contains numerous duplicate coordinates or lacks a meaningful sequential order, making it difficult to render a proper boundary or contour from those points. It is an optional tool—used only when such issues arise—and not required in every workflow. To demonstrate its functionality, this guide uses the point set provided in the downloaded 'sample.csv' file. Please use that file when following the steps, as it establishes the context for the examples shown.
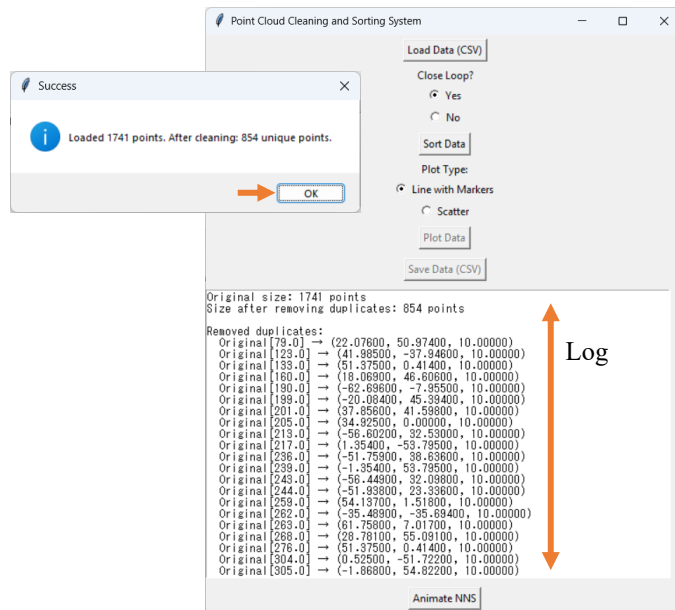
2. To understand the need for ordering or sequencing, it is helpful to examine the CSV file directly. As seen below, when the X–Y points are plotted as a scatter plot, the individual points appear well distributed and clearly resemble a spur gear profile. However, when the same points are plotted as a line plot using their original order in the file, the result is a tangled curve in which points are connected in a seemingly random manner, producing a meaningless shape. In other words, while the point coordinates themselves are appropriate, their sequence is not yet suitable for constructing a meaningful path or boundary in script-based CAD environments. System D is designed to address this situation when required: it accepts such point sets, removes duplicates, orders the points, and produces a final, sequenced dataset. With this context in mind, the following steps describe how to operate the system.


```
X,Y,Z
5.018,-59.51,10
-22.383,-51.22,10
45.628,-38.532,10
-63.919,-9.279,10
52.672,-38.57,10
-20.907,-49.961,10
-41.985,37.946,10
61.124,6.419,10
30.406,55.799,10
-38.606,-52.215,10
-51.759,38.636,10
0,-49.291,10
-1.868,54.822,10
-35.86,-36.304,10
47.781,-18.882,10
57.861,3.758,10
37.946,-36.668,10
57.175,-34.302,10
53.795,1.354,10
20.085,-54.023,10
-34.925,0,10
...
```
∴∵ CSV Data

Scatter Plot

Line Plot

3. Double-click the executable (.exe) file to launch the system. The interface shown below will appear. Click the 'Load Data (CSV)' button and select the sample.csv file.

4. After the file is loaded successfully, a pop-up appears. If duplicates are present, the system automatically removes them and reports the result in the pop-up. In this example, 1,741 points were loaded, and after cleaning, 854 unique points remain, as shown below. After selecting 'OK', detailed information about the removed duplicates—including their original indices and coordinate values—is displayed in the log panel on the interface.

5. After the cleaning step, the user must proceed as follows:

(a) Select either 'Yes' or 'No' for the 'Close Loop?' option. Selecting Yes instructs the system to treat the dataset as a closed boundary; the first point of the sequence is appended at the end to complete the loop. Selecting No leaves the dataset open, with no additional point appended. The choice depends on the intended application. The default is Yes. In this example, we keep Yes because the dataset corresponds to a gear profile, which must form a closed boundary.
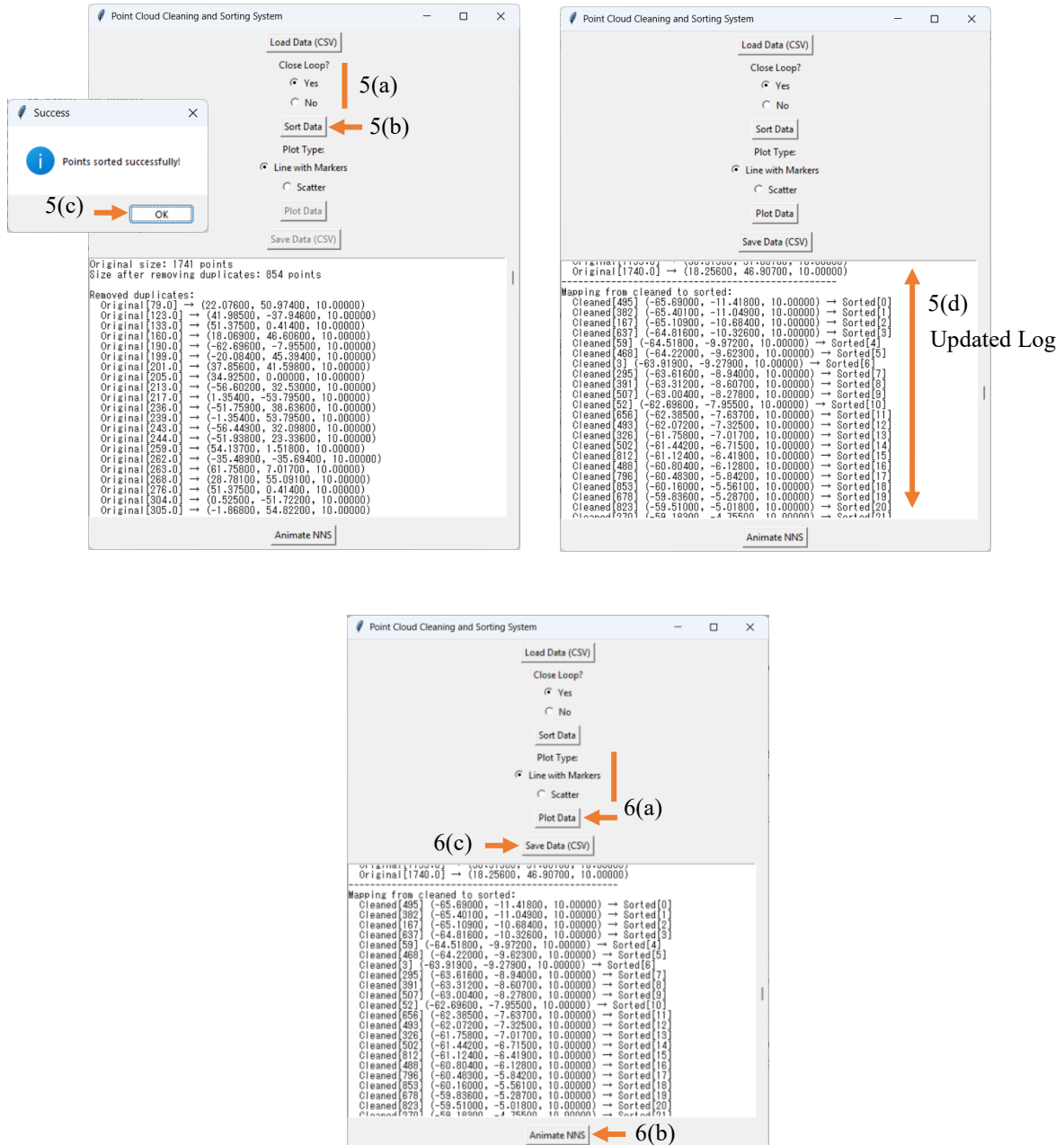
(b) Click the 'Sort Data' button (see below). The system then applies the nearest-neighbor search (NNS) method to order the cleaned points and generate a meaningful boundary sequence.

(c) When the confirmation pop-up appears, click 'OK' to proceed.

(d) The log is then updated to show the mapping produced by the algorithm between each

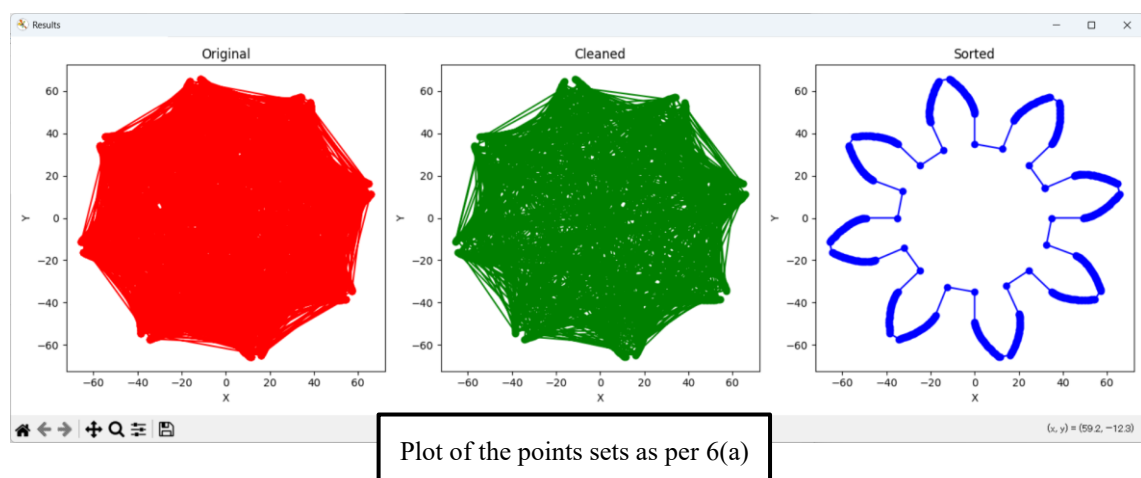cleaned point and its corresponding position in the sorted sequence.

The following screenshot show these steps (5a-d).

6. (a) After sorting, the user may visualize the outcomes by plotting the originally loaded points, the cleaned points, and the final sorted points. Select the desired plot type (Scatter or Line with Marker), choose the dataset(s) to display, and click the 'Plot' button.

(b) The system also provides an option to animate the nearest-neighbor sorting process. Clicking 'Animate NNS Method' generates a step-by-step animation illustrating how each successive point is selected during sorting.

(c) Finally, the processed datasets can be exported using the 'Save Data (CSV)' button. Upon providing a filename—say, points—the system saves three separate CSV files: points_original.csv, points_cleaned.csv, and points_sorted.csv. These files correspond respectively to the initially loaded dataset, the duplicate-removed dataset, and the ordered dataset produced by the nearest-neighbor method.

Plot of the points sets as per 6(a)

The figure above shows the line plots for the originally loaded, cleaned, and sorted point sets, respectively. As evident from the final plot, the ordering issue has been resolved, and the points now form a coherent boundary as intended.