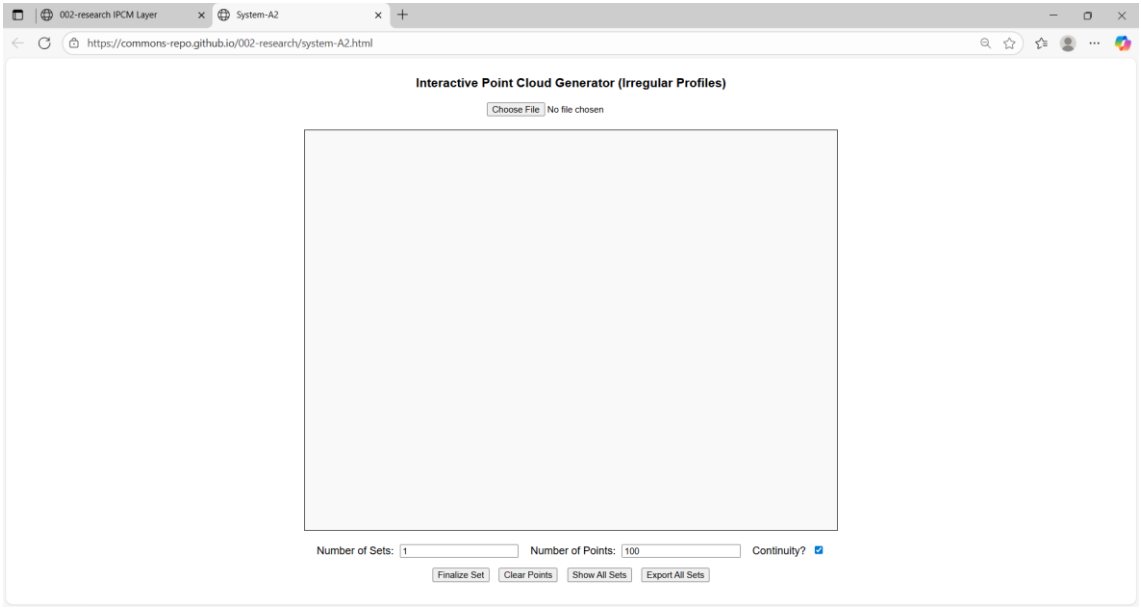
How to use System A

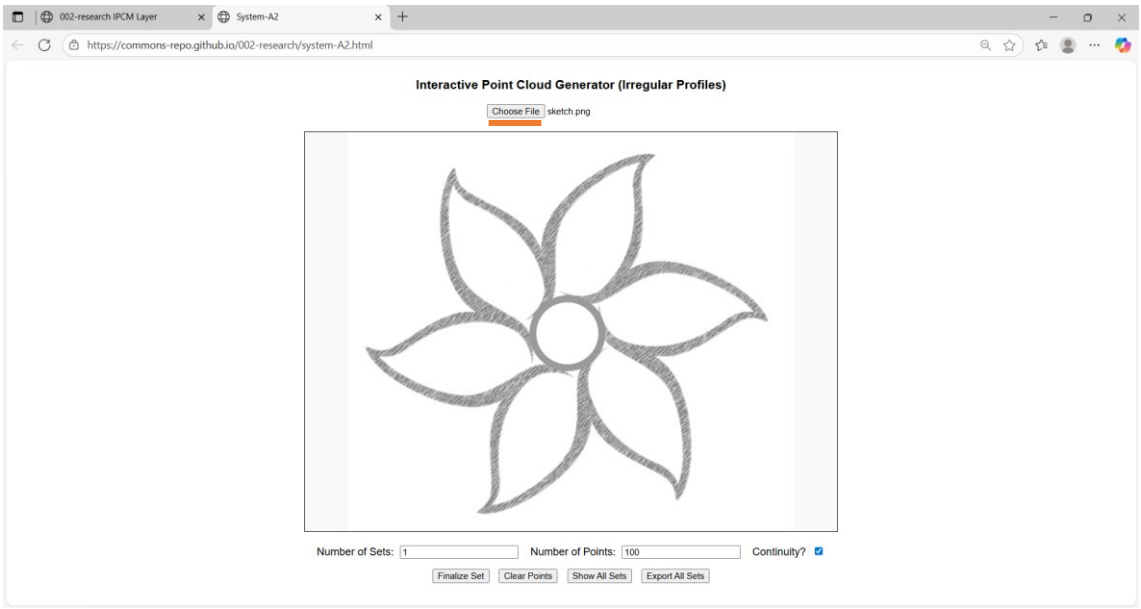
(Interactive Point Cloud Generator (Irregular Profiles))

A2: Spline (D3.js)-based algorithm

1. Open the system. An interface will be opened like below.

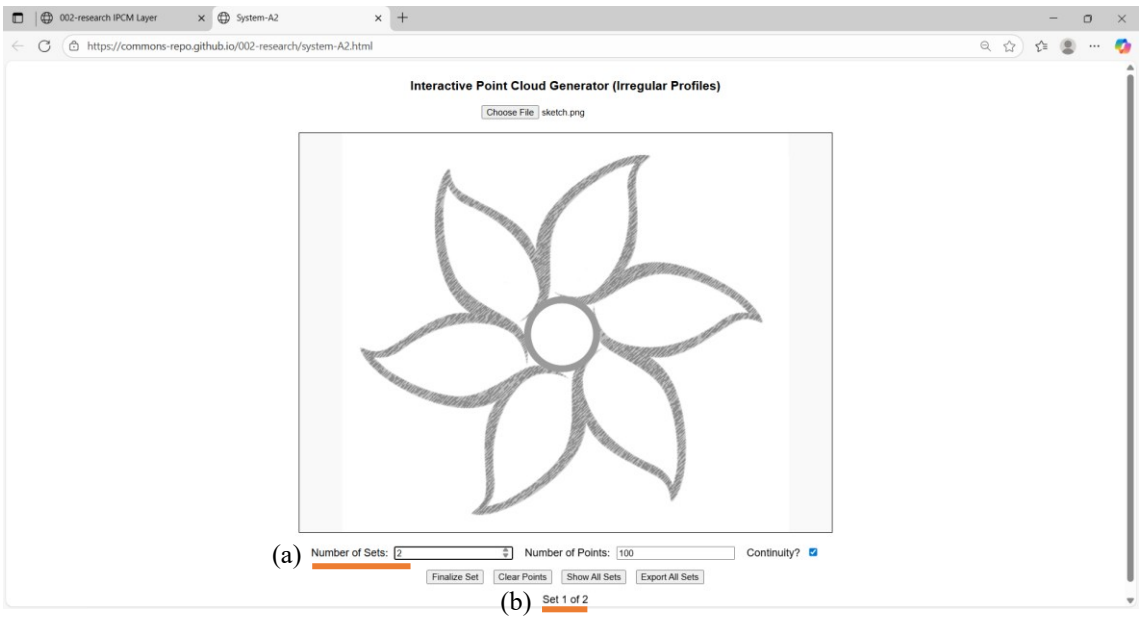


2. Load the concept image into the workspace using the ‘Choose File’ button. The image appears and serves as a visual reference for placing control points.



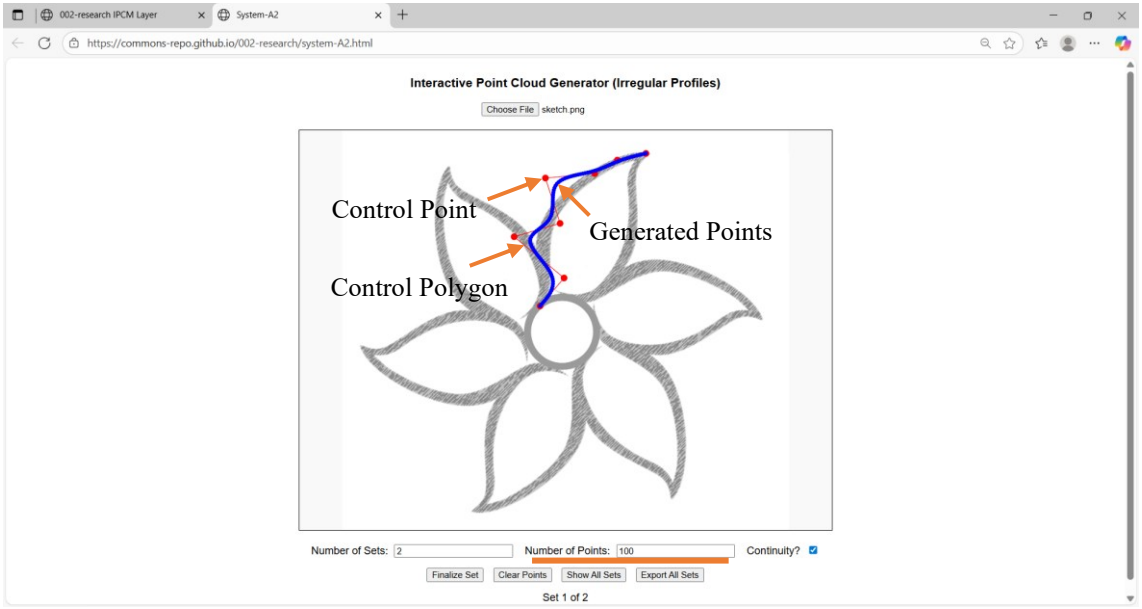
3. (a) Set the ‘Number of Sets’, which can range from 1 to any positive integer. For example, the above image contains six symmetric circular petals, but only one petal needs to be constructed manually; the remaining petals can be created later through mirroring or rotation. To generate the geometry of a single petal, 2 sets are sufficient, because one petal consists of two directional segments: from the starting position to the sharp tip, and from the tip to the end position. The following screenshot illustrates this setup with the value set to 2.

   (b) Once the number of sets is defined, the system becomes immediately ready for point placement. A message label appears on the interface indicating the active set (e.g., Set 1 of 2). This label updates automatically as the workflow progresses. The following screenshot shows this as well.

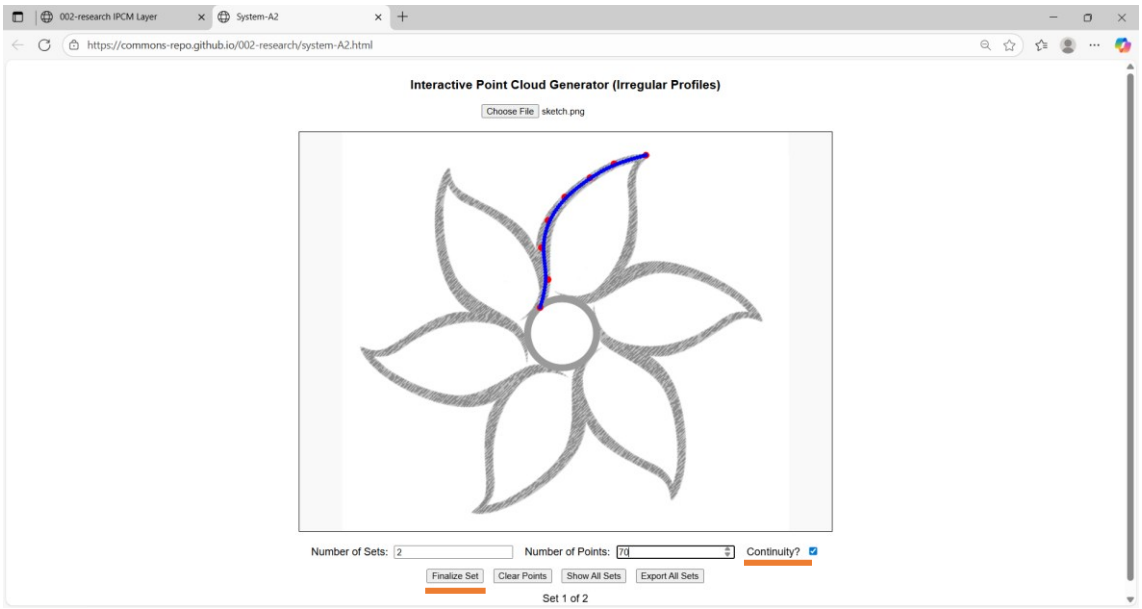


4. After that, control points are placed directly on the canvas by clicking on the desired positions. Each control point appears in red, and the control polygon connecting the points is rendered immediately. Because this system uses D3.js spline interpolation, the corresponding dense point cloud (shown in blue) is generated and updated dynamically with each new point. The curve also adjusts continuously whenever a control point is dragged to a new location. The number of dense points, which is set to 100 by default, can be changed at any time through the “Number of Points” input field; updates take effect immediately and the curve is regenerated automatically. This creates an entirely iterative workflow in which point placement, refinement, and curve formation occur simultaneously. Note that a minimum of

four control points is required for the cubic spline basis to produce a stable and meaningful curve. The following screen shot shows a relevant example.

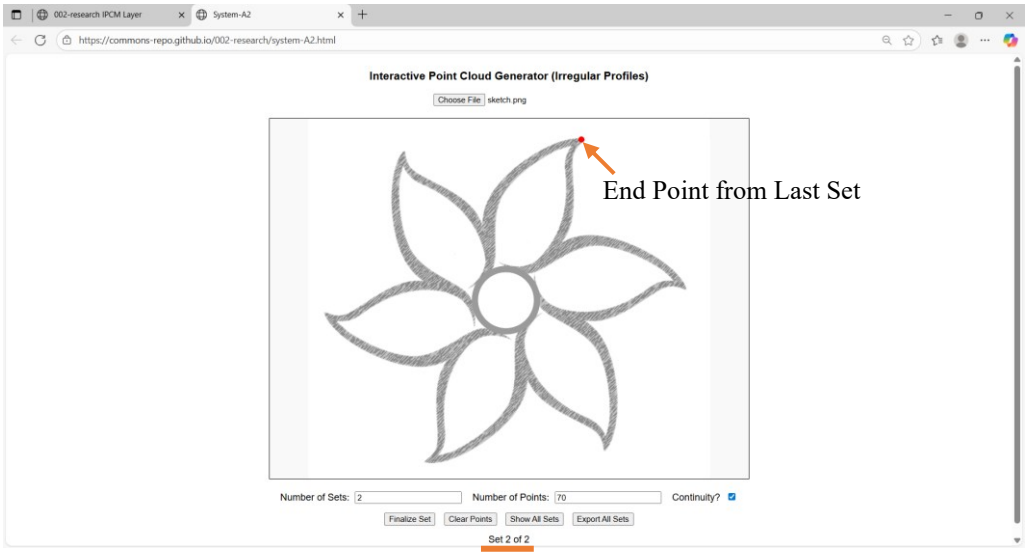


5. Once a satisfactory curve for Set 1 is obtained, click the ‘Finalize Set’ button. This stores both the control points and the dynamically generated dense points for the current set. Before finalizing, ensure that the ‘Continuity?’ checkbox reflects the intended behavior: keep it checked if the first point of the next set should automatically align with the last point of the current set (C0 continuity), or uncheck it if the next set should begin independently.

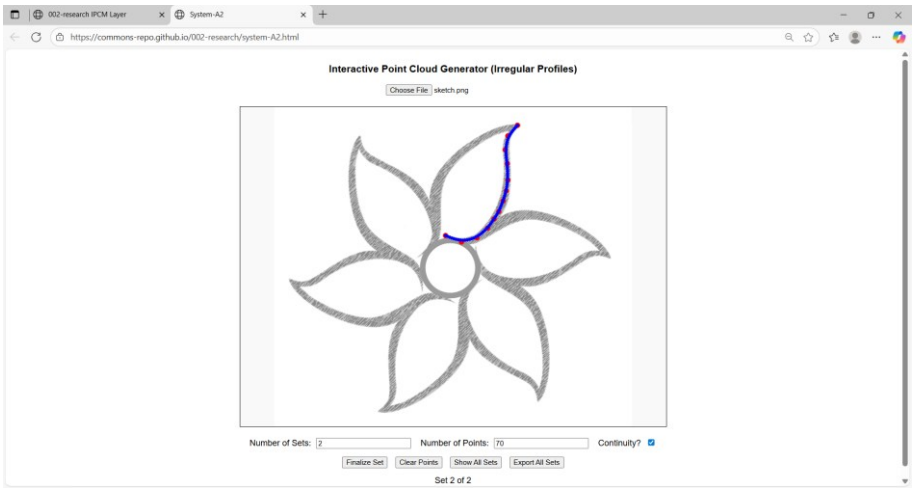


In this example, the continuity option is kept enabled, and the ‘Finalize Set’ button is selected as shown in the above image.

6. After finalization, a pop-up appears confirming that the current set is complete and that the system is ready to proceed to the next one. Selecting ‘OK’ closes the pop-up, after which the interface updates the status label (e.g., Set 2 of 2) to indicate that the workflow has moved to the next set. The following screenshot shows this scenario.

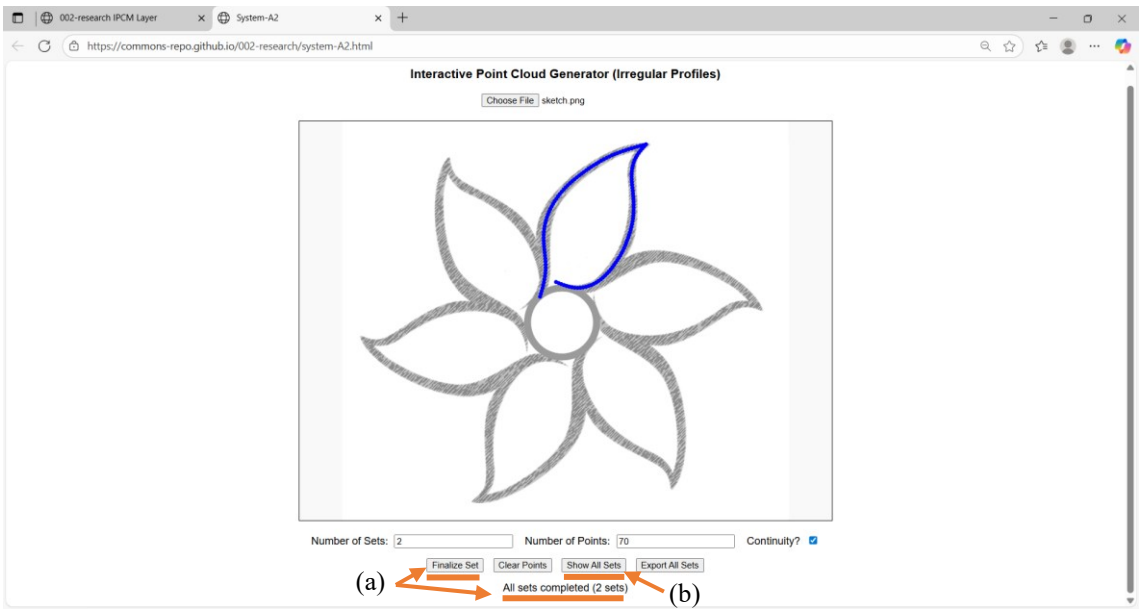


7. With Set 2 now active, control points can be placed on the canvas as before (see step 4). Additional control points can be placed, adjusted, and refined iteratively, and the dense point cloud updates dynamically as the user manipulates the control polygon. The following screenshot shows this scenario.

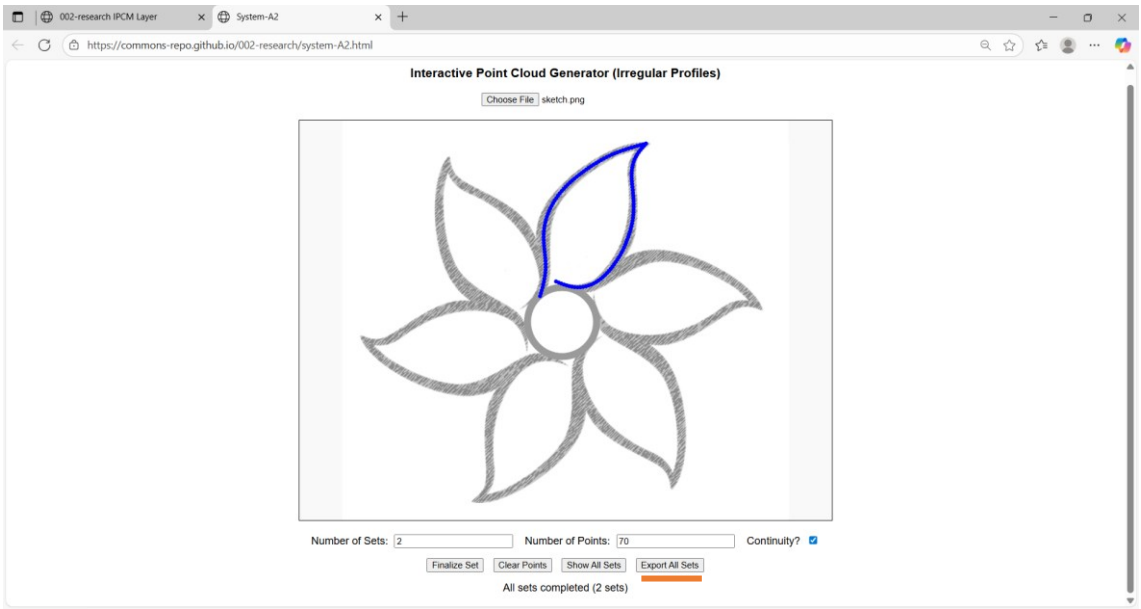


8. (a) Once a satisfactory outcome is reached for Set 2, click the ‘Finalize Set’ button. Since the total number of sets was specified as 2, this action completes the entire point-generation process. A pop-up appears confirming that all sets have been successfully created. Select ‘OK’ to close the pop-up and return to the canvas. Note that if additional sets are specified (more than two), the same sequence of operations—placing control points, generating dense points, adjusting as needed, and finalizing—continues in the same cyclic manner for each remaining set.

   (b) To visualize the combined result, click the ‘Show All Sets’ button. This displays all finalized sets—both control points and dense points—together on the canvas, allowing the user to inspect the assembled geometry. The following screenshot shows an example.



9. Click the ‘Export All Sets’ button to download the points data in CSV format. The exported CSV file contains all sets in a consolidated format, where each row specifies the set identifier, the point type, and the corresponding coordinates. The column structure is Set, Type, X, Y. The X and Y values represent the canvas-space coordinates used during point creation, based on the 800×600 drawing canvas. For each set, the file lists the control points first, followed by the generated dense points. An example excerpt is shown below, where Set 1 includes its control points and dense points in sequence, followed by Set 2 with its corresponding entries. This format ensures that all point-cloud data are organized sequentially and remain clearly distinguishable across multiple sets.



Exported data format in CSV:

```
Set,Type,X,Y
1,Control,361.55554,263.69443
1,Control,373.55554,221.69444
1,Control,363.55554,173.69444
1,Control,373.55554,132.69444
1,Control,398.55554,97.69444
1,Control,436.55554,68.69444
1,Control,472.55554,47.69444
1,Control,520.55554,34.69444
1,Dense,361.55554,263.69443
1,Dense,362.78452,259.39297
1,Dense,364.01202,255.09113
1,Dense,365.19644,250.77727
1,Dense,366.28922,246.43933
...
...
2,Control,493.55554,176.69444
2,Control,485.55554,196.69444
2,Control,476.55554,210.69444
2,Control,464.55554,227.69444
2,Control,444.55554,245.69444
2,Control,415.55554,253.69443
2,Control,385.55554,241.69444
2,Dense,520.55554,34.69444
2,Dense,517.73529,37.82806
2,Dense,514.93903,40.98299
2,Dense,512.24518,44.22555
2,Dense,509.69797,47.58435
2,Dense,507.33890,51.07757
2,Dense,505.22266,54.72258
2,Dense,503.41980,58.53192
...
...
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