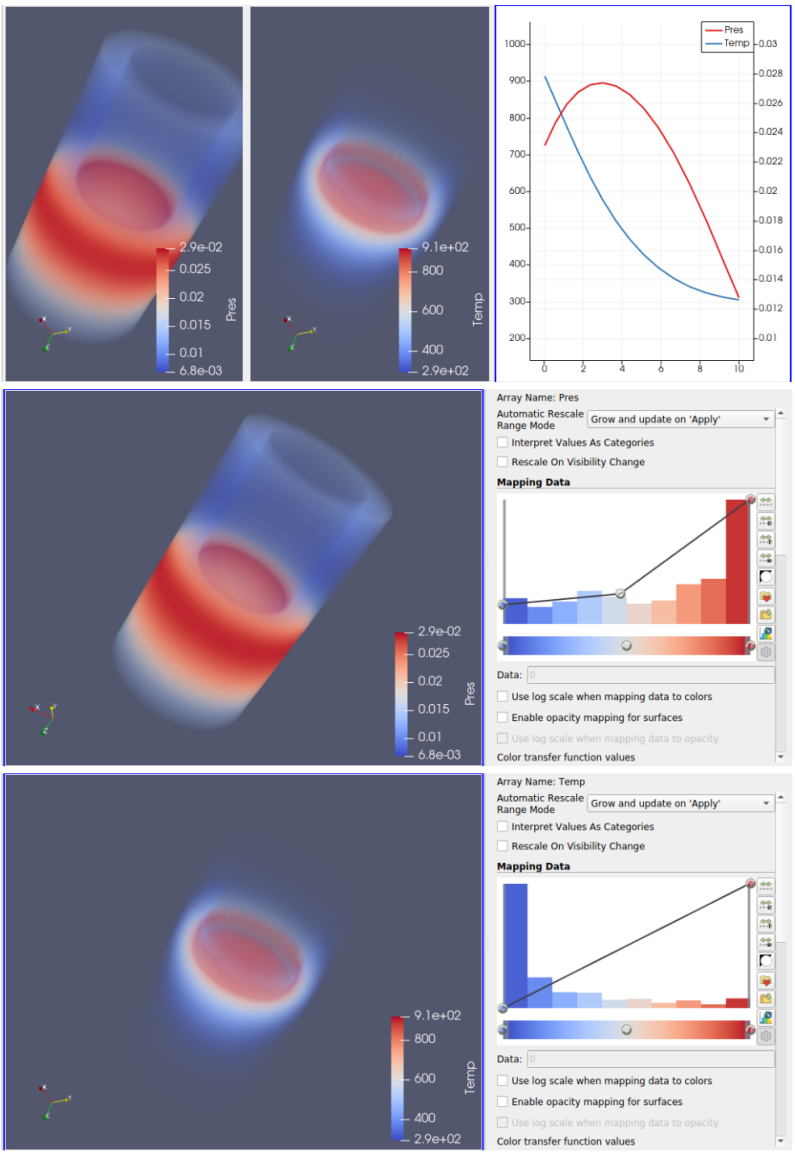
Visualization 1

Aim (aim): This visualization aims to find data attributes, analyse the attributes and thereby plot a graph to see the relation between the attributes. The trend of each data attribute would be inferred by showing the volume representation of the display. The data set used for visualization is the default example data file provided by Paraview (disk_out_ref.ex2). The value of pressure is getting increased at the beginning and then lowered from the point near to 0.028. The temperature on the other hand is decreased right from the value 900 to its end.

Visual Design Type (vistype): Volume visualization with line chart

Image:



Visual Mappings (vismapping): The unique concept that is generated from data is to visualize the relation between data attributes in the given volume data set. Hence visualization is done by loading the data into paraview and applied transfer functions to identify the trends and plot a line chart combining both attributes. The data attributes taken here is temperature and pressure. Both of them are visualized separately and enhanced viewing capabilities of trend by altering transfer functions. The next objective was to plot both temperature and pressure in the same window so that it would be more clear for comparing the trend. Both attributes' color coding and opacity determination is in the range from blue to red. Legends are given in each window. Data histogram is also displayed along with the transfer function diagram. For the line chart plot over line is applied and different colors are assigned to data variables. Red color is given to the pressure and blue color is given to the temperature for plotting the line chart.

Data Preparation (dataprep): Dataset used here for visualization is an example data set given by paraview. It is loaded into paraview and creates two different windows consisting of data variables such as pressure and temperature. For pressure, color mapping is applied by three points which is given below.

```
Value 1: 0.00678552, Red: 0.231373, Green: 0.298039, Blue: 0.752941
Value 2: 0.017802, Red: 0.865003, Green: 0.865003, Blue: 0.865003
Value 3: 0.0288185, Red: 0.705882, Green: 0.0156863, Blue: 0.14902
```

Opacity is also applied by three points and the corresponding values are given below.

```
Value 1: 0.00678552, Opacity: 0.15625
Value 2: 0.0172477, Opacity: 0.24375
Value 3: 0.0288185, Opacity: 1
```

For temperature, color mapping is applied by three points and it is explained below.

```
Value 1: 293.15, Red: 0.231373, Green: 0.298039, Blue: 0.752941
Value 2: 603.15, Red: 0.865003, Green: 0.865003, Blue: 0.865003
Value 3: 913.15, Red: 0.705882, Green: 0.0156863, Blue: 0.14902
```

Opacity is applied by two points and the corresponding values are given below.

```
Value 1: 293.15, Opacity: 0
Value 2: 913.15, Opacity: 1
```

A plot over line filter has been applied to plot the line chart. Point 1 and point 2 values of the line are 0,0,0 and 0,0,10 respectively.

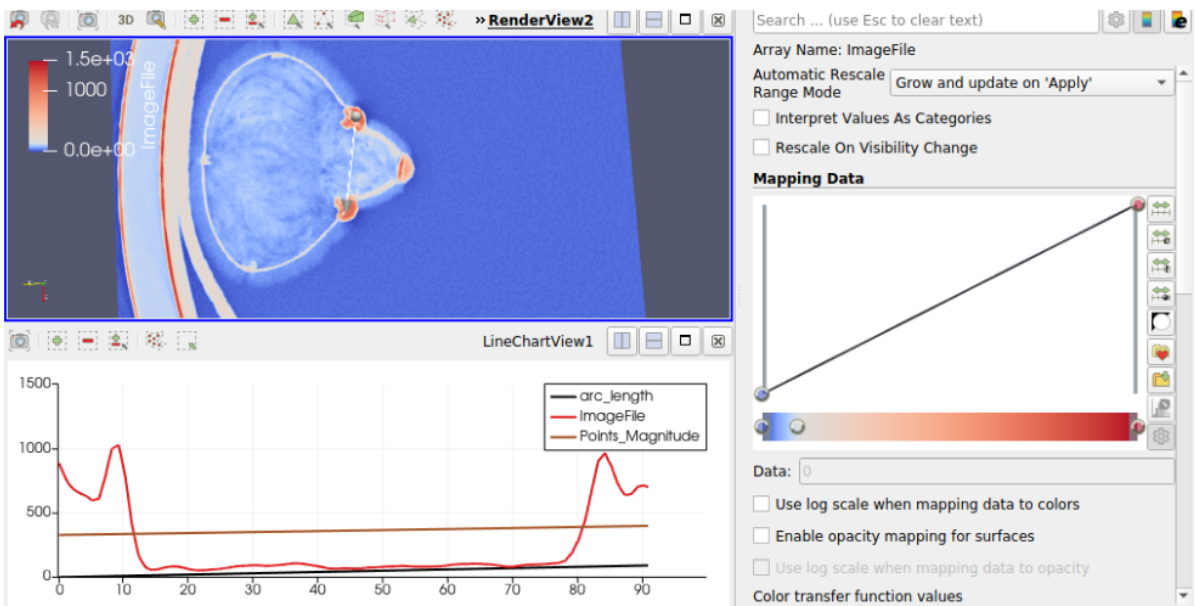
Improvements (improvements): Couple of improvements could be done by selecting more data variables to plot the chart so that the relation between those variables and pressure or temperature could be analysed. The data could be extracted over a particular area of the data set or slice through some part of the object in order to deeply scrutinize the trend over the extracted data.

Visualization 2

Aim (aim): From this visualization, it is seen that there are three mushroom-like knob structures which have high data magnitudes. The aim of this visualization is to plot lines over two of the knob structures and analyse how much is the peak magnitude and how much is the value in between two peak magnitudes. The data would be taken from a layer which has the most data visibility by slicing through the X-Y plane. The peak points are identified as (18.3467, 2049.98) and (84.2017,963) after plotting.

Visual Design Type (vistype): Volume visualization using slicing and line chart

Image:



Visual Mappings (vismapping): For this visualization, the data is loaded into paraview and applied to the transfer function to clearly identify the data variations. The representation is selected as a slice to check each layer and identify the layer where most of the information could be gained. A line is drawn in between two knobs to get the data. The plane used to slice here is the X-Y plane. The data over the line is plotted below the visualization object. The line is plotted over the X-Y plane as a surface representation. The most peak visibility of the data is at the slice number 15. Hence the Z axis value for two endpoints of the line is 15. Legends are given by default. In pipeline browser on plotoverline, "show line" property is checked in order to get a view of the line. Orientation axes visibility is also checked true. Probe type for plotoverline is selected as a high resolution line source. While plotting data in the graph, black color is chosen for arc_length, red is for ImageFile and brown is for points_magnitude.

Data Preparation (dataprep): Dataset used here is data1.raw. This data file is loaded into paraview and applied the following properties. File dimensionality is selected as 3. Data extent is given as (0, 511), (0, 511) and (0, 62). Data scalar type is short and data byte order is BigEndian. Number of scalar components is given as 1. Data origin and data spacing are (0,0,0) and (1,1,1) respectively.

Transfer functions applied with color values are as below

```
Value 1: 0, Red: 0.231373, Green: 0.298039, Blue: 0.752941
Value 2: 140.755, Red: 0.865003, Green: 0.865003, Blue: 0.865003
Value 3: 1492, Red: 0.705882, Green: 0.0156863, Blue: 0.14902
```

Opacity transfer function values are given below

```
Value 1: 0, Opacity: 0
Value 2: 1492, Opacity: 1
```

The data is sliced over 62 slices and the 15th slice has been taken to find the peak values. Data over line filters has applied to this slice and the line is stretched between two knobs. Point 1 and point 2 have the coordinates (194.933, 262.76, 15) and (284.569,277.455,15) respectively. The length of the line is 90.8325. The representation of the plot over line has been chosen as surface and a plot data filter has been applied to plot a line chart with the following data arc_length, ImageFile and Points_Magnitude which is mapped on the same plot. Attribute type is point data.

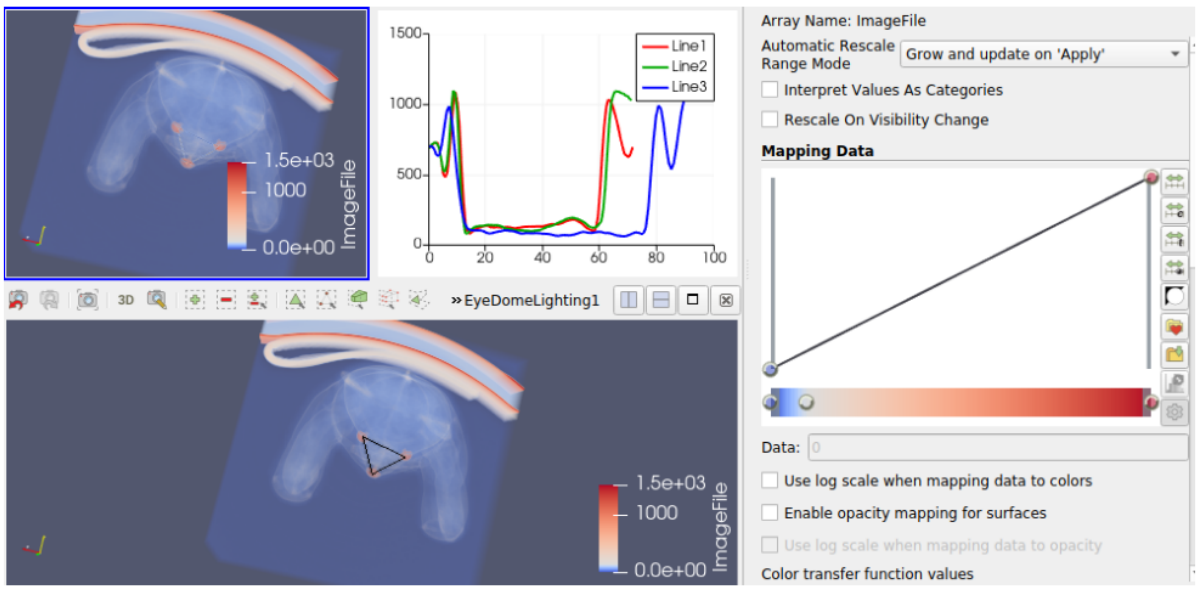
Improvements (improvements): Instead of restricting two points, taking three knobs into consideration could be an improvement so that a triangle could be formed with three knobs and plot data for observing the trend between these points. Slicing could be done on XZ and YZ planes also and find if the data has changed or not.

Visualization 3

Aim (aim): This visualization aims to produce a detailed analysis of data between three knob-like structures in the volume data set and infer that the data between those points are not similar or identical. This could be used for finding the distance between three points by analysing the peak data points of three lines. From the visualization it could be found that there are two identical data trends and the other one as more lengthier X axis values. The data has been taken from a layer which has the most data visibility.

Visual Design Type (vistype): Volume visualization using volume data and line chart

Image:



Visual Mappings (vismapping): For this visualization, the data is loaded into paraview and transfer function is applied to clearly identify the knob-like structures inside the data set. The representation is selected as volume for the dataset. Three lines are drawn and formed a triangle. The data is plotted on the right side of the volume image representation. Line 1, Line 2 and Line 3 have given red, green and blue colours respectively. It is identified as the third line has more length than the other two. For showing the lines between the knobs, eye-dome lighting is applied and shown in a separate window. Representation of this model is chosen as volume. Volume rendering mode is chosen as smart and blend mode is chosen as composite. Appropriate legends are shown on each window as well. The windows of both volume data and eye-dome lighting is linked together. Camera angle is set from the top to visualize the extracted data between lines. Orientation axes visibility is also set as marked.

Data Preparation (dataprep): Dataset used here is data1.raw. This data file is loaded into paraview and applied the following properties. File dimensionality is selected as 3. Data extent is given as (0, 511), (0, 511) and (0, 62). Data scalar type is short and data byte order is BigEndian. Number of scalar components is given as 1. Data origin and data spacing are (0,0,0) and (1,1,1) respectively.

Transfer functions applied with color values are as below

```
Value 1: 0, Red: 0.231373, Green: 0.298039, Blue: 0.752941
Value 2: 140.755, Red: 0.865003, Green: 0.865003, Blue: 0.865003
Value 3: 1492, Red: 0.705882, Green: 0.0156863, Blue: 0.14902
```

Opacity transfer functions are given below

```
Value 1: 0, Opacity: 0
Value 2: 1492, Opacity: 1
```

Data over line filter has applied between three points. Point 1, point 2, and point 3 have the coordinates (250.606, 214.583, 15), (284.569, 277.455, 15) and (196.693, 260.879, 15) respectively. Line 1 is drawn from point 1 to point 2. Line 2 is drawn from point 2 to point 3 and line 3 is drawn from point 1 to point 3 and thus forms a triangle. Eye-dome lighting is applied to the volume rendering and the same transformation is applied which is given above.

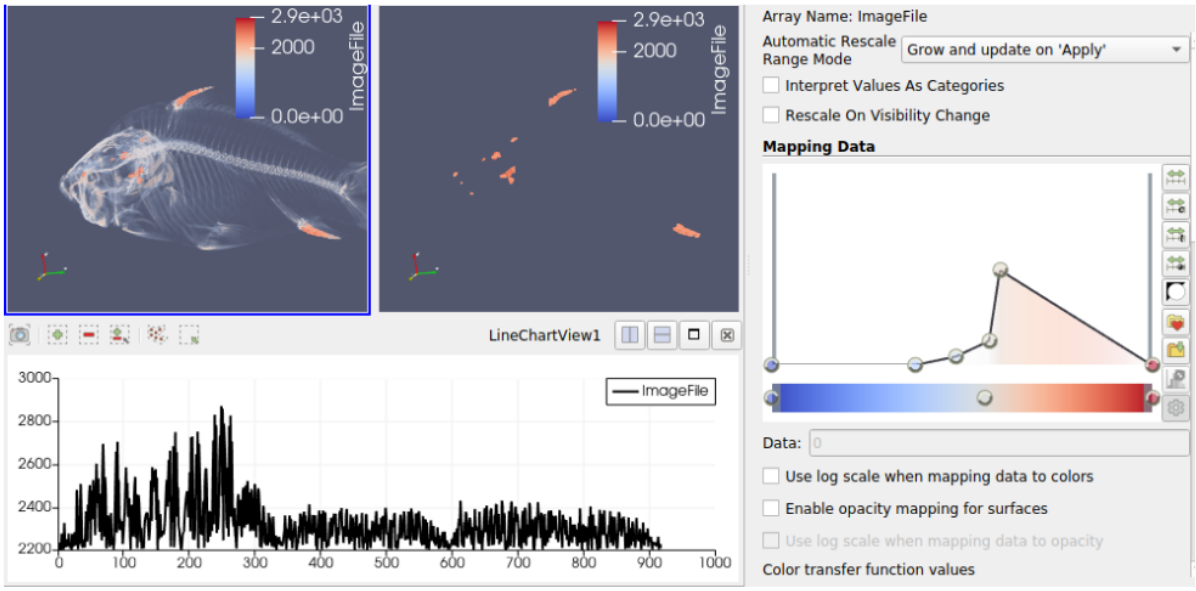
Improvements (improvements): Even though the data is plotted with three different colors on a single plot, it was unable to find what kind of data is plotted in the graph. Statistical transformation of data such as k means or principal component analysis also could be applied in order to find more interesting phenomenons in the data set.

Visualization 4

Aim (aim): The main aim of this visualization is to identify what kind of data model hidden in the given data set (dat2.raw) and find what all parts of the object have peak values which are greater than or equal to 2200. From the visualization, it is inferred that the hidden object is a fish bone structure in a 3D way. The data which has values greater than or equal to 2200 are identified as the top and bottom fin of the fish bone, and some parts of the head such as upper jaw, lower jaw and operculum.

Visual Design Type (vistype): Volume visualization

Image:



Visual Mappings (vismapping): The data is loaded into paraview and transfer functions are applied. The data "ImageFile" values are shown as legend on top right side of the visualization. The parts of the object having values greater than or equal to 2200 are given with different colors. Here it's given as dark reddish brown. For better viewability of selected data, the camera angle is set from the top right corner of the object. Since the data on the head part of the bone is not clearly visible, the extracted data is shown lonely in a separate window on the right side and a graph just below the volume visualization. The cameras of object and extracted content are linked together as well. The representation of the object is set to volume. Orientation axes are also shown on the bottom left corner of the window where the object is visualized.

Data Preparation (dataprep): Dataset used here is data2.raw. This data file is loaded into paraview and applied the following properties. File dimensionality is selected as 3. Data extent is given as (0, 255), (0, 255) and (0, 511). Data scalar type is short and data byte order is BigEndian. Number of scalar components is given as 1. Data origin and data spacing are (0,0,0) and (1,1,1) respectively.

Transfer functions are applied by six points in opacity and three points in color which is depicted below. Color values are

```
Value 1: 0, Red: 0.231373, Green: 0.298039, Blue: 0.752941
Value 2: 1607.04, Red: 0.865003, Green: 0.865003, Blue: 0.865003
Value 3: 2871, Red: 0.705882, Green: 0.0156863, Blue: 0.14902
```

Opacity transfer function values are given below

```
Value 1: 0, Opacity: 0
Value 2: 1083.4, Opacity: 0
Value 3: 1390.36, Opacity: 0.04375
Value 4: 1643.15, Opacity: 0.125
Value 5: 1724.41, Opacity: 0.49375
Value 6: 2871, Opacity: 0
```

From the whole data found from the data set, the aim was to extract the values greater than or equal to 2200. From paraview, the option to filter data from various criteria is chosen. From the selection window, points have been selected to choose ImageFile values. This process was followed by selecting "is >=" from the dropdown and given 2200 in the text box.

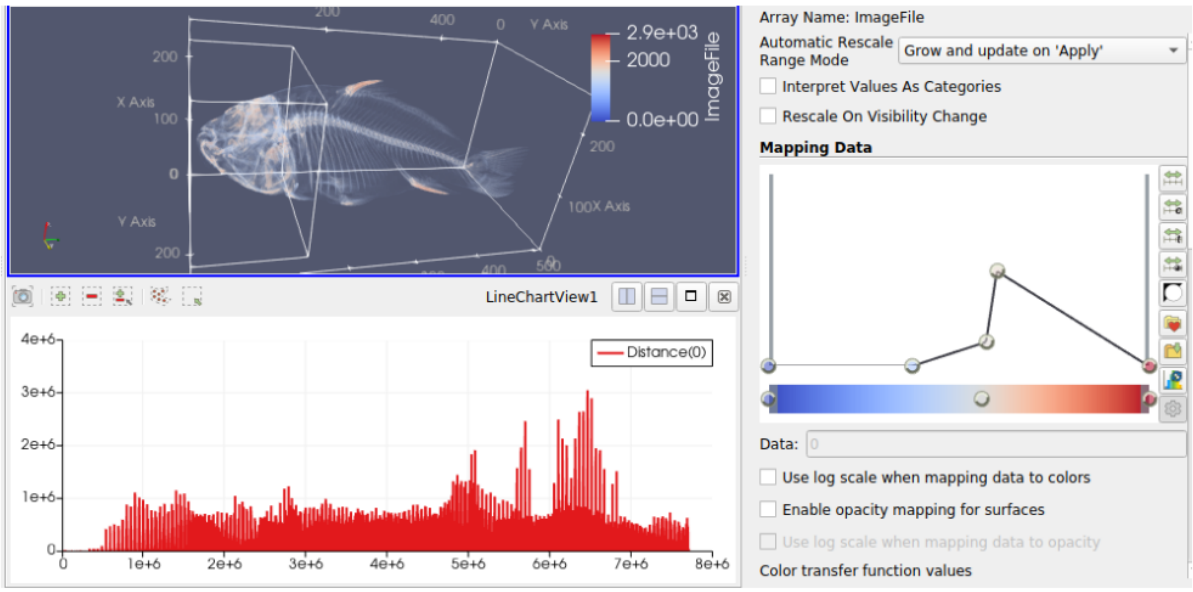
Improvements (improvements): The data extraction could be done in different ways. Not just greater than or equal to 2200. The extracted data could be plotted and would have shown different trends in those data.

Visualization 5

Aim (aim): The aim of this visualization is to extract data from the head part of the fish bone data and find K-means for all the data and identify the longest distances by plotting the trend of distances in a graph. From the visualization it is clear that the data is extracted from the head of the fish bone and looking into the plot, it is seen that the data is upsurge at the end.

Visual Design Type (vistype): Volume visualization by subset

Image:



Visual Mappings (vismapping): The data set is loaded in paraview and from the visualization is done as volume.The subset of the data extracted is shown as outline which is in the top window of the visualization. Transfer functions are also applied to clearly visible the head part. The camera angle is set in between the top and side part of the object. For the graph, the data values are represented in red color. Among the values obtained from applying k-means, the distance variable is plotted in the graph. Orientation axes visibility is enabled in visualization and appropriate legends are also given in the top right corner. The axes grid is selected as well. K-means statistical model is exported as spreadsheet and attached (statistical_model_viz5.csv). For plotting data, attribute type is chosen as point data. Three different variables were available such as Closest id, distance and imagefile. Among these three, distance is chosen to plot on the graph.

Data Preparation (dataprep): Dataset used here is data2.raw. This data file is loaded into paraview and applied the following properties. File dimensionality is selected as 3. Data extent is given as (0, 255), (0, 255) and (0, 511). Data scalar type is short and data byte order is BigEndian. Number of scalar components is given as 1. Data origin and data spacing are (0,0,0) and (1,1,1) respectively.

Transfer functions are applied by five points in opacity and three points in color which is depicted below. Color values are

```
Value 1: 0, Red: 0.231373, Green: 0.298039, Blue: 0.752941
Value 2: 1607.04, Red: 0.865003, Green: 0.865003, Blue: 0.865003
Value 3: 2871, Red: 0.705882, Green: 0.0156863, Blue: 0.14902
```

Opacity transfer function values are given below

```
Value 1: 0, Opacity: 0
Value 2: 1083.4, Opacity: 0
Value 3: 1643.15, Opacity: 0.125
Value 5: 1724.41, Opacity: 0.49375
Value 6: 2871, Opacity: 0
```

The data set is loaded and identifies the data as a fish bone object. Data extraction is done as a subset which is taken from the head part of the fish bone. The representation of the data subset is selected as an outline with opacity 1. Maximum number of labels is given as 100. This is followed by applying the k-means statistical filter to the extracted subset of data. For the statistical model of k-means, the task is selected as "Model and assess the same data". Other properties are as follows.

```
Training Fraction: 0.1
Value of k: 5
Maximum iterations: 50
Tolerance: 0.01
```

Improvements (improvements): Multiple subsets of data could be filtered from the data set and could compare statistical filters. For example, a subset of data from tail could be taken and by applying the same filters analyse what all differences are there when applying k means. While plotting the data, closest id could also be selected and shown along with the distance which might be helpful while comparing the trends.