

CS 6635: VISUALIZATION OF SCIENTIFIC DATA

HOMEWORK 3

PARAVIEW AND IMAGEVIS3D

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1 Recreation of the Hand Images - ImageVis3D

Ans. The results are attached as follows:

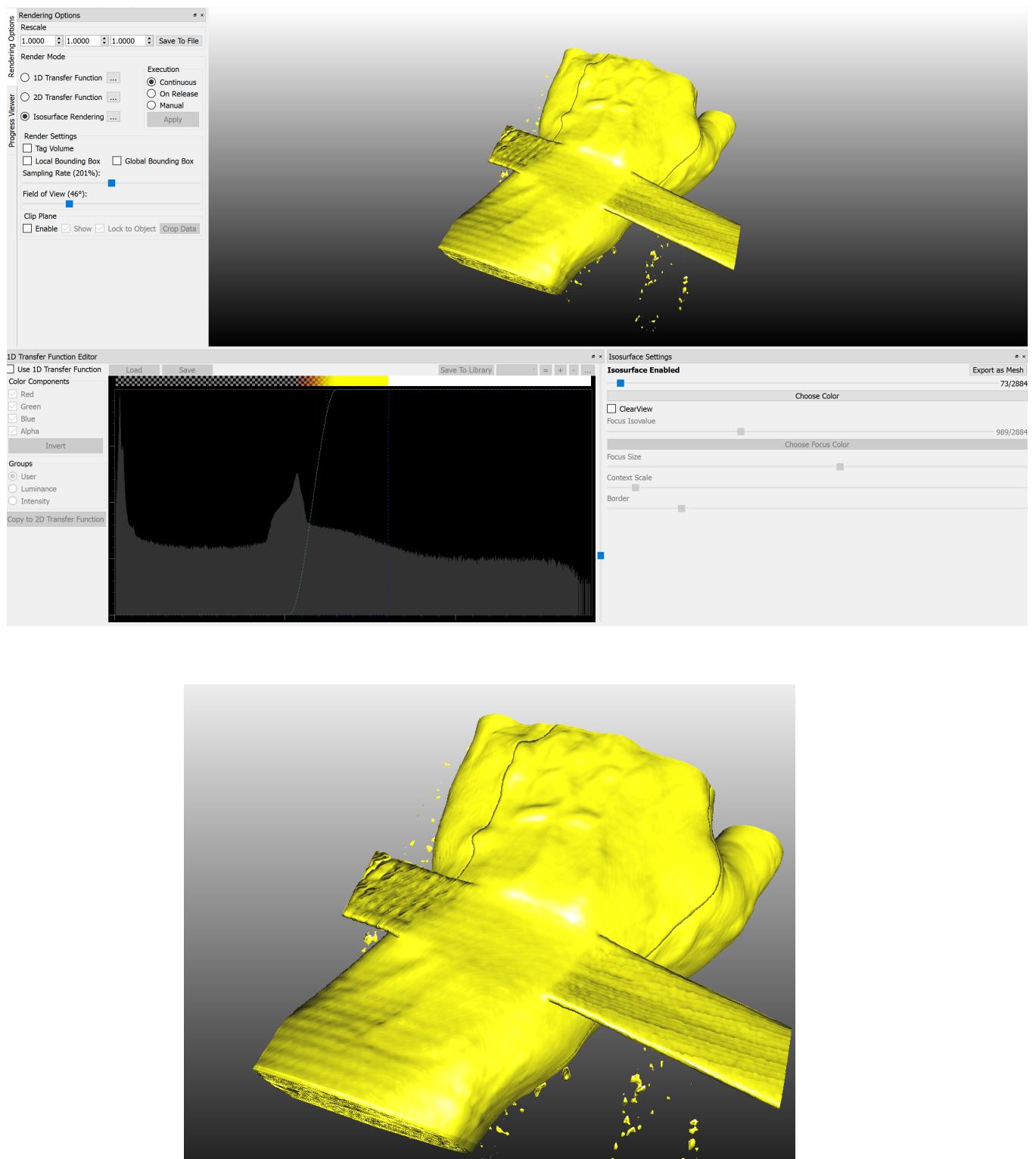


Figure 1: Hand-1 -> Top: Parametric Window View, Bottom: Resultant Diagram

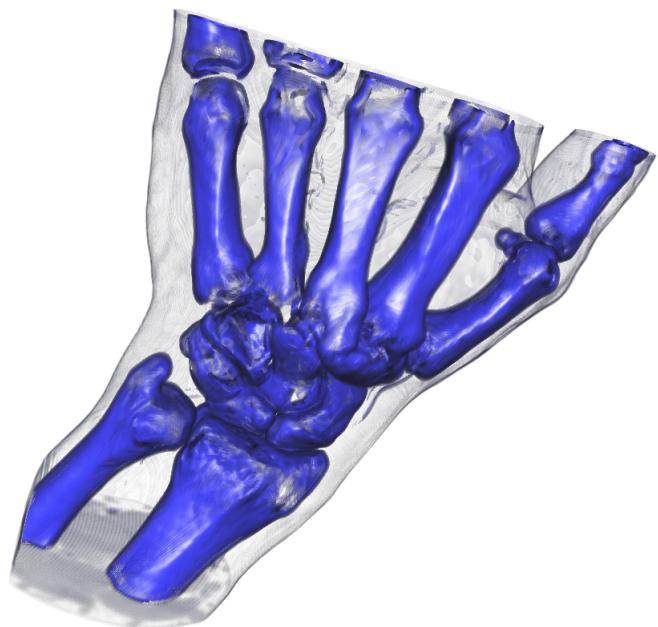
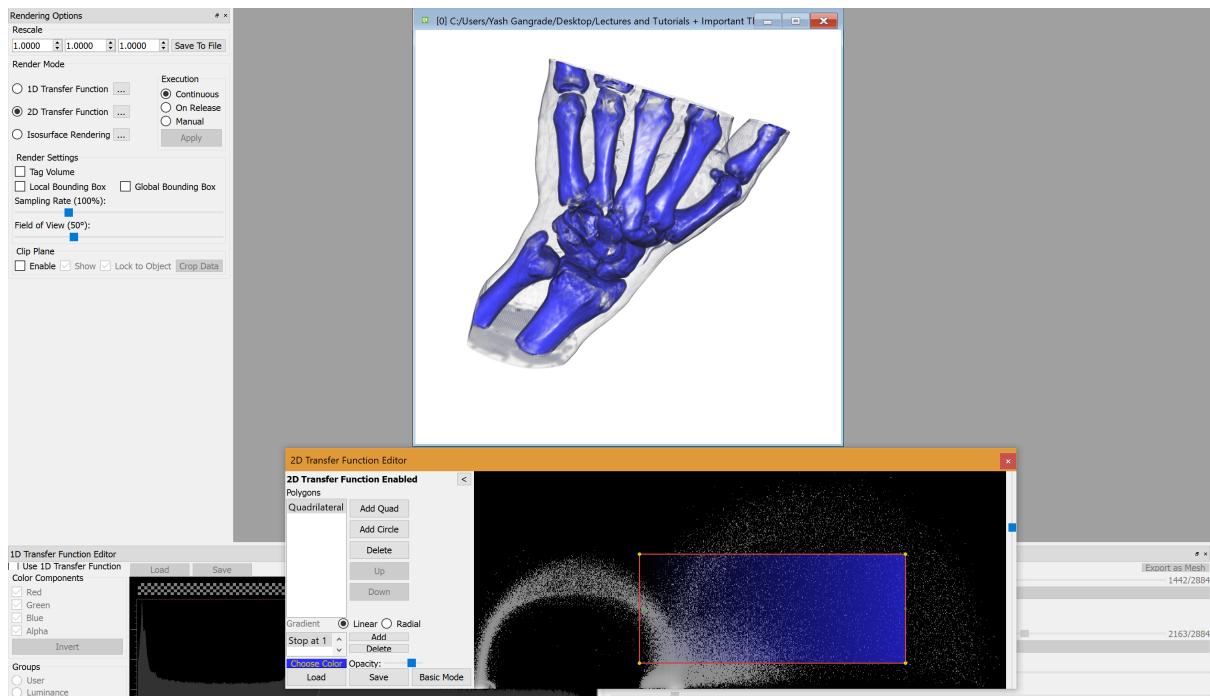


Figure 2: Hand-2 -> Top: Parametric Window View, Bottom: Resultant Diagram

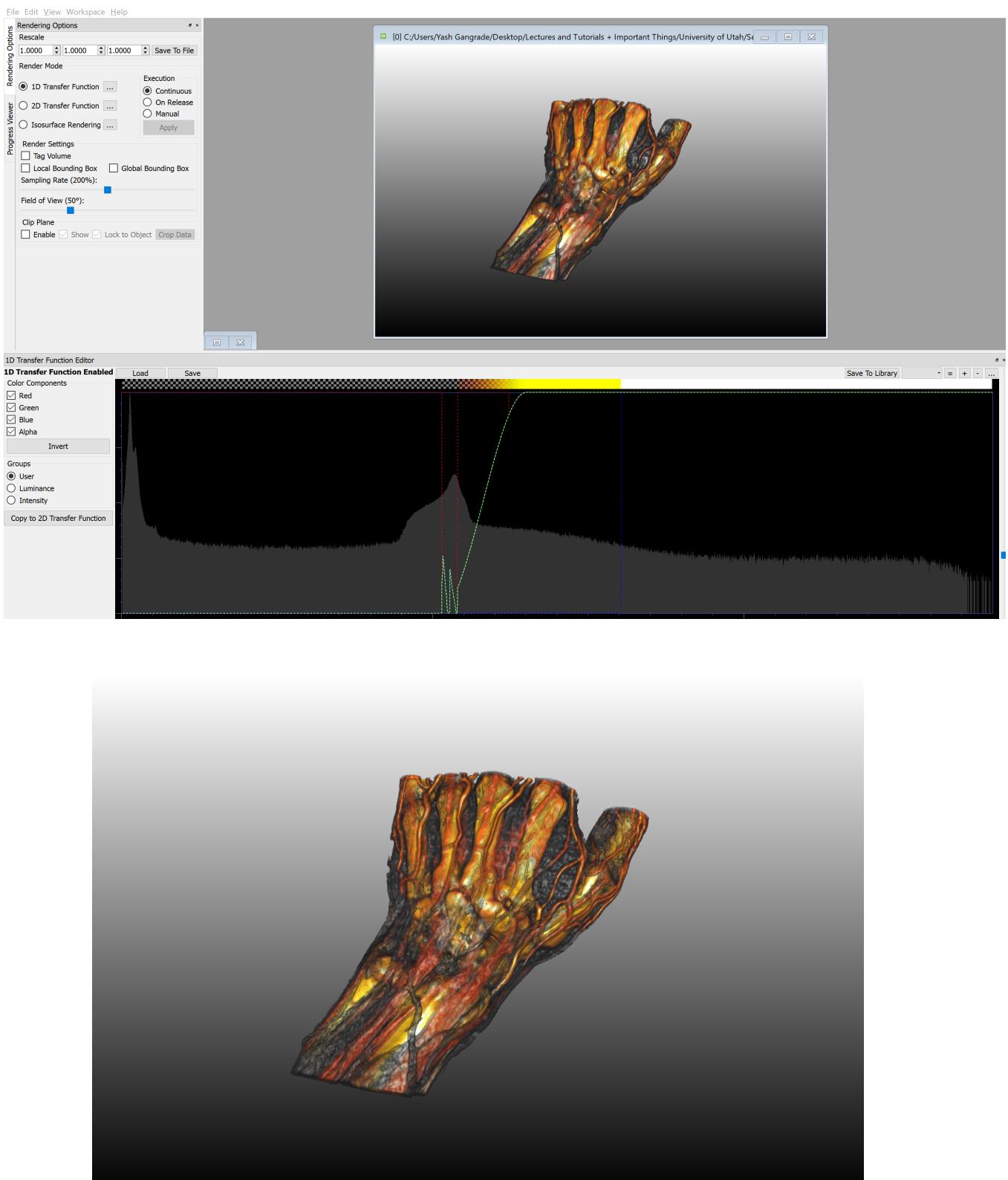


Figure 3: Hand-3 -> Top: Parametric Window View, Bottom: Resultant Diagram

For Hand 1 image, I used Isosurfacing as the rendering method. I tried to recreate the same image with 1D, 2D Transfer functions too but Isosurfacing seems like the easiest way to get the required image. I used "Yellow" Color for Isosurfacing with iso-value of 77 (nearby values also provided similar results). Although, I wasn't able to get rid of the yellow dots nearby the hand. Refer to Fig. 1.

For Hand 2 image, I used 2D-Transfer function as the rendering method. As seen in the tutorial video, I realized 2D transfer function can be chose to make the hand dataset look like this. A quadrilateral widget at the right location does the job. Also, I changed the color of the second stop to 'blue' to separate out the bone part. Refer to Fig. 2.

For Hand 3 image, I used 1D transfer function as the rendering method. I first loaded the 'hand16.1dt' transfer function downloaded from the imagevis3d website. Then, I changed the transfer function settings a bit to get the desired result. Refer to Fig. 3.

After loading the dataset and applying isosurfacing as the rendering method, I found the following results.

Iso-values corresponding to the skin: 140 to 950 (approx.)

Iso-values corresponding to the bone: 1250 onwards (approx.)

2 Recreation of the Hand Images - Paraview

Ans. The results are attached as follows:

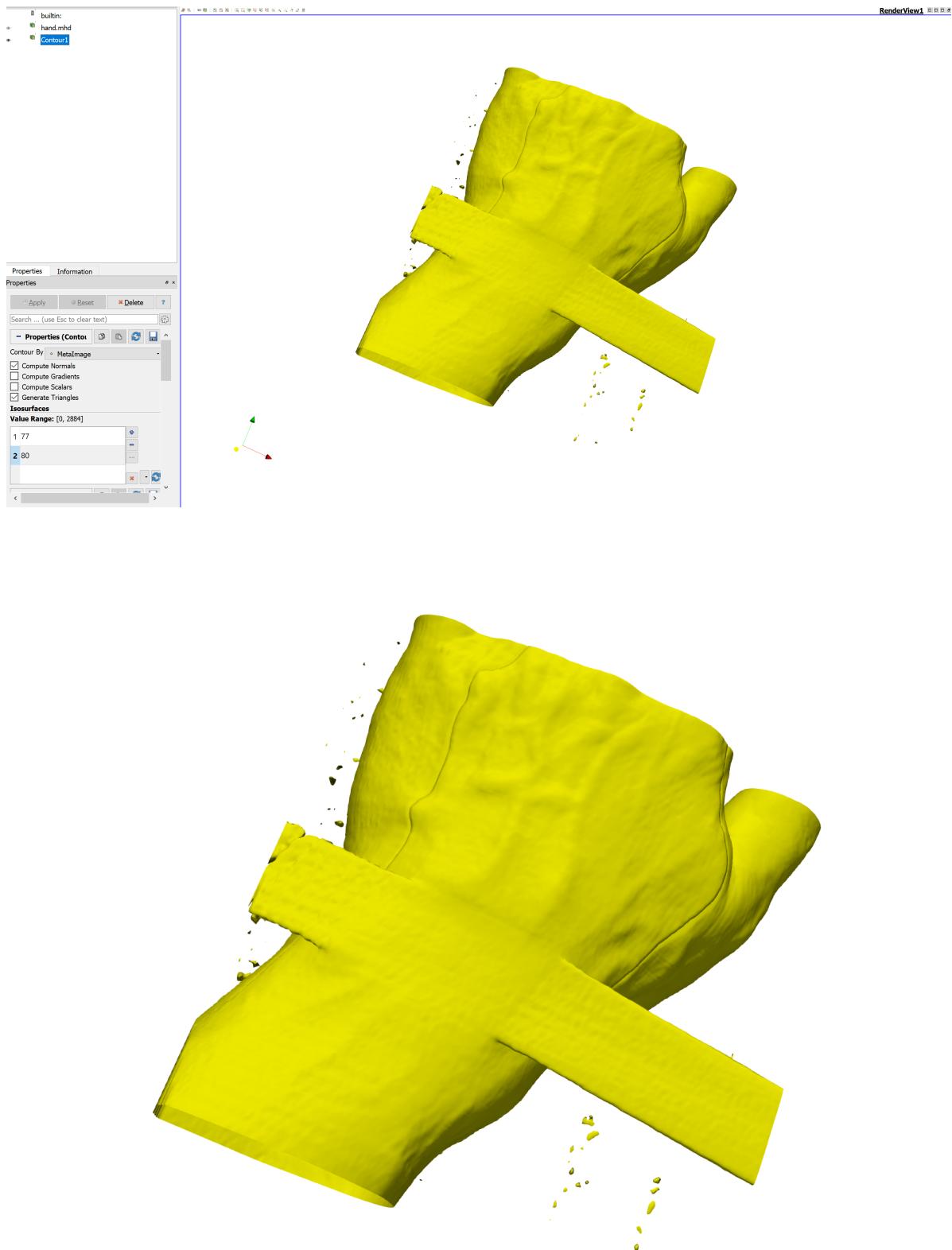


Figure 4: Hand-1 -> Top: Parametric Window View, Bottom: Resultant Diagram

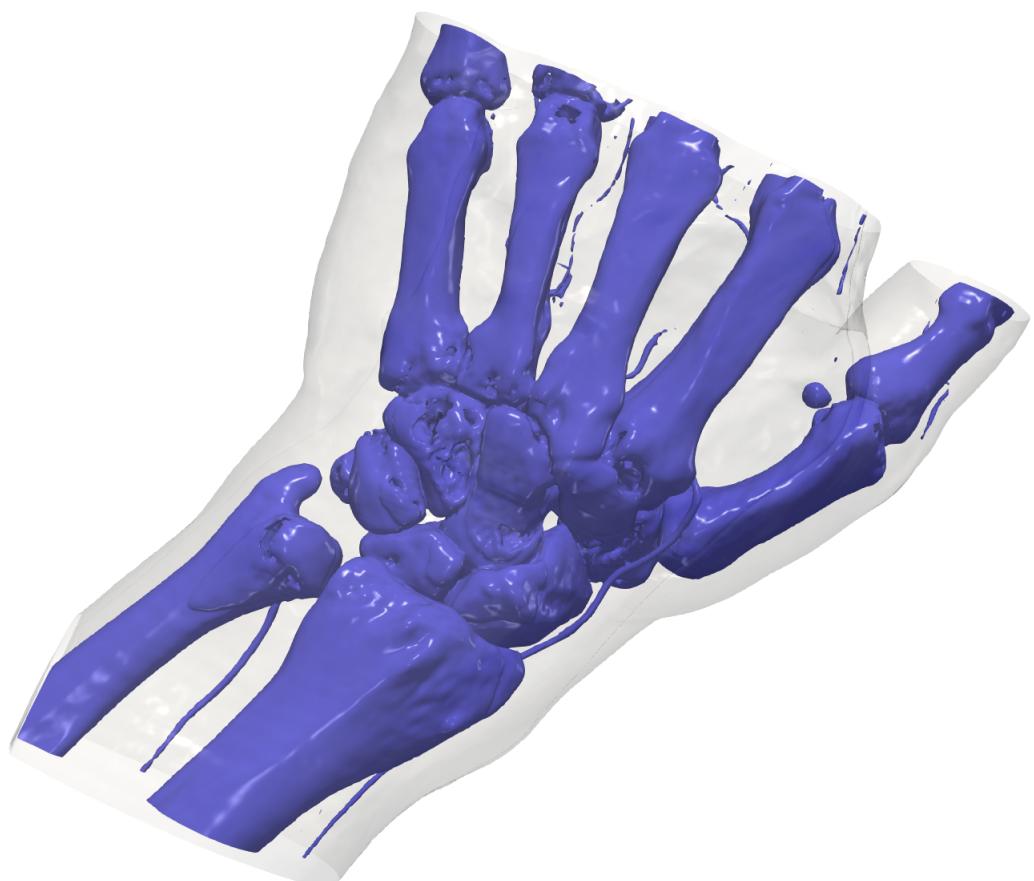
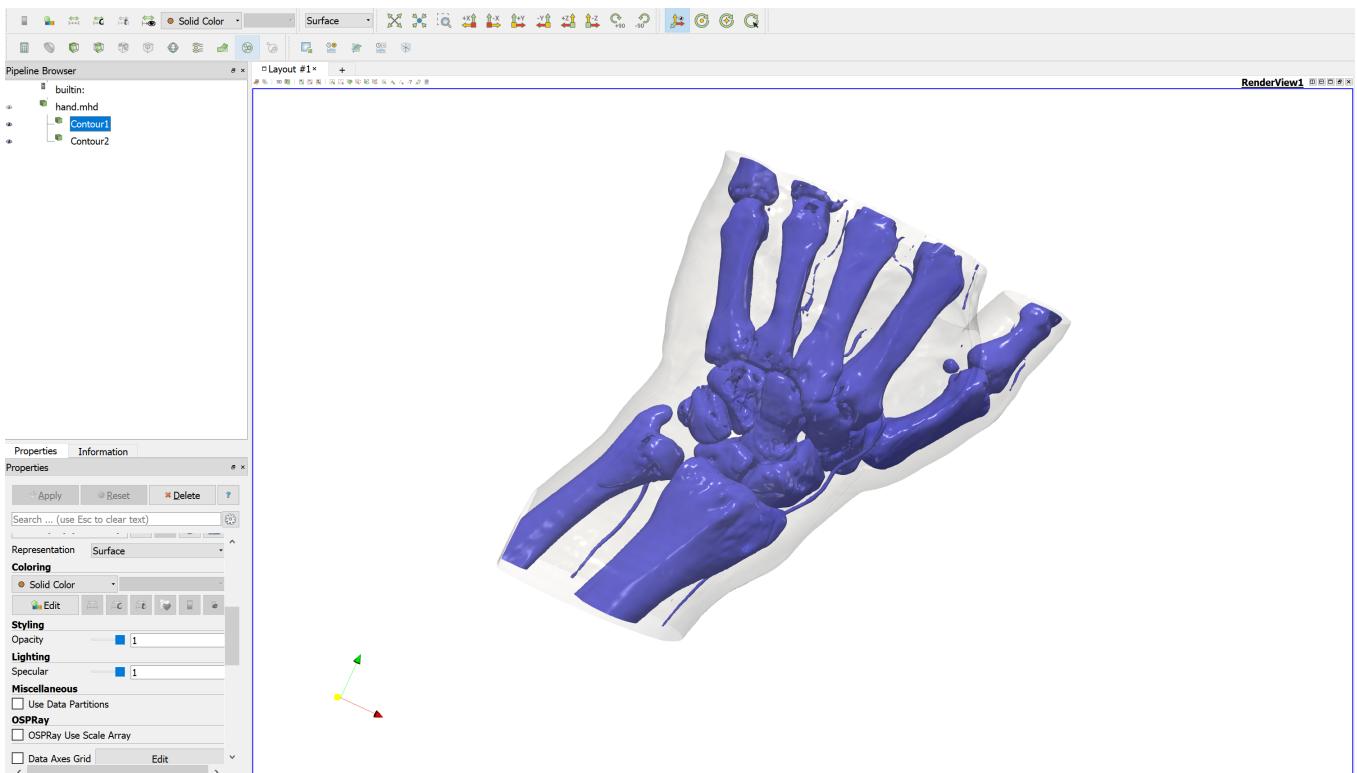


Figure 5: Hand-2-> Top: Parametric Window View, Bottom: Resultant Diagram

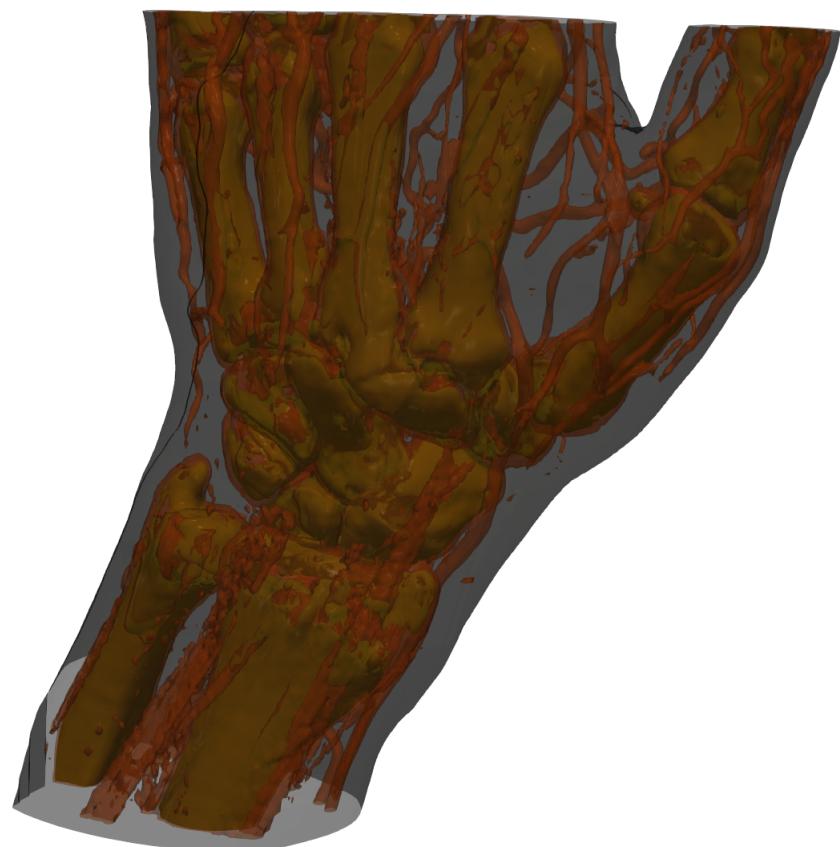
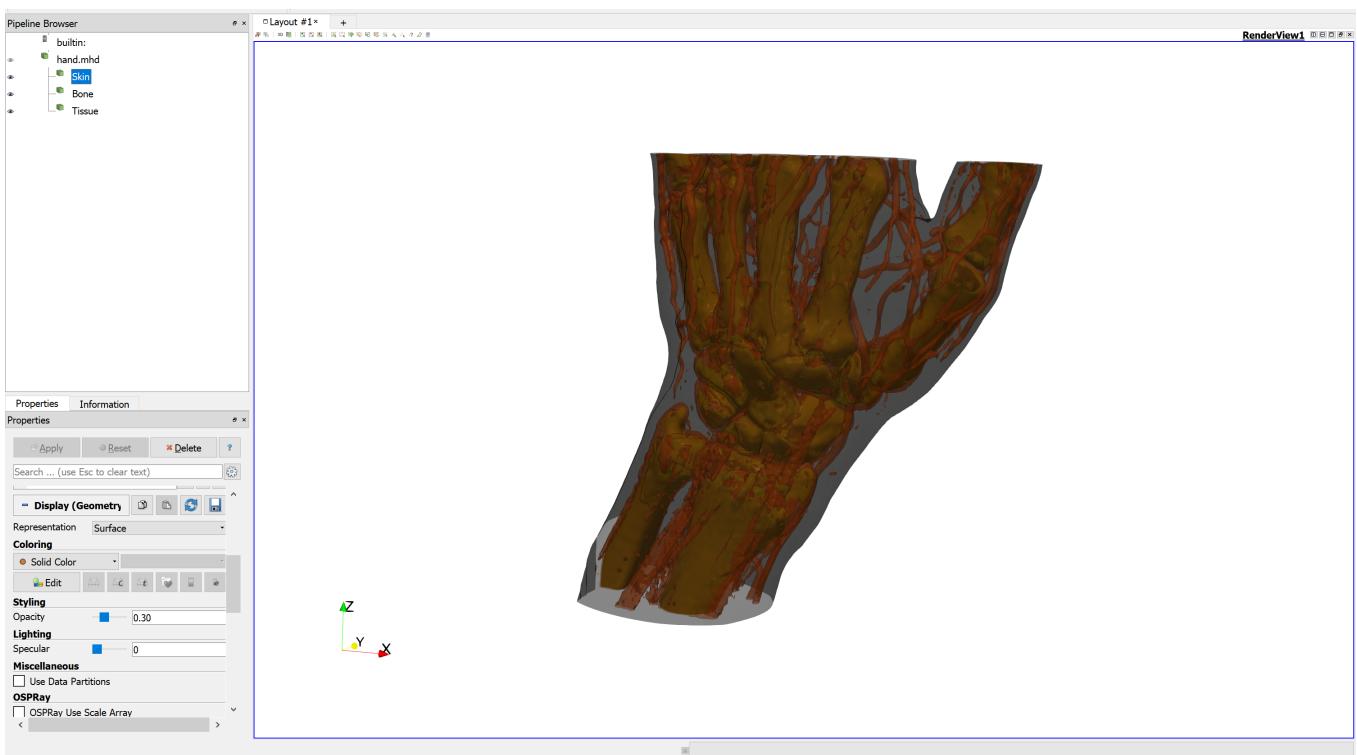


Figure 6: Hand-3-> Top: Parametric Window View, Bottom: Resultant Diagram

For Hand 1 image, I used Isosurfacing as the rendering method. I used "Yellow" Color for Isosurfacing (contour) with iso-value of 77 and 80 (any other nearby values also provided similar results). Refer to Fig. 4.

For Hand 2 image, since I wasn't able to figure out how to use 2D transfer function, I used two isosurfaces (contours) to get the required result. First, I used an isosurface with iso-value of 1280 (nearby values does the job too. Secondly, I used an isosurface with iso-value of 77 (skin) and then I reduced the opacity of this isosurface so as to visualize the isosurface 1. The resultant diagram is similar to the expected one. Refer to Fig. 5.

For Hand 3 image, it was hard to replicate 1D transfer function used in ImageVis3D, so I used three iso-surfaces (contours) to get as close result as possible. First, I used an isosurface with iso-value of 340 with opacity of 0.5 to make a base of skin. I changed the color to (R:24, G:24, B:24) to distinguish from others. This iso-surface represents Skin. Secondly, I used an iso-surface with an iso-value of 1450 and opacity of 1. This iso-surface represents Bone structure in the dataset. I changed the color of this part to Pale Green (R:179, G:179, B:0). Third, I used an iso-surface with an iso-value of 1125 with opacity of 0.5 along with the lighting specular of 0.8. I changed the color of this iso-surface to a version of Orange (R:255, G:85, B:0). It represents Tissue part of the hand. Altogether, these three depicts the required figure. Refer to Fig. 6.

3 Finding the items in present.uvf (ImageVis3D)

Ans: I load the dataset in ImageVis3D and first of all tried to understand the dataset using 1D and 2D transfer functions. Then I used isosurfacing based on the histogram range of intensity I found in the 1D transfer function background. I started with Isosurface 0 and then I proceed to increase it to higher values, to visualize different objects in the present dataset. I changed the color of the isosurfaces to 'blue'. The objects found throughout this procedure are described in detail below. Images associated with each of these objects are attached after the description. In the following list, there are different objects I found at each step by changing the rendering options.

1. At isosurface value 0, I found a big box enclosing everything. It has 4 stripes on the side. Also, a lid like structure which will be opened to find what's inside. Refer to Fig. 8a.
2. Increasing isosurface value, I found a cylinder container. Refer to Fig. 8b.
3. Next, I found a box (a cube probably), packed using wrapping paper and badly wrapped using rope and wires. Also, the box is decorated using 'stars'. Refer to Fig. 9.
4. A letter/greeting card at the top of the box (underneath the ropes). It was a bit tricky to see, I had to change iso-values very slowly to find this. Refer to Fig. 10a.
5. A bow decoration on top of the present. Refer to Fig. 12.
6. "DIESEL" written on the present. Visible only when we click on the dataset, as soon as we unclick, it becomes hard to visualize.
7. A safe (metallic - iron/steel) with small bullet grooves (they have the highest and widest range of intensity values). It has a lid as well which opens from one side i.e. not detachable. This safe has equidistant holes at the top. Refer to Fig. 10b.
8. A snow bowl. Refer to Fig. 11a.
9. A cathedral. Other view point is, a small inverted cylindrical container with a mini castle like structure on top of it. It's visual when you click on the dataset view in imagevis3d, as soon as I unclick, it becomes hard to see. Refer to Fig. 11.
10. A mouse/rat sitting inside the container. Also, an eel near the surface of the pot, this is my closest guess. Refer to Fig. 11b.

I used a few techniques like changing the color of the isosurface, 1D, and 2D transfer function to visualize the dataset. I increased sampling rate to 200% ensuring high quality images. I also changed the lighting conditions at each step to identify all the objects (I found the letter at the top by doing this).

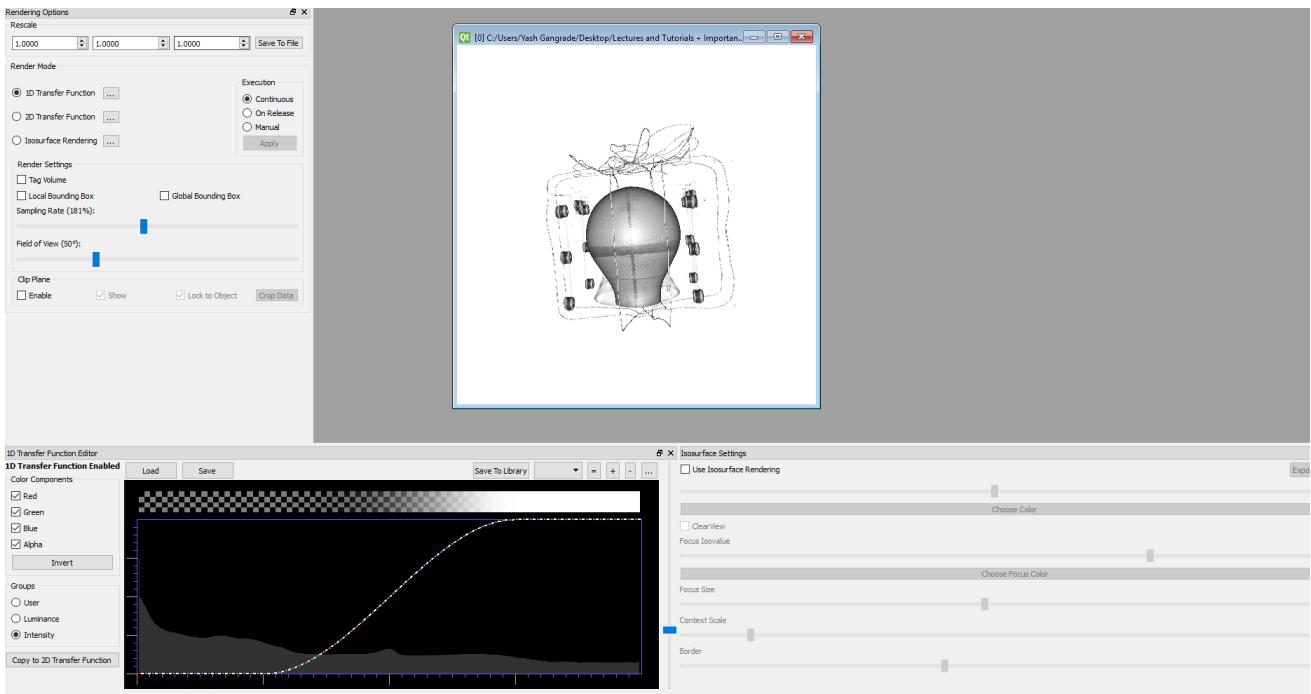


Figure 7: Initial Settings

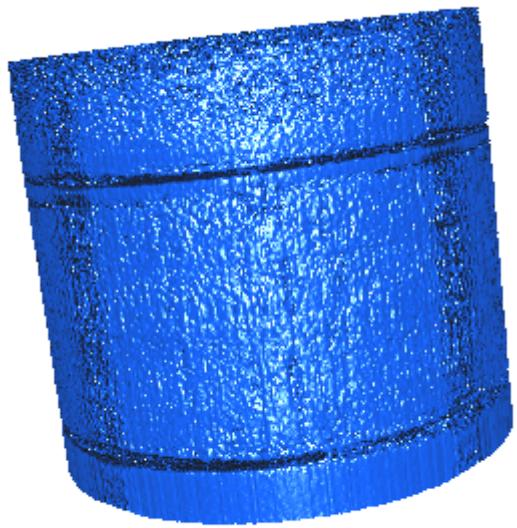
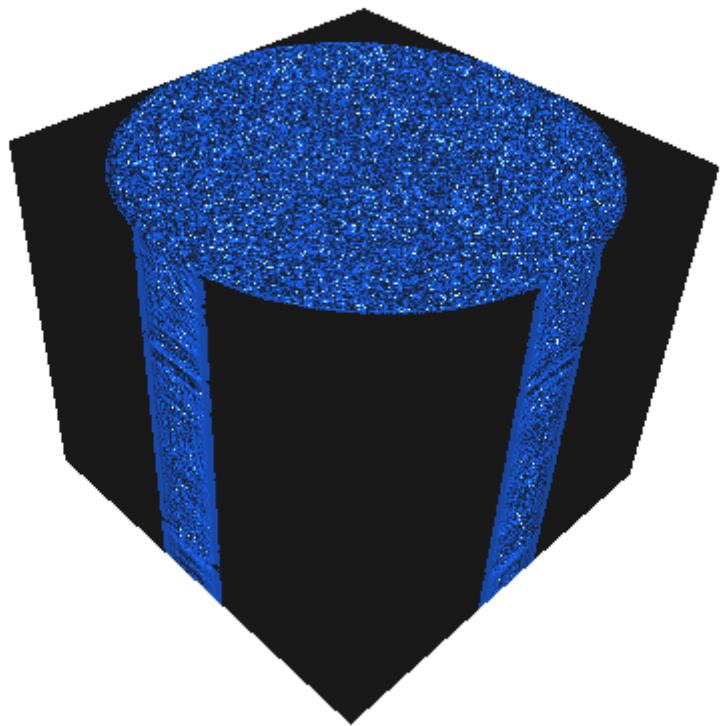


Figure 8: a) Iso-value = 0, Big box enclosing everything; b) A cylinder containing everything

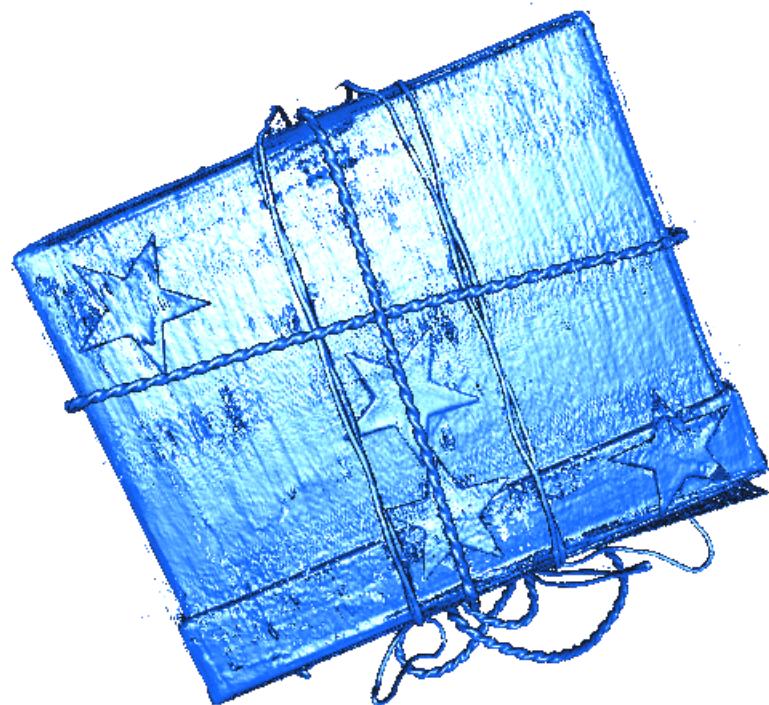
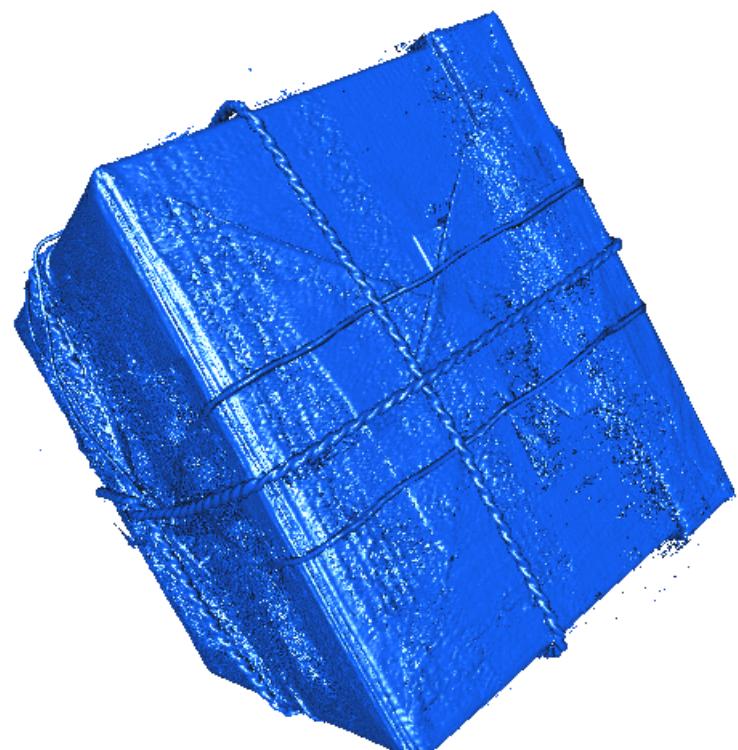


Figure 9: a) Figure showing the wrapping paper used to cover the box b) Stars are used to decorate the box, it also shows the ropes used around the box

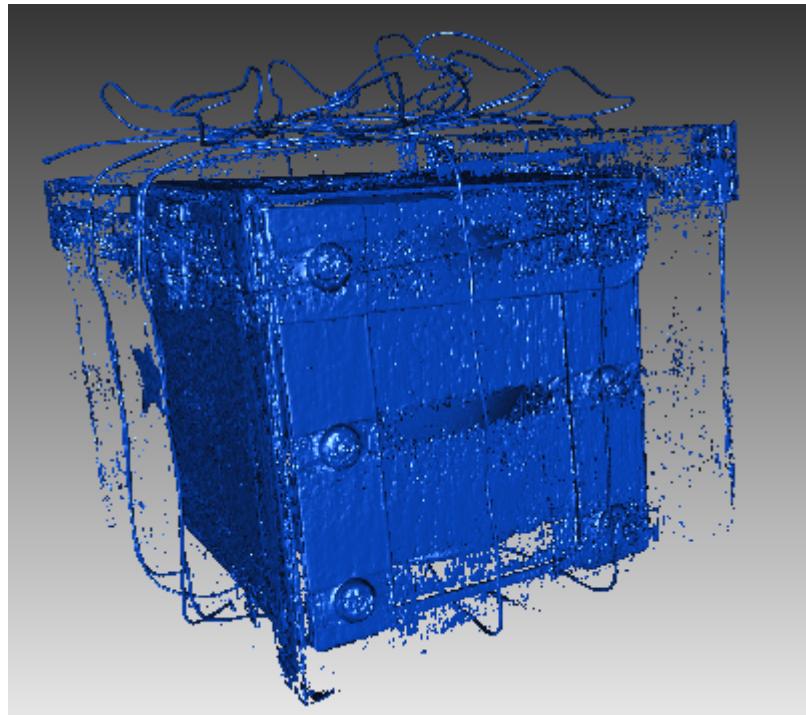
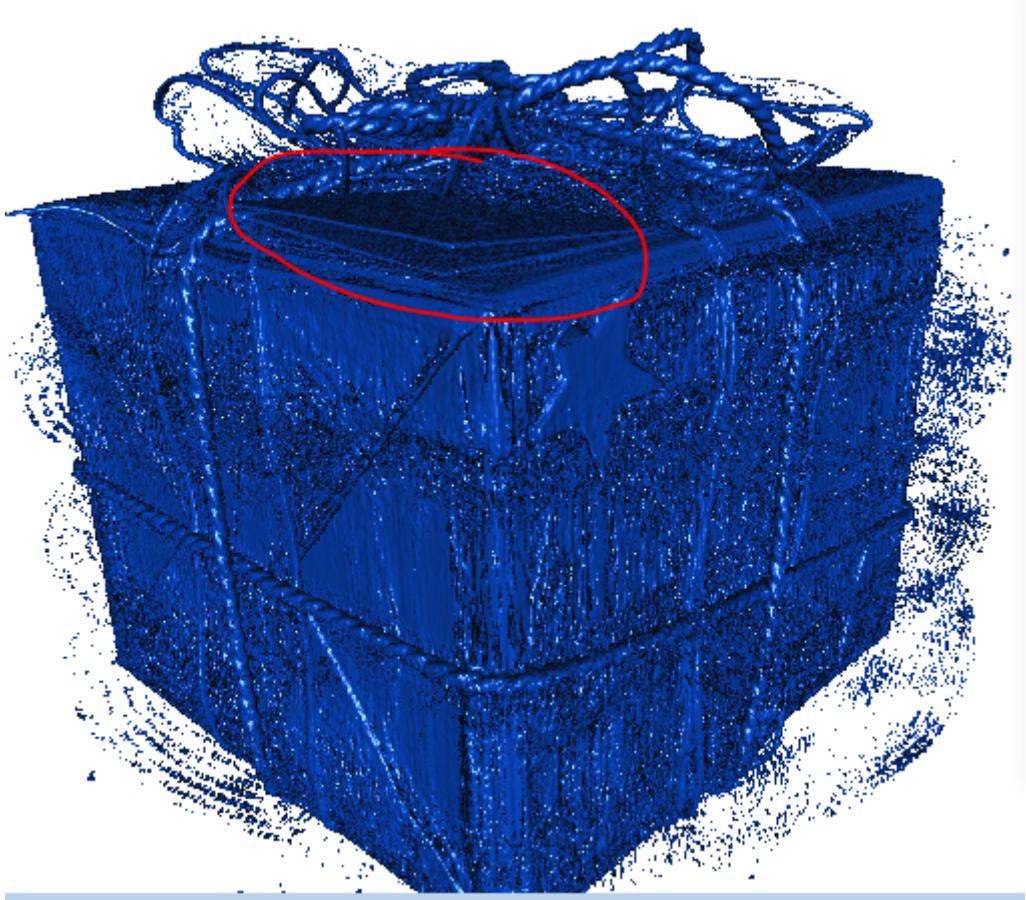


Figure 10: a) Identifying the letter/greeting card at the top (red marker added for better identification);
b) Steel/Iron Safe with metal bullets/grooves inside the box

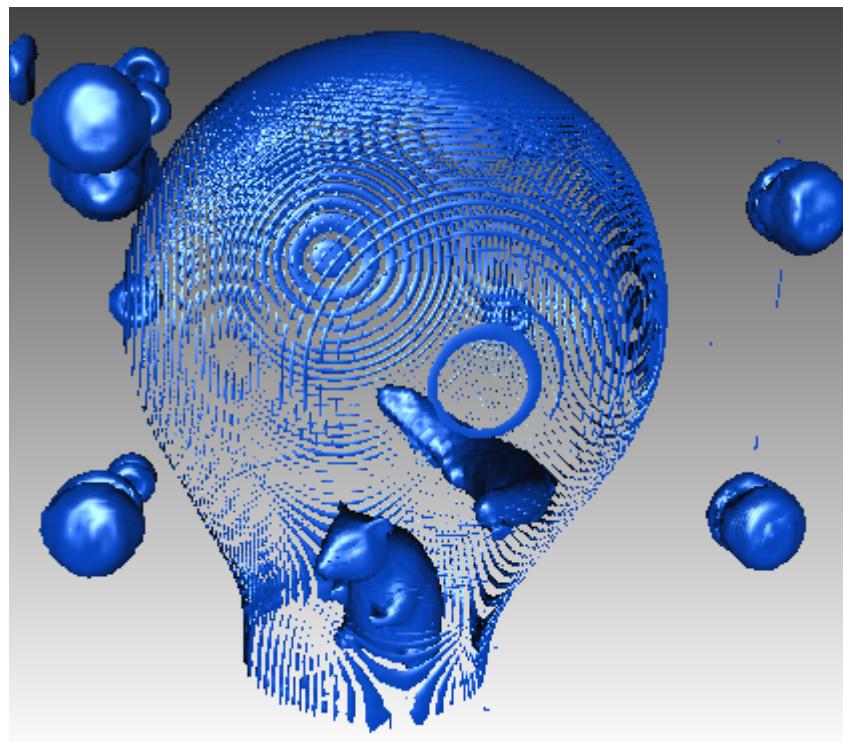
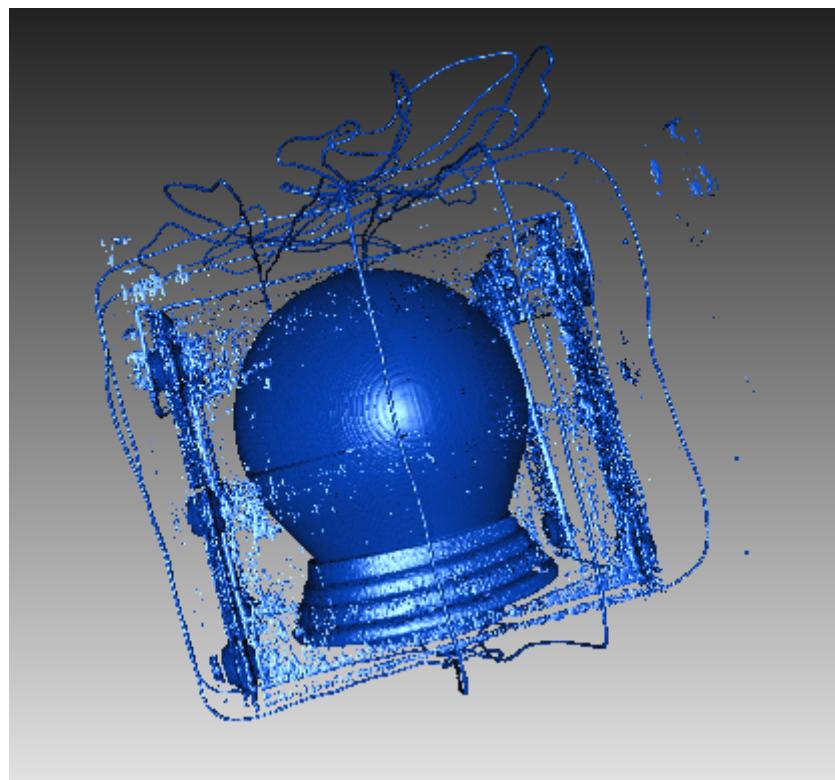


Figure 11: a) A snow bowl b) A mouse (rat) and an eel inside the container

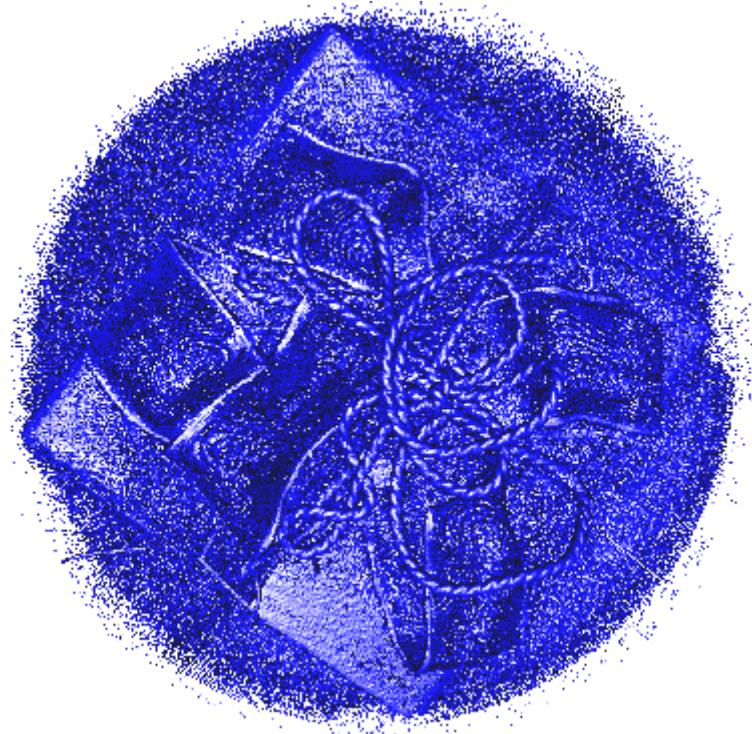


Figure 12: a) Bow on the present

4 Finding the items in present.uvf (ImageVis3D)

Here, I load the dataset and I first render a histogram of the dataset to understand the intensity range in the dataset. Then I used different checkpoints in the color map editor to identify different parts of the data. Images of the objects are after the description. The list of objects is as follows.

1. A cylindrical container enclosing everything. Refer to Fig. 13a.
2. A box wrapped in wrapping paper. Also, it is wrapped using ropes and wires around it. Refer to Fig. 13.
3. A letter (or greeting card) at the top of the box. Refer to Fig. 15b.
4. A bow decoration on top of the present. Refer to Fig. 16b.
5. A safe probably metallic (iron/steel) with metallic bullets/grooves to provide rigidness. It has small holes at the top as well. It has a lid as well which opens from one side. Refer to Fig. 14.
6. A snow bowl Refer to Fig. 14a.
7. In one of the views, we can see a cathedral. Other understanding is, it's a glass container and a mini castle like structure at the top of it. Refer to Fig. 14.
8. Changing the intensity values in the color map, I found a mouse (rat) and an eel (not totally sure whether it's an eel or something else. Best guess is eel because zooming in, it has small fins just like eel) inside the container. Refer to Fig. 15a.
9. "DIESEL" written on the present. Refer to Fig. 17.

I found almost similar number of items as the ImageVis3D. I found paraview easy to use for this question because the ability to play with different colors, creating multiple iso-surfaces is really good. Also, the controls are much better in paraview. Although, I gained much more information from the visualization in ImageVis3D. The 1D, 2D transfer functions, and Isosurface rendering is much more powerful in ImageVis3D.

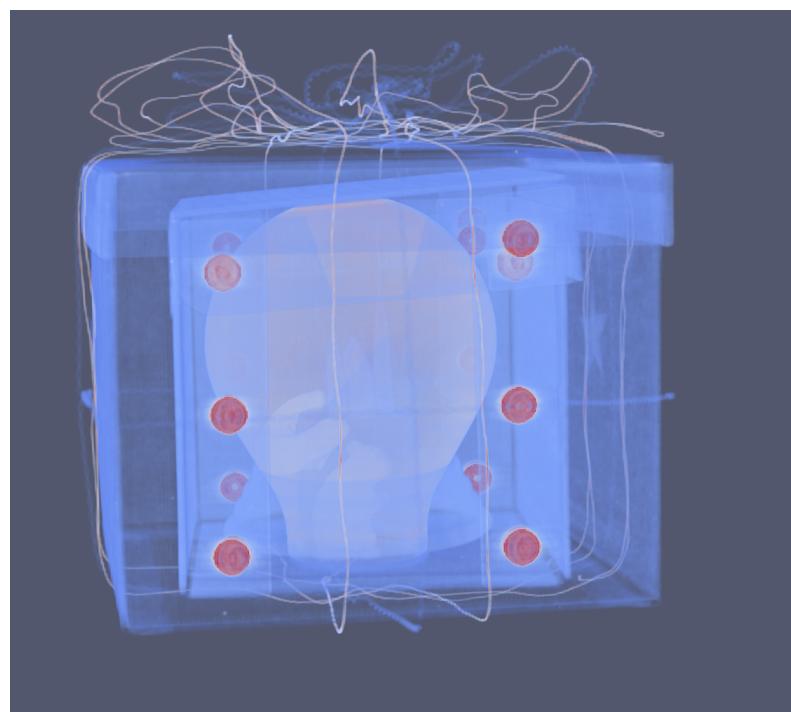
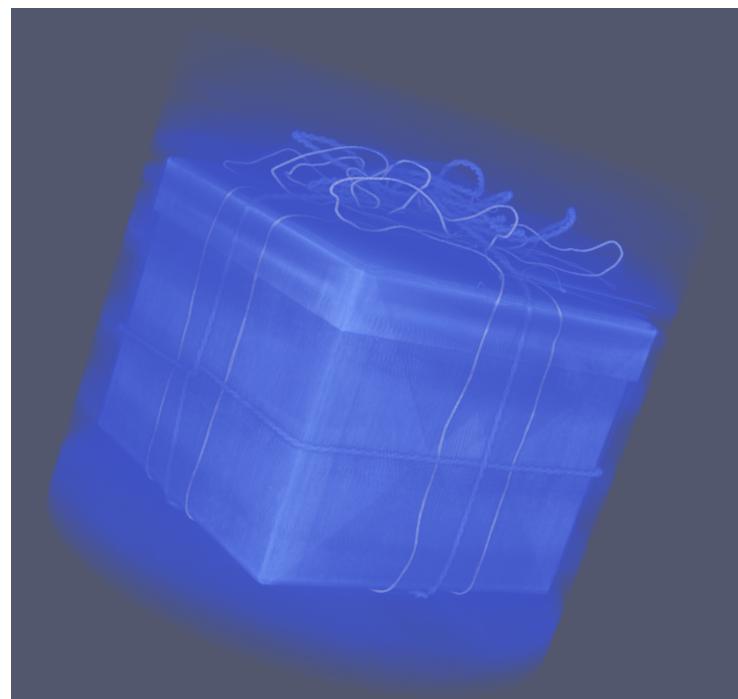


Figure 13: a) A cylindrical container; b) A metallic safe (also a preview of contents inside)

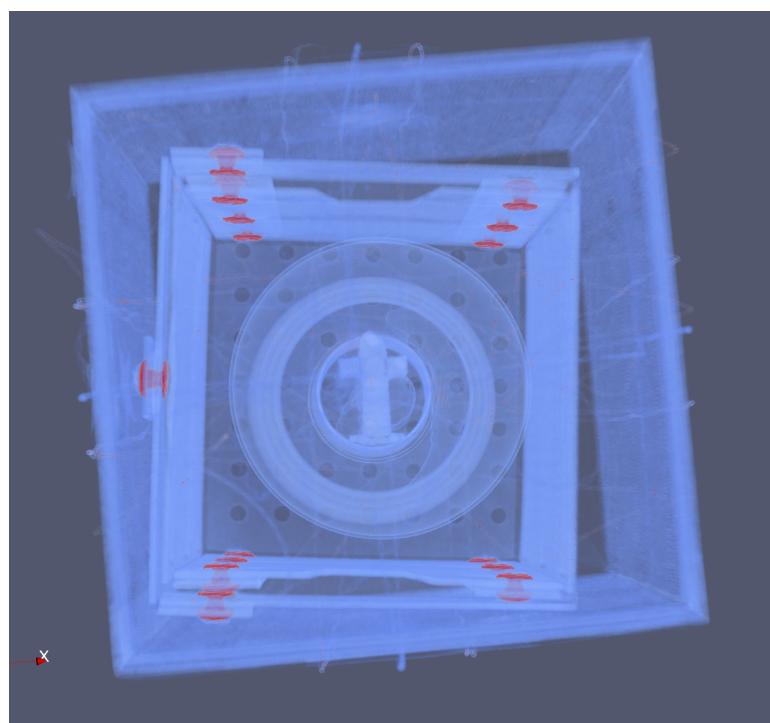
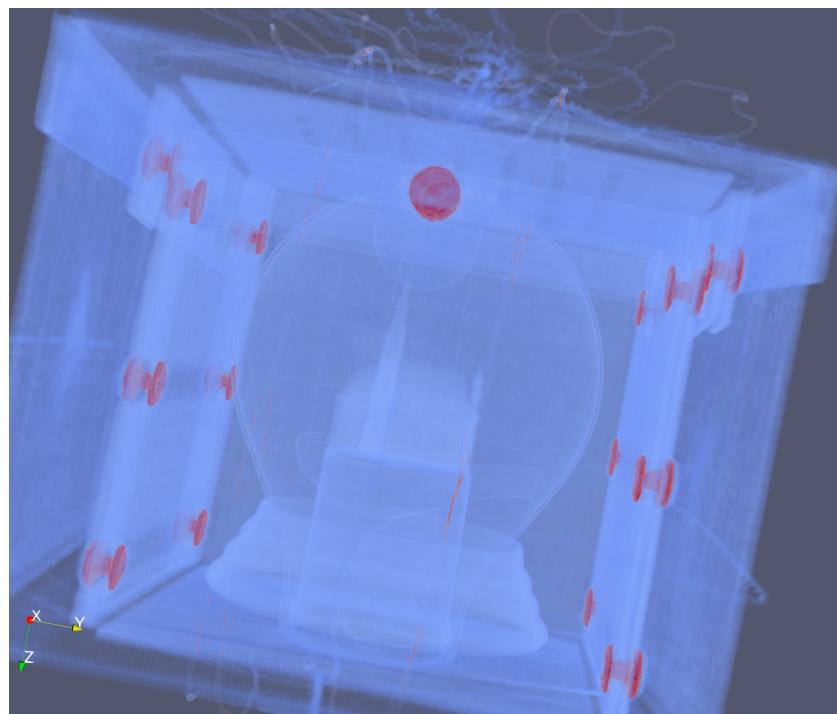


Figure 14: a) & b) A cathedral. Another interpretation is, an inverted container with a mini castle on top. Everything is inside a metal safe.

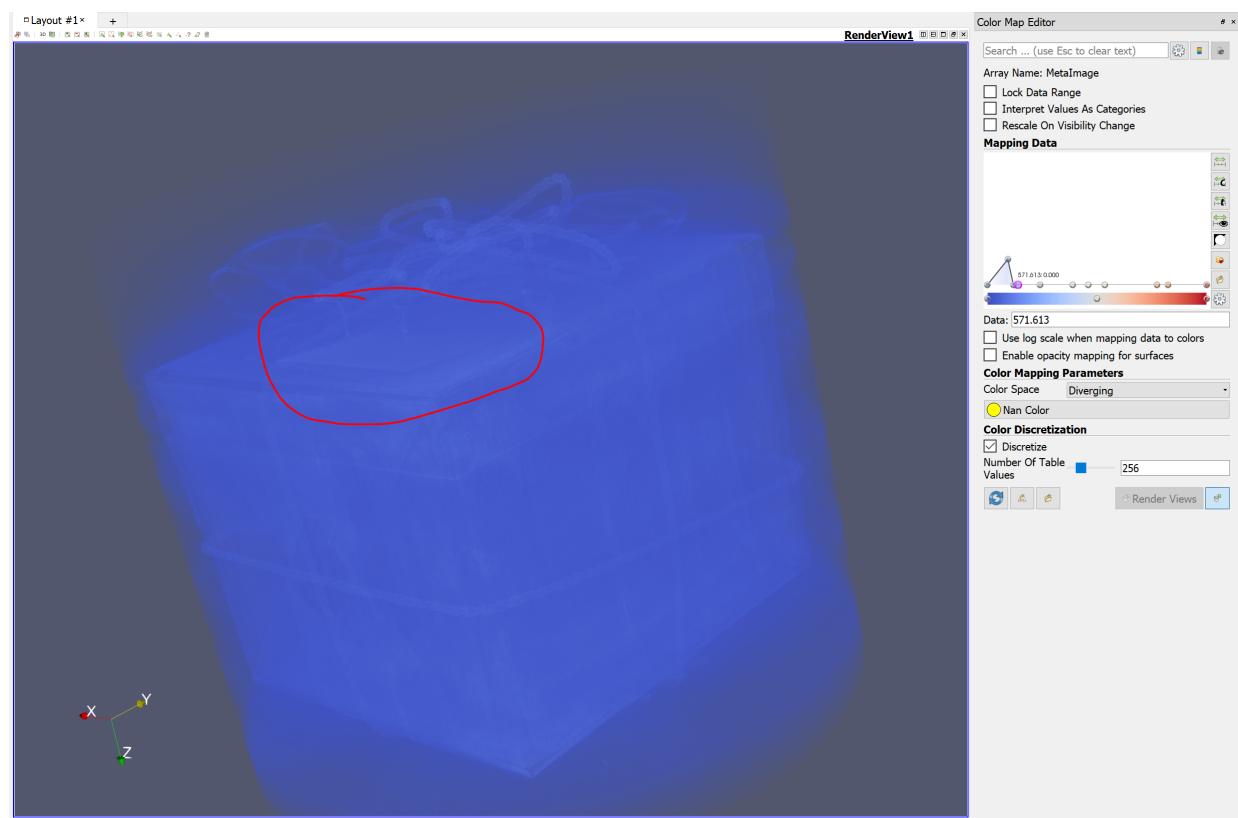
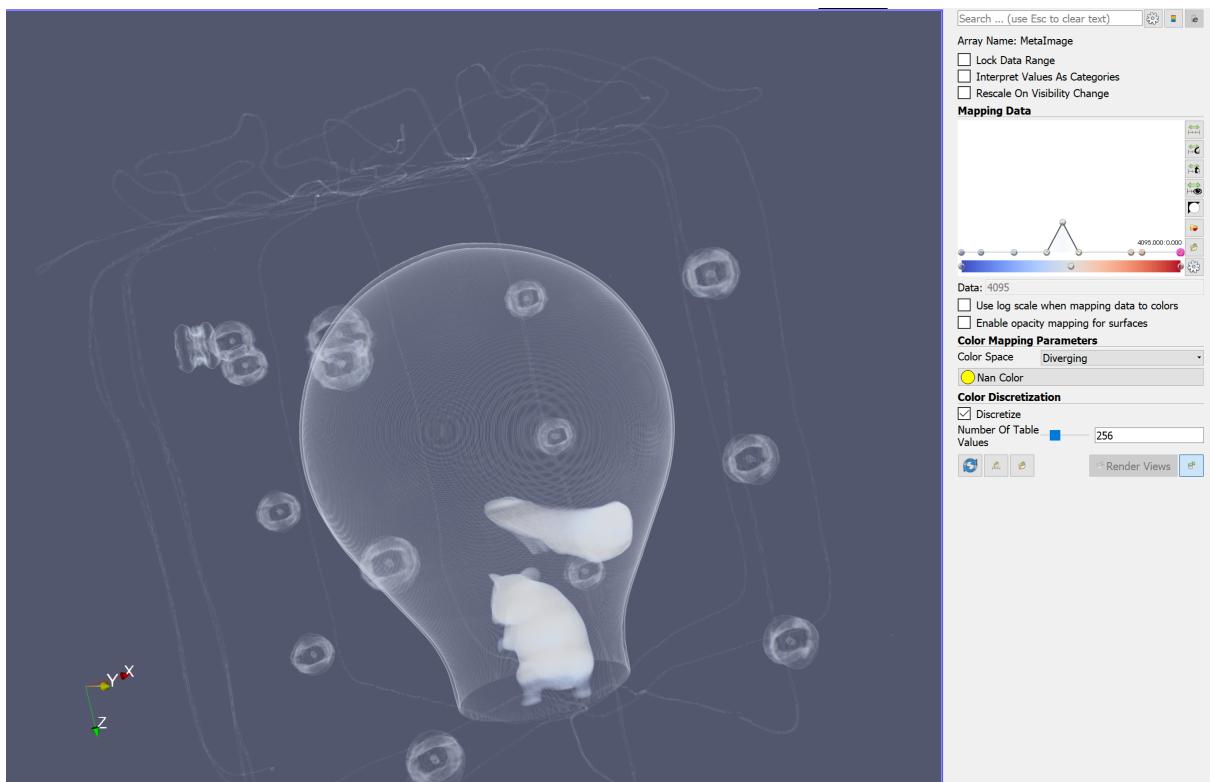


Figure 15: a) A mouse (rat) and an eel inside the container; b) A letter (or greeting card) at the top of the box

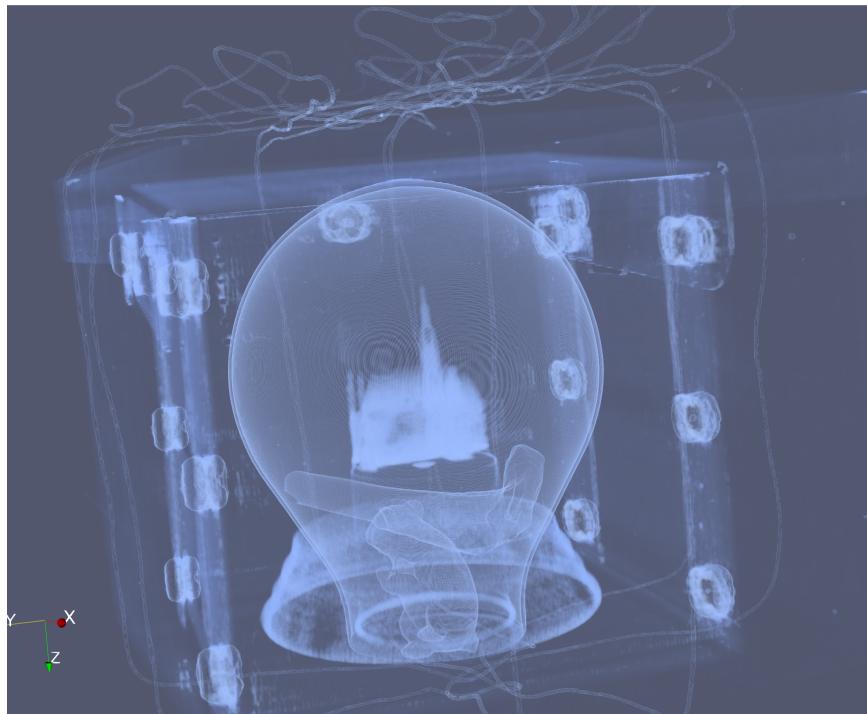


Figure 16: a) An inverted pot (or jug or vase) with a preview of things inside b) A bow on the top of the present (found later so in a different color)

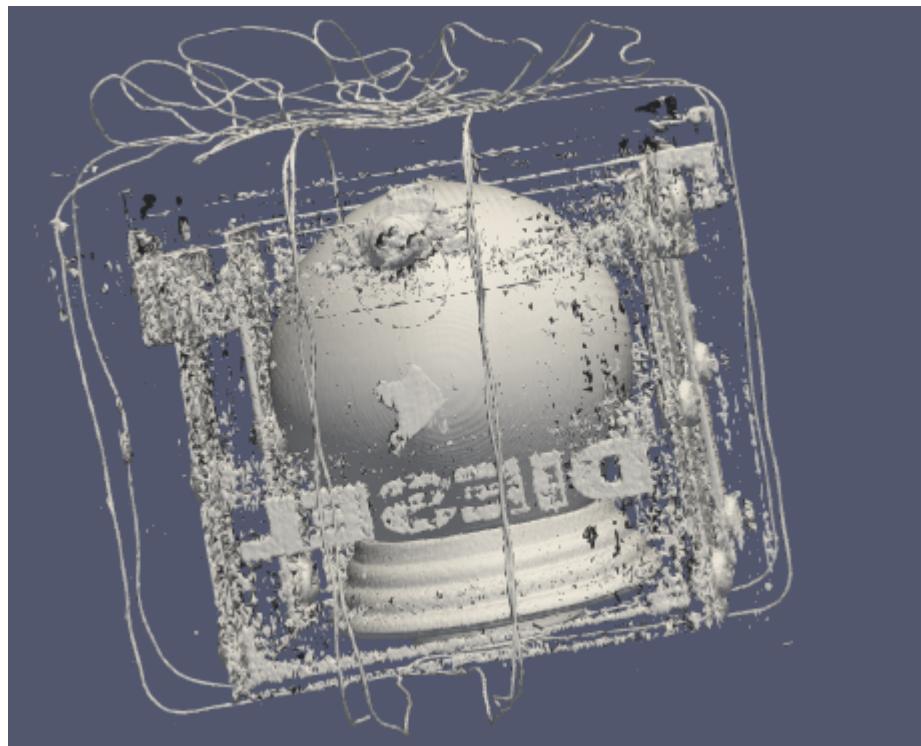


Figure 17: a) "DIESEL" written on the present (found later so in a different color)

5 Analyzing and Visualizing Unknown Dataset

Ans. First of all, I loaded the raw dataset and tried to convert it to uvf format so that it can be visualized in ImageVis3D. Here, all the 8 raw data files are of size 16 MB - 16777216 bytes each. The parameter window asks for specifying the parameters for the generated file, I used 32 bit float to specify the data values. To conform to the size of the raw file and generated dataset, I used 64x256x256 as the domain size. All other specs can be found in the figure on the next page Fig. 18. For other datasets, I used the same settings since all datasets are of same size and format. The individual images of each of the dataset is followed after the specifications page.

After seeing and manipulating the datasets with different volume rendering methods like iso-surfacing, 1D/2D transfer functions etc. I have a few different ideas on what dataset could be, those are listed as follows:

1. Simulation of fire on a hot plate kind of structure. Here, if we arrange all the datasets in one window, it looks like a representation of fire growing progressively for e.g. fire starting in data 1 to fully energized fire in data 8. It can be seen in the Fig. 23a.
2. From changing the iso-surface value and color, I believe it also looks like wind simulation for a given terrains. Essentially, it looks like a wind pattern study over a terrain and each dataset here shows this progressive effect of winds in time.
3. Similar to the previous point, this can also be seen as the simulation of water streamlines on a terrain. Each line and curve here might be representing the water canals.

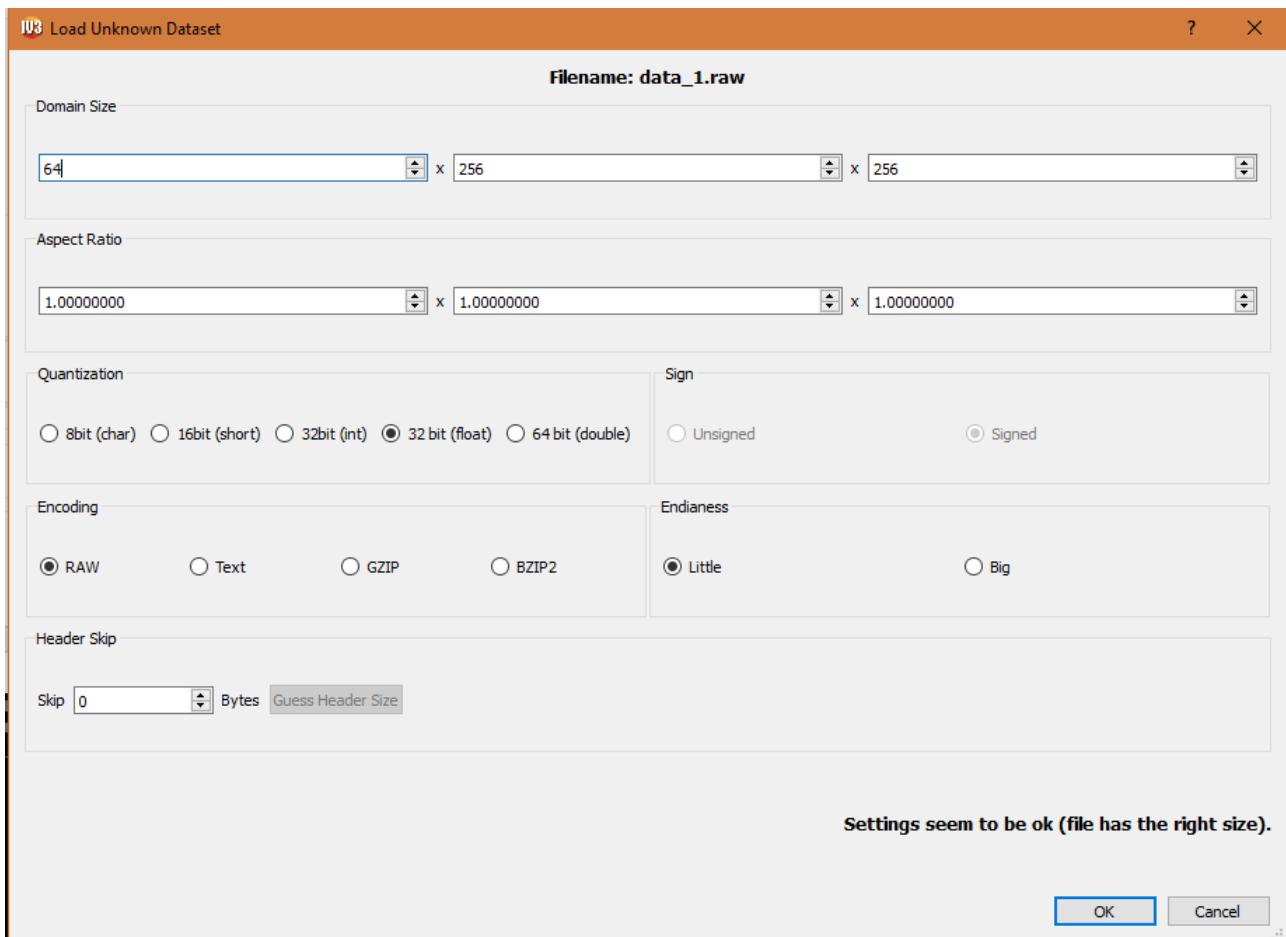


Figure 18: a) Settings used to convert raw data files to uvf format

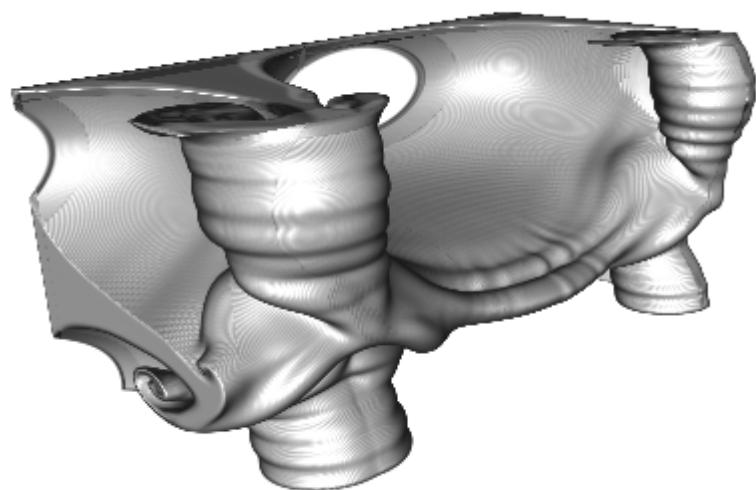
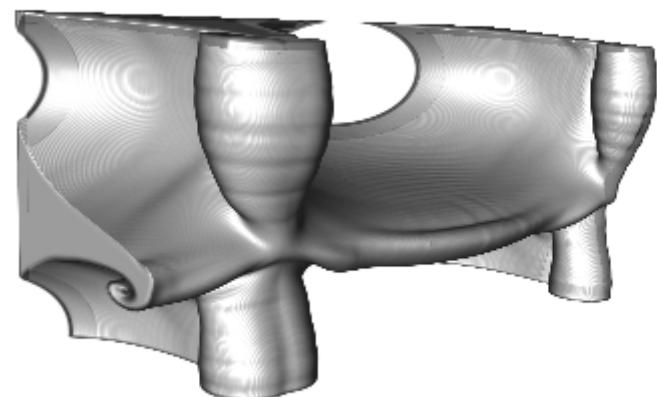


Figure 19: a) Data_1.uvf b) Data_2.uvf

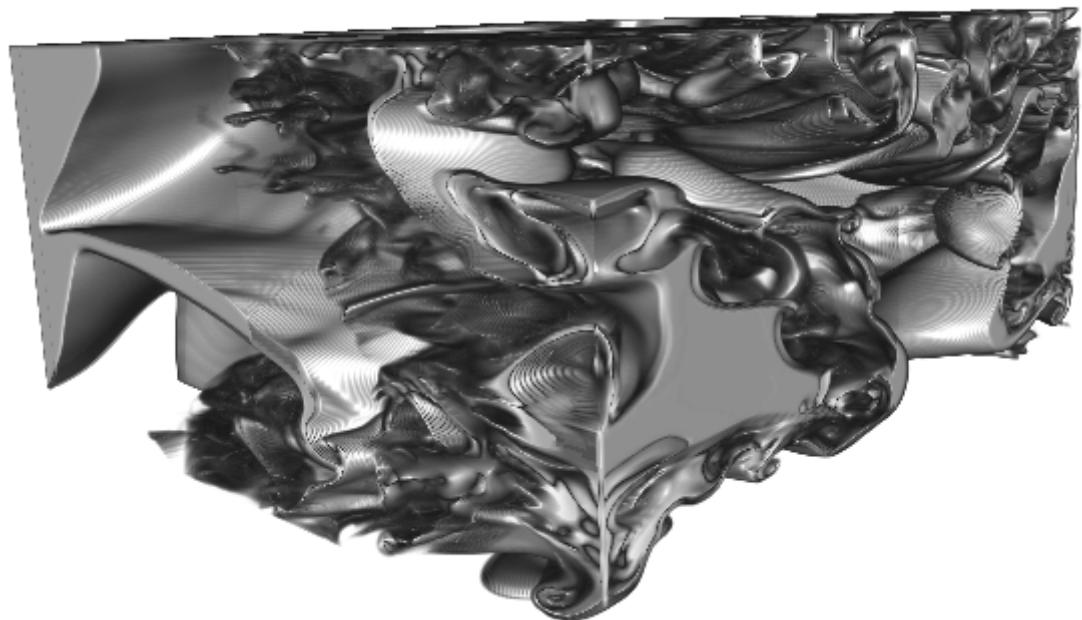
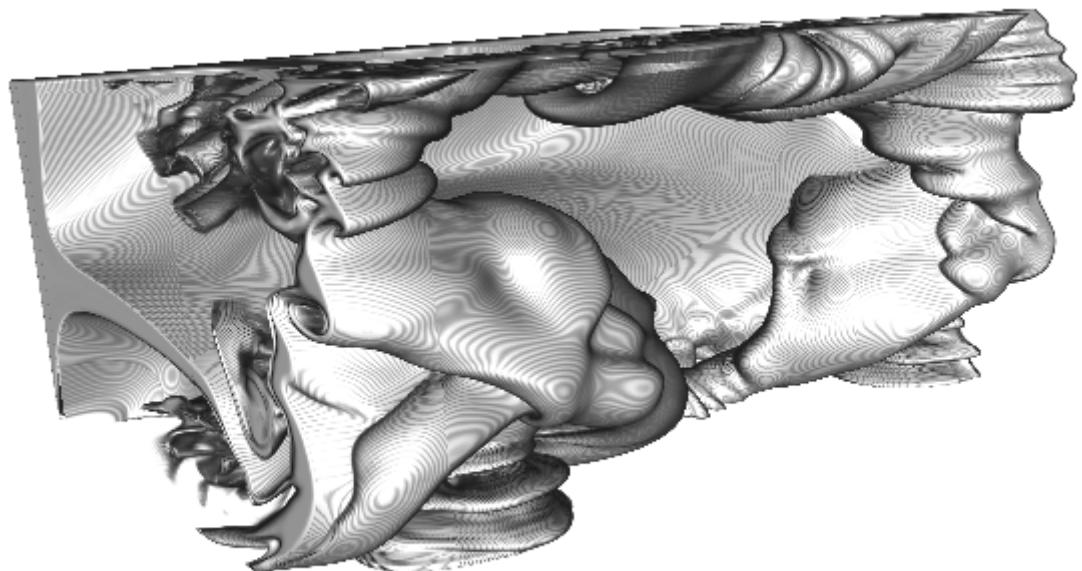


Figure 20: a) Data_3.uvf b) Data_4.uvf

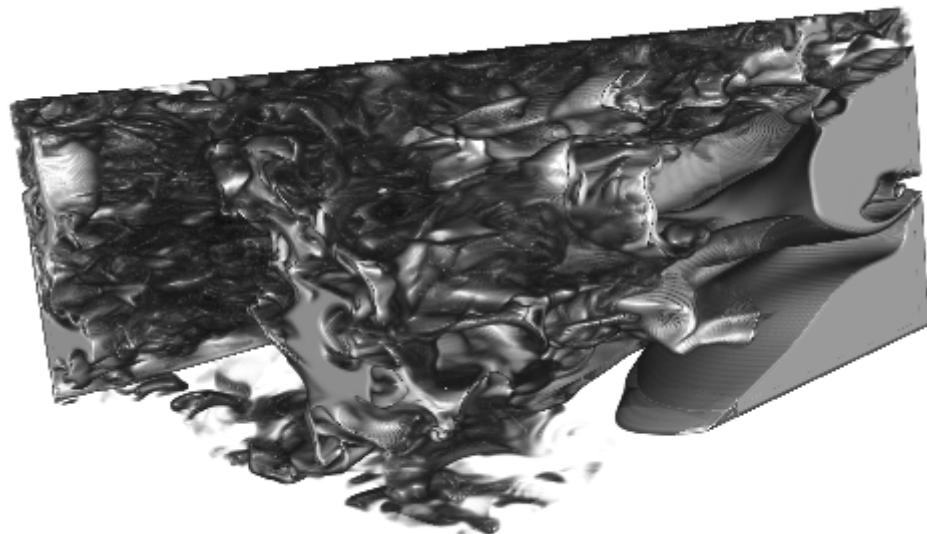
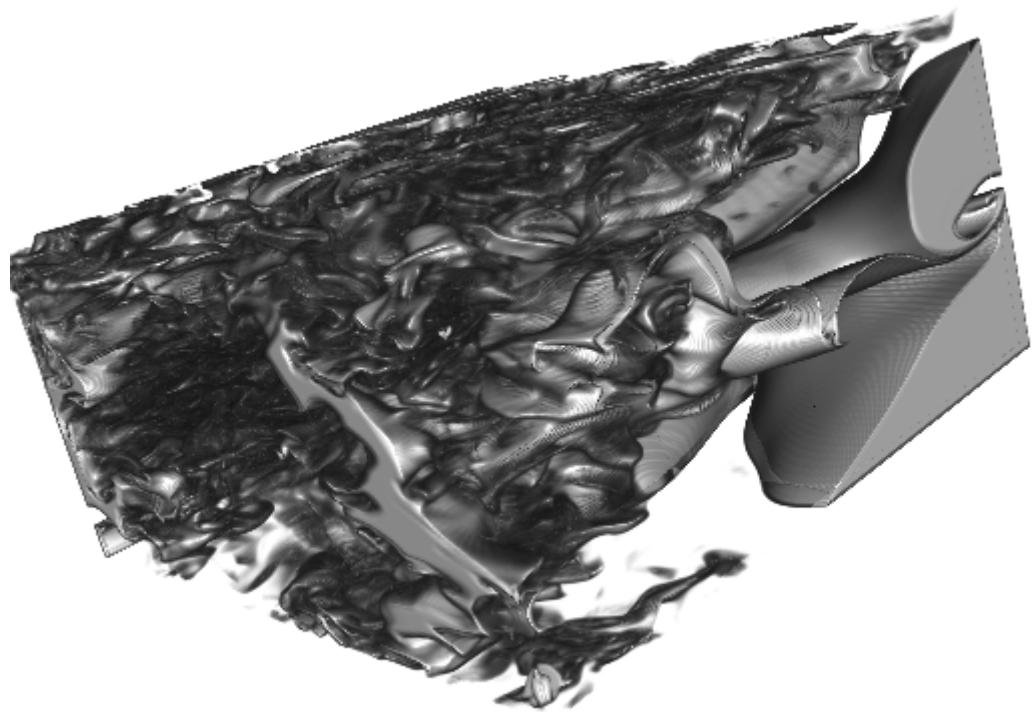


Figure 21: a) Data_5.uvf b) Data_6.uvf

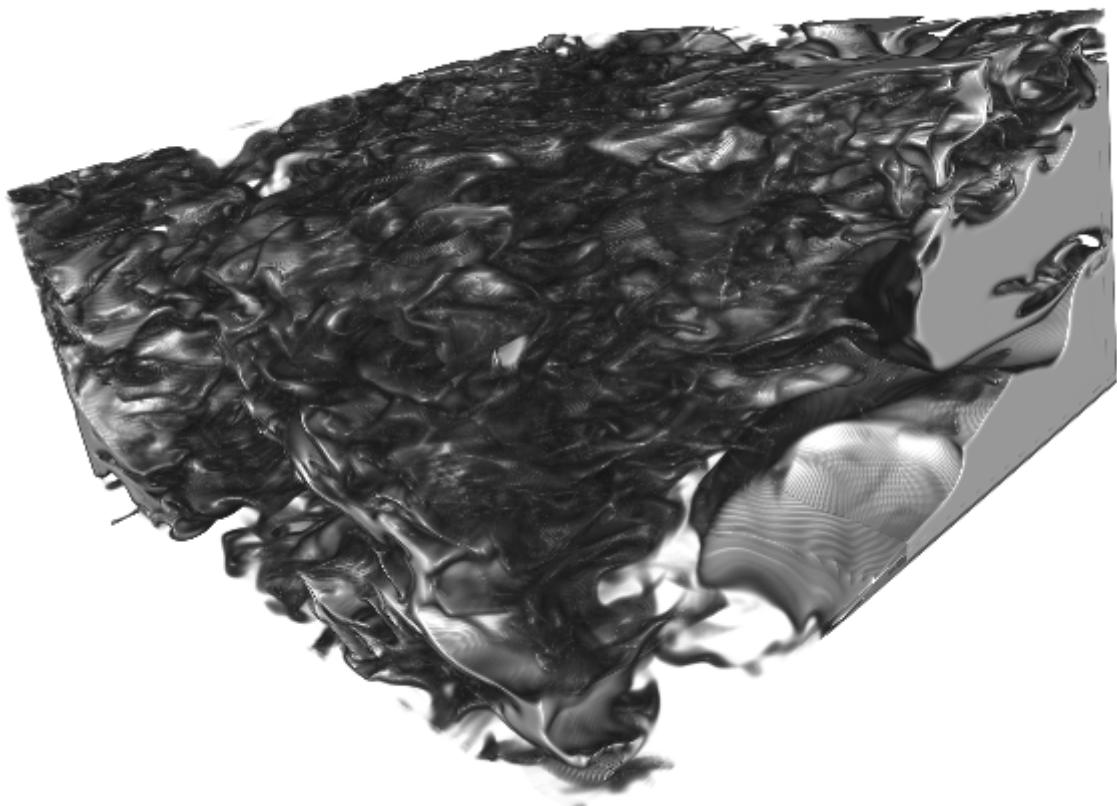


Figure 22: a) Data_7.uvf b) Data_8.uvf

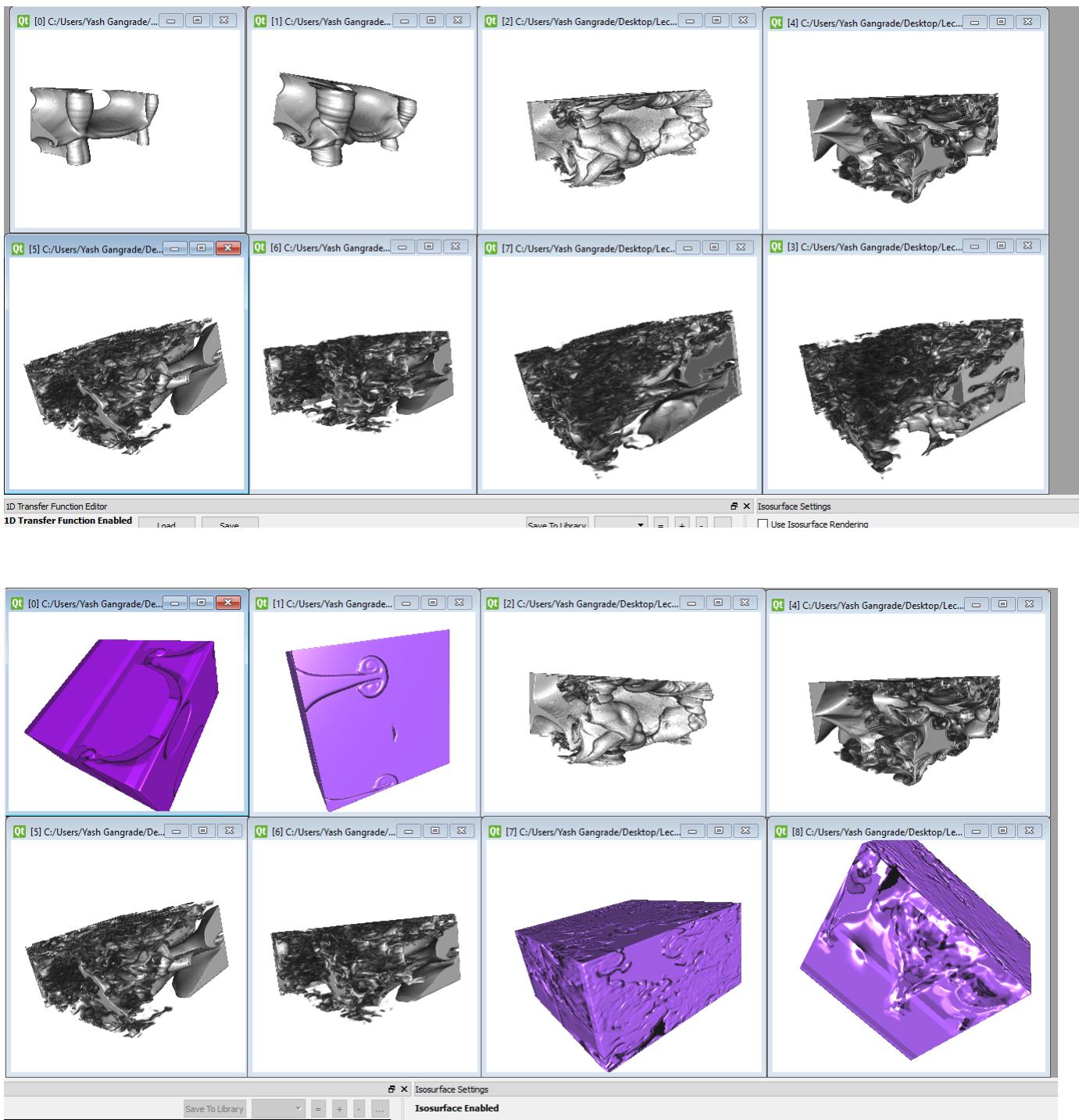


Figure 23: a) All datasets together to aid in understanding the visualization b) Changing the color and applying isosurface rendering to understand the dataset

6 References

1. ParaView Tutorials and Handbook
2. ImageVis3D Tutorials
3. ImageVis3D Dataset and Transfer Function - Hand, Hand16 Transfer Function.