

All the codes are here:

<https://github.com/elizaan/Viz-Scientific-Data-HWs/blob/main/hw3/main.py>

All the state files are here:

https://github.com/elizaan/Viz-Scientific-Data-HWs/tree/main/hw3/paraview_state_files

1. 1D Transfer Function

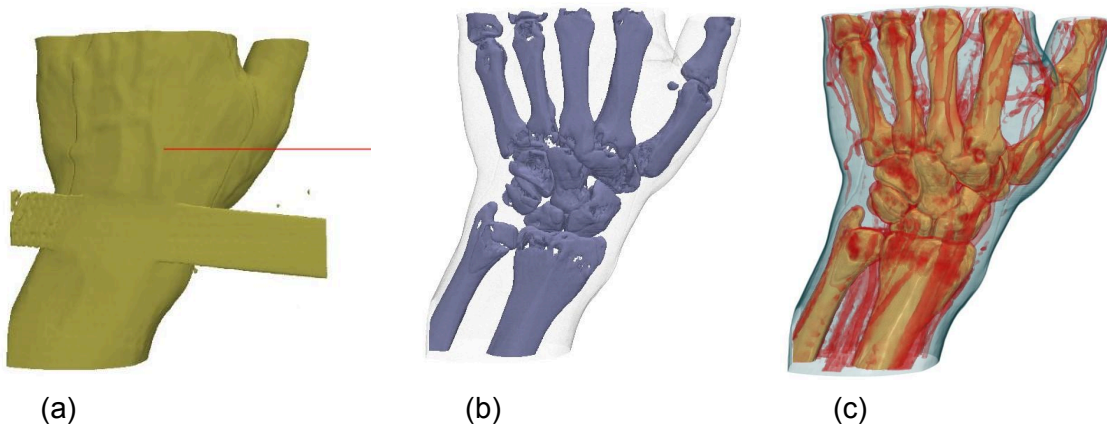


Figure 1: 1D Transfer function output (a) Skin, (b) Bone, and Transparent Skin; (c) Bones, Blood Vessels; and Transparent Skin

Figure 1 shows the final output after the colormap changes in opacity and color. First, I opened the histogram for the transfer function to identify the densities and adjusted opacities in different density values

2. 2D Transfer Function



Figure 2: 2D Transfer function output (a) Skin, (b) Bone, and Transparent Skin; (c) Bones, Blood Vessel; and Transparent Skin

Which one took longer to create? Was either one more intuitive? Discuss the pros and cons of 1D and 2D transfer functions.

ANS: 1D took almost double the time to figure out the exact colormaps and opacities needed lot of trial and error. In short, the 2D transfer function was more intuitive because it has a density graph that helps to track changes in opacity values.

The 1D transfer function is easy to interpret as it has a single variable that is visually easy to understand, but for the same reason, it makes it harder to capture complex relationships between different variables.

The 2D transfer function uses two variables that make the scalar variable easier to visualize and help to capture complex relationships more intuitively. The 2D transfer function requires more understanding to use it perfectly than the 1D one.

3. Identify objects by volume Rendering

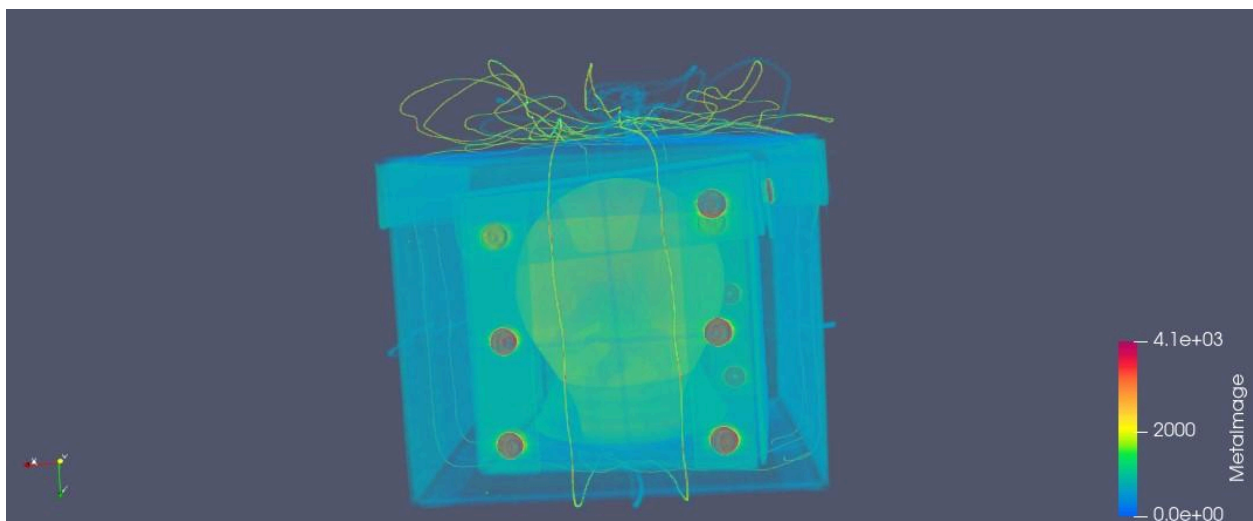


Figure 3: Volume rendering of 'present' data

In Figure 3, I volume rendered and found out there was a present with two boxes. One bigger box and inside another small box, at the top, it looks like ropes are used to seal the present box.

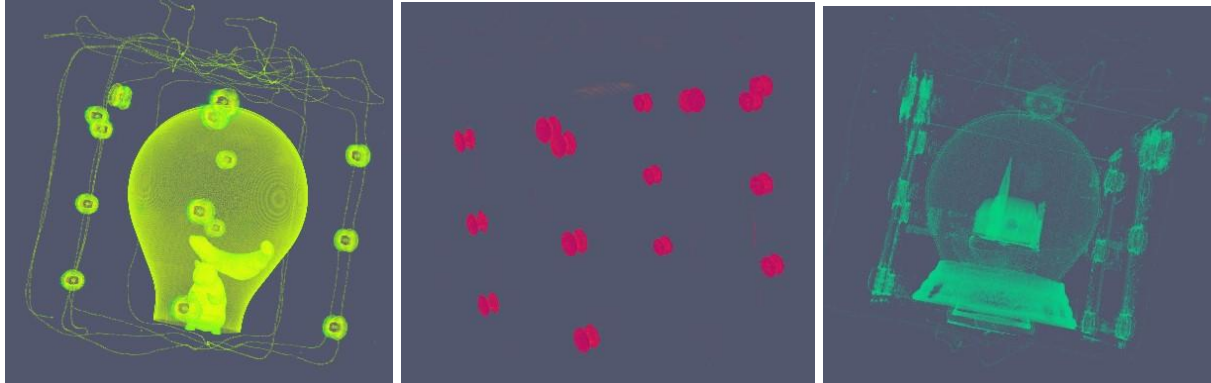


Figure 4: Different objects inside the present box

In Figure 4, the leftmost one looks like some board pins, a bulb-shaped bowl, an animal toy, and something that looks like a banana to me. They are all inside a present box bound by ropes. The middle picture is the pictures of board pins; the rightmost picture is very interesting because I do not clearly understand what these are, but it looks like the base of a round-shaped bowl, and it is very unclear. Overall, it looks like a showpiece with different parts, such as a base, glass bowl, creature inside, sculptures, and other decorative pieces.

I used rainbow uniform colormap and 1D transfer function to adjust the opacities to identify objects.

4. Multiresolution Data

I have added the code in the main.py file that is inside the hw3 folder in this link:

<https://github.com/elizaan/Viz-Scientific-Data-HWs/blob/main/hw3/main.py>

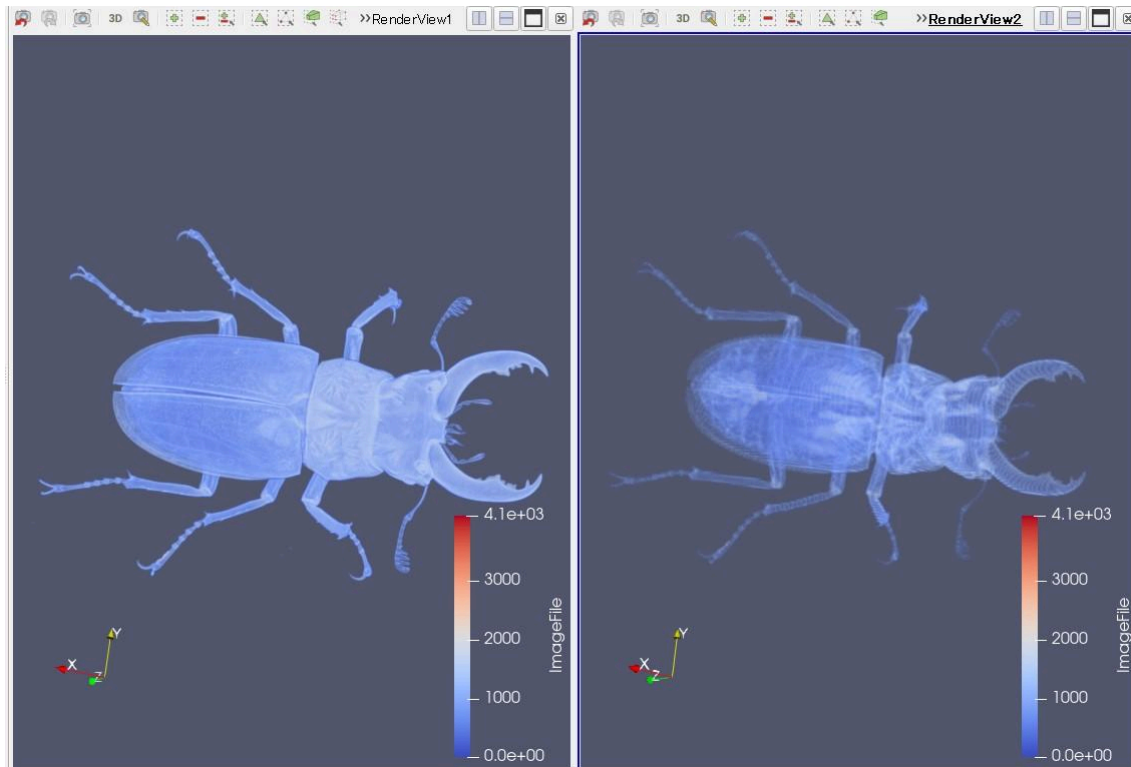


Figure 5: The volume rendering of beetle data in different resolutions (a) 832*832*494 (b) 208*208*123

From Figure 5, We see that the volume rendering is different between these two different resolutions of beetle volume. In the 832X832X494 volume visualization, the beetle's body parts are more distinguishable than the 208X208X123 beetle volume. Moreover, the 208X208X123 beetle is more transparent than the 832X832X494 one. The image quality is better for the left one.

5. Real Research Dataset

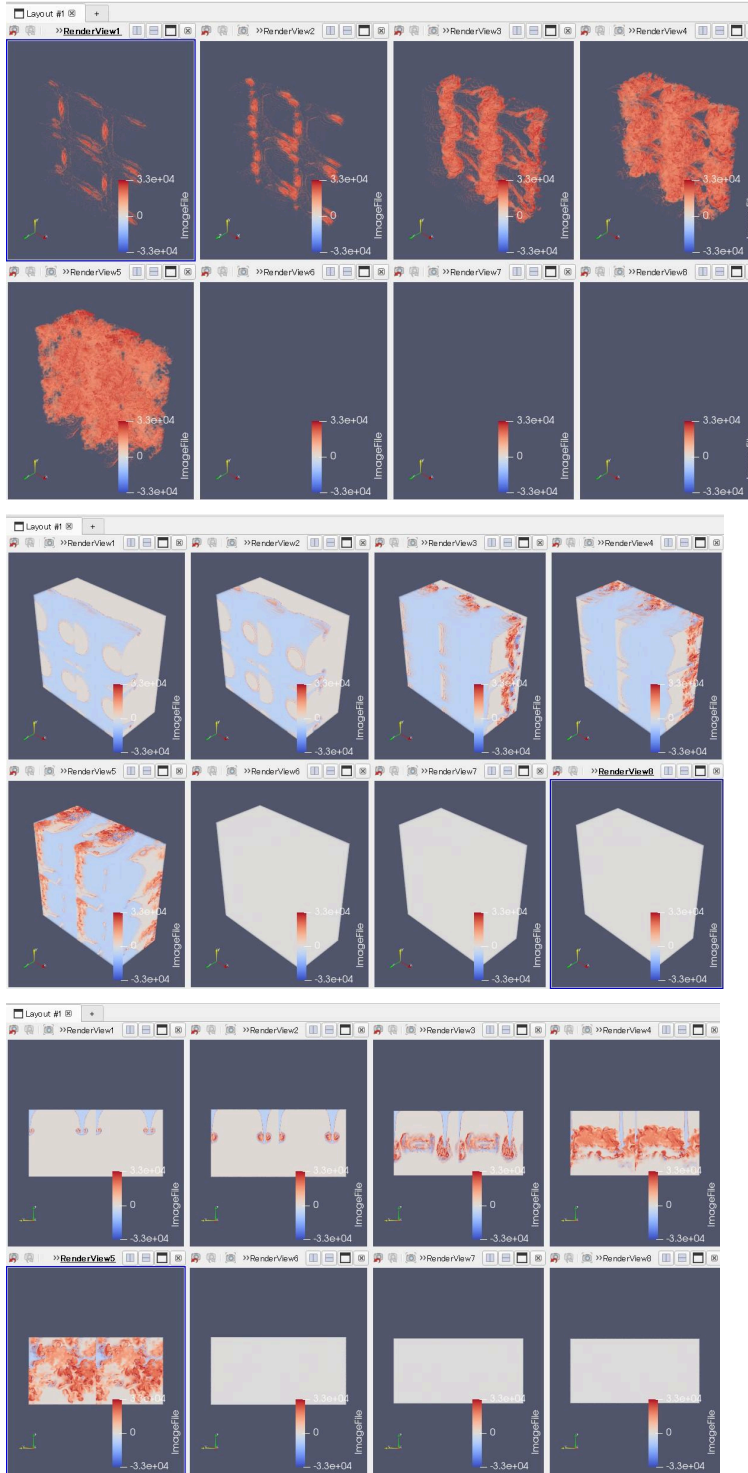
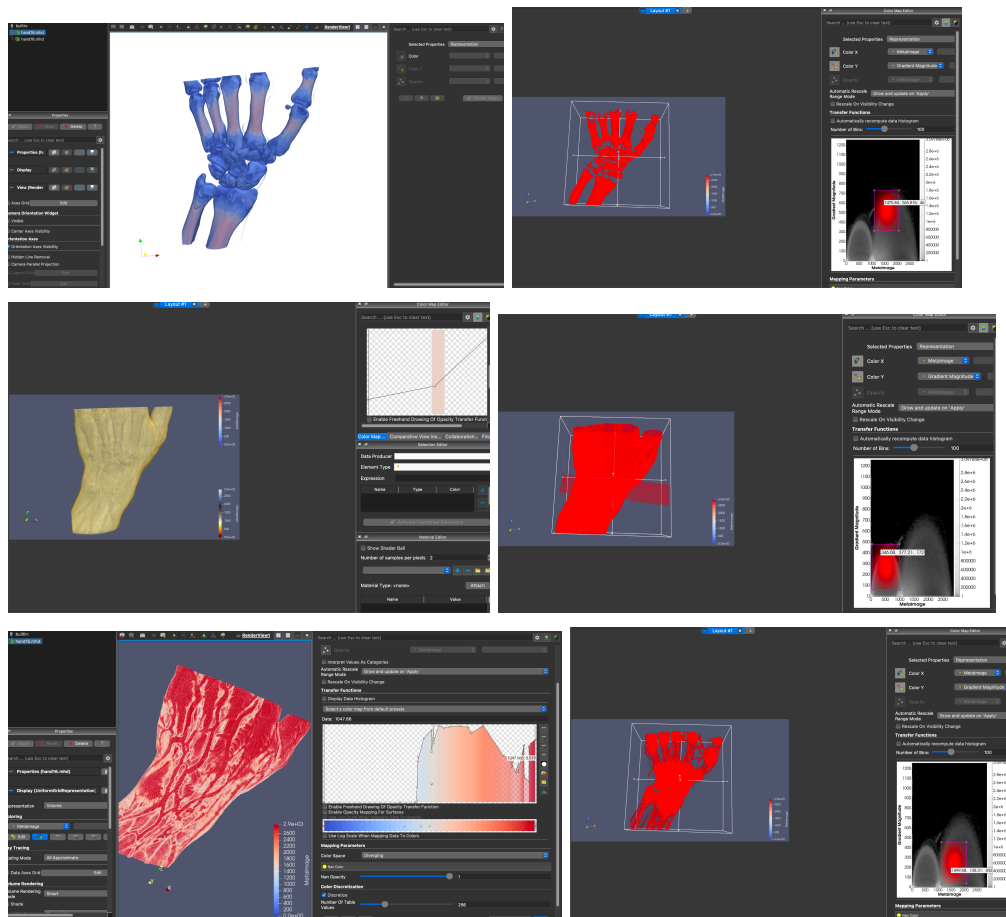


Figure 6: Visualization of real research data (8 data) in different camera angles, axes, and transfer function values

From Figure 6, the data looks like biological cell data to me, and Data 6,7 and 8 have no data points visible, but Data 5 has the highest value and volume changes from 1 to 5.

Conclusion

It was very hard for the first-hand picture generation, and I attach some struggles output here below:



After figuring out how to handle the colormap and transfer function, finishing the other parts of the assignment was a lot easier. For parts 4 and 5, loading the datasets was a bit tough because, in my case, the paraview was getting hanged multiple times. Overall, I learned a lot about the transfer function and loved the assignment.