Class - CS 6635
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Assignment-3

Q1. Fig 1, 2, 3 represents the "skin with yellow band", "bone with transparent skin" and "bone, blood vessel with skin" respectively obtained by using the 1D transfer function. For the yellow skin I changed the color to yellow and make the skin region (76 - 480) opacity to 1. For fig 2 used the bone region opacity high and the skin region opacity less keeping rest of the region opacity to 0. For fig 3. I used the 3 different selective regions for skin, bone and blood vessel and adjusted their opacity to get the required image. I have also used the shade option.

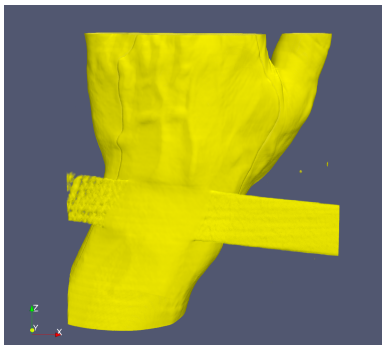
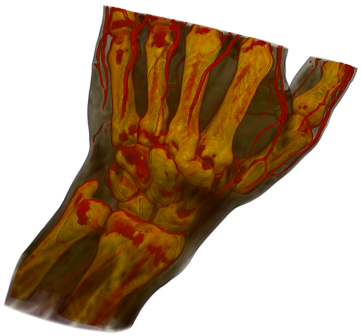


Fig 1. Skin with yellow band (1D TF)

Fig 2. Bone with transparent skin (1D TF)

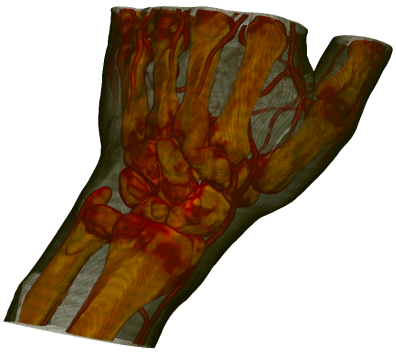


3. Bone, Blood Vessel with skin (1D TF)

Q2. Fig 4, 5, 6 represents the "skin with yellow band", "bone with transparent skin" and "bone, blood vessel with skin" respectively obtained by using the 2D transfer function. In 2D transfer functions I obtained the below images by selecting different regions, changing the area of the selected regions and by changing the color.

Fig 4. Skin with yellow band (2D TF)

Fig 5. Bone with transparent skin (2D TF)



6. Blood Vessel with bones and skin (2D TF)

I took more time to generate the images using 1D transfer function as I started with 1D and took a time to understand the scalar values of each region and opacity gradient and selecting an appropriate transfer function.

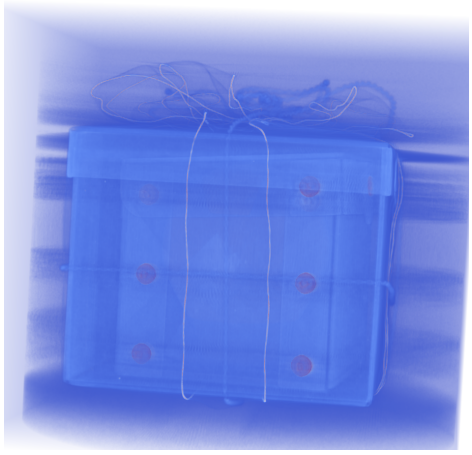
I feel the 1D transfer function is more intuitive, as I can control the effect by selecting the scalar region, color and their opacity to obtain the required images and know how each parameter controls the final image. For 2D transfer function it is easier to get the image, but it is less intuitive while selecting the appropriate region and area.

	1 D transfer Function	2D Transfer function
Pros	1. Faster as less computation 2. Large dataset can be viewed easily 3. Its intuitive	1. Simple to use more flexibility 2. Able to detect boundaries between different materials. 3. Higher quality visualization
Cons	1. We may loose information, if different features have similar scalar value. 2. A lot of effort requires to select an appropriate transfer function for some features. 3. A small difference in transfer function may produce a completely different image. 4. It does not capture all material boundaries.	1. Less intuitive. 2. More computationally challenging

Q3. In order to know what is there inside the present first I tried with iso-surface filtering with animation view but that does not help me as the objects are of similar scalar values. I used 1D transfer function to capture some of the regions, but it does not help much as it is not able to differentiate the boundaries between materials and time consuming for selecting appropriate transfer function. Hence tried with 2D transfer function which utilizes gradient to view the objects inside the present and able to define boundaries between different materials.

I used different boundary box at different scalar position to see the objects by using 2D transfer function. I am able to identify the below objects.

1. Outer gift box with strings attached (fig 7)
2. Inner box with fasteners at different positions (fig 8)
3. A showpiece with castle like structure (fig 9)
4. Cylindrical Stand (fig 9)
5. Round ring type base structure, it could be part of the crystal pot of different material (fig 9)
6. A crystal pot (fig 10)
7. A squirrel (fig 11)
8. A lizard (fig11)



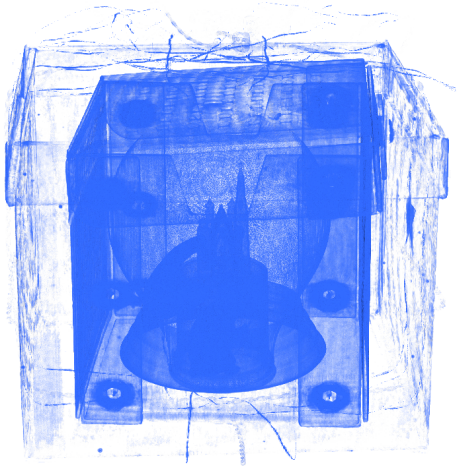
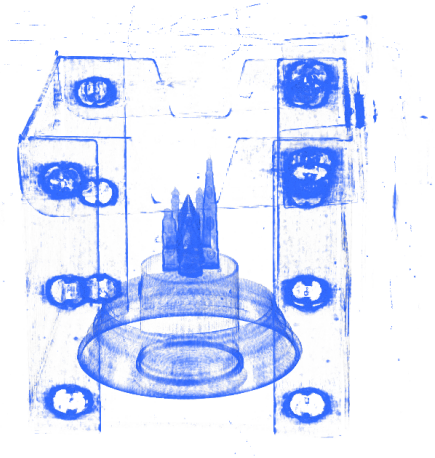


Fig 7. present with outer cover with strings attached. Fig 8. Inside box with fasteners at fixed position



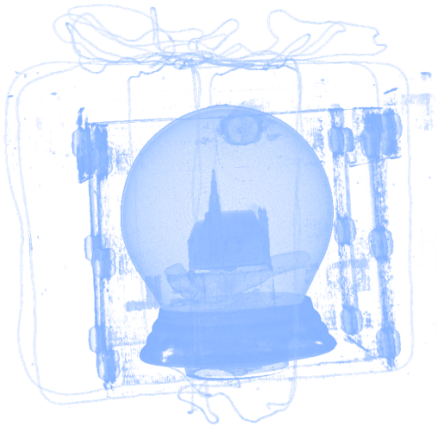


Fig 9. (Left) Castle, cylindrical stand, round ring type base structure. (right) the ring type base structure could be the part of crystal pot but with different scalar value.

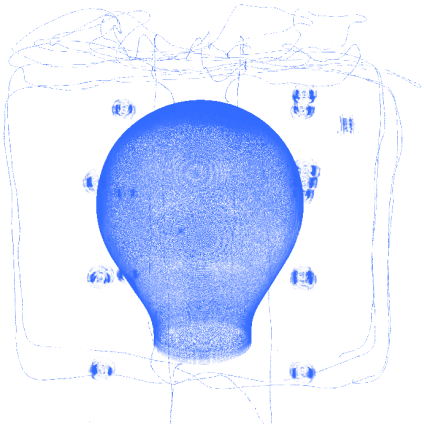


Fig 10. Crystal pot

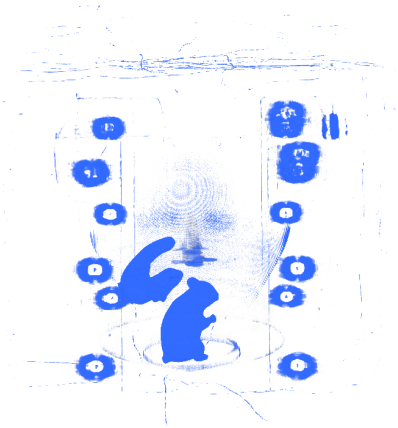


Fig 11. Squirrel and Lizard

Q4. I downloaded the Stag beetle DAT file 832x832x494 and 208x208x123 from the given website and converted the DAT format to RAW format using python code.

Used the same transfer function to view both the images using volume rendering. It can be seen that the high-resolution beetle has finer details with sharper visuals and low-resolution beetle is not able to capture finer details and is less sharp. In high resolution image we can see clearly the antennas. Finer details of the complex structure near to the head and leg regions are captured well in high resolution image. In terms of performance, while loading the raw file in paraview, I did not observe any significant difference, however while applying the transfer function, for high resolution beetle it takes longer time to get the effect as compared to the low-resolution beetle.

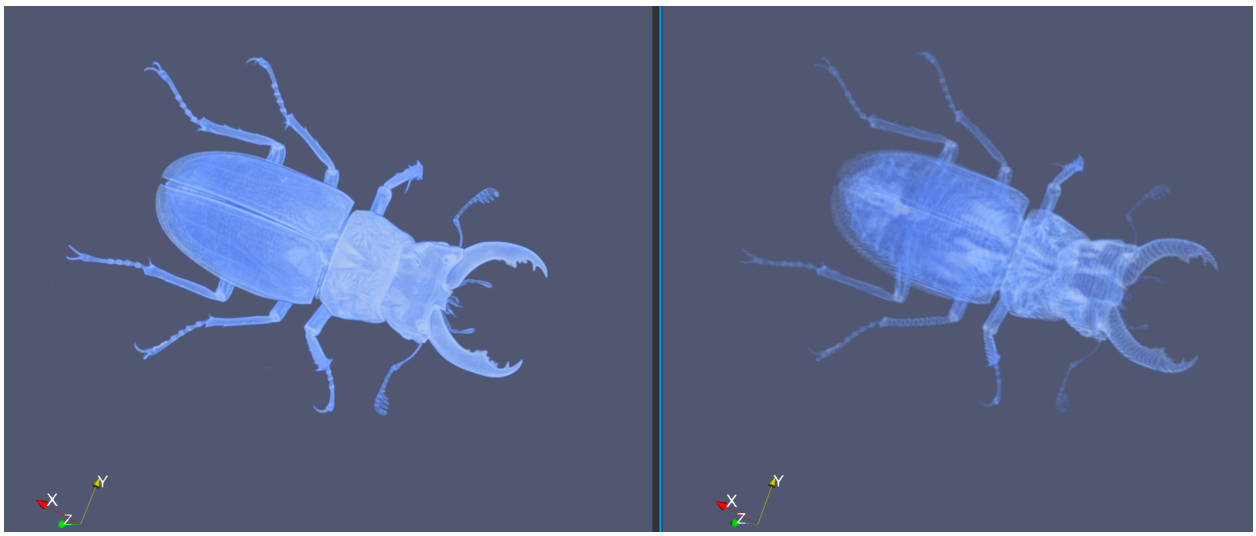


Fig 12. High resolution Beetle (Left) Low resoltion Beetle (Right)

Q5. Downloded the unknown dataset which has 8 different .raw datasets.

The datasets are aranged from left to right and top to bottom. First row represents the dataset 1, 2, 3 and 4 from left to right. Second row represents the dataset 5, 6, 7 and 8 from left to right. I used volume rendering to visulaize the dataset. Fig 13 represents the volume rendering with the default 1D transfer function for all the dataset.

In my view Its represents a fluid motion involving two distinct liquid characterized by variation in density or temperature. The dataset indicates transition towards turbulence from dataset 1 to dataset 8. In dataset 1 the flow appears to be more stable (laminar flow) while the successive dataset shows incresing turbulence due to gradual increse in disturbances in the flow.

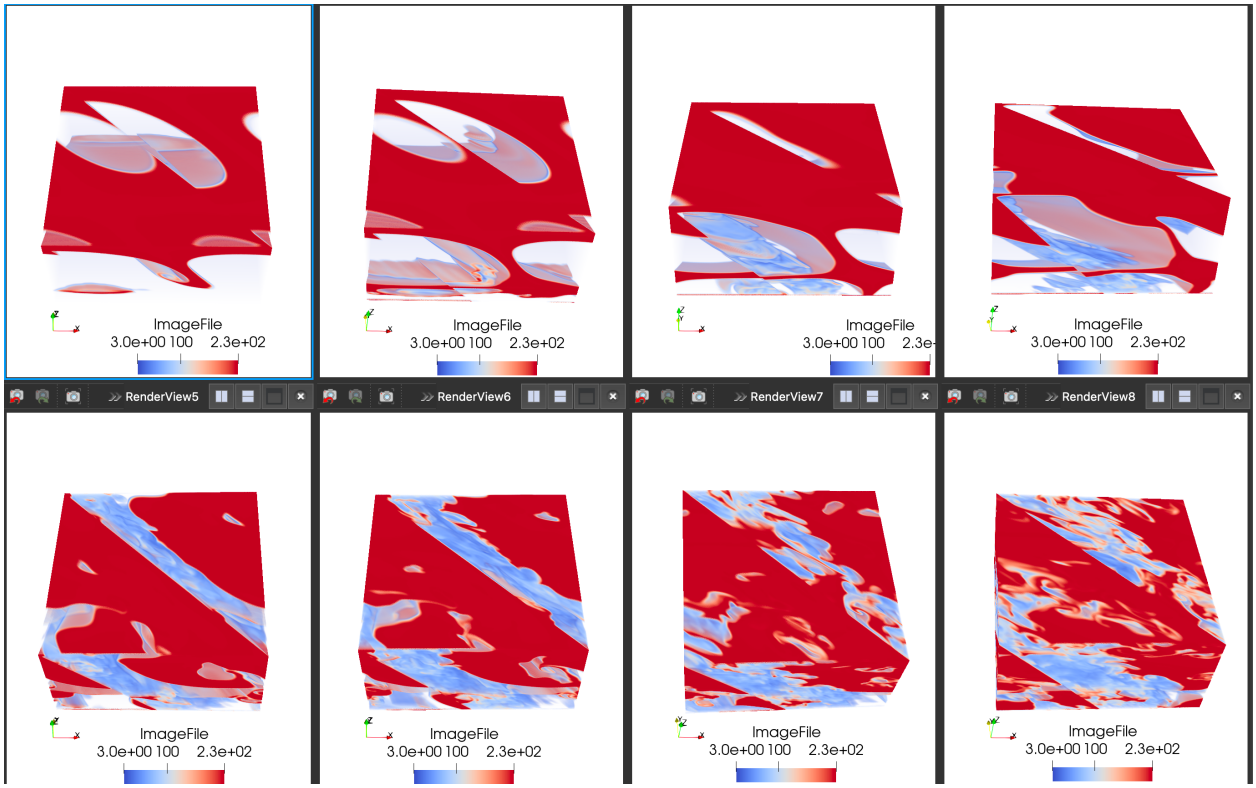


Fig 13. Volume rendering with default 1D transfer function

I modified the 1D transfer function to visulaize only the red region making the blue region opacity 0 and red region opacity 1. It can seen from the figure 14, more stable flow in dataset 1 and gradually disturbances observed from dataset 1 to 8. Initial dataset the flow (velocity) boundaries are well defined (dark red (high velocity) / light red (low velocity)) but gradually it tries to moves towards low velocity. Similarly inorder to capture only blue region, I used highest opacity for blue region and 0 opacity for red region similar phenomena observed as shown in figure 15. Initial dataset (dark blue (low velocity) / light blue (high velocity)) moves towards high velocity side.

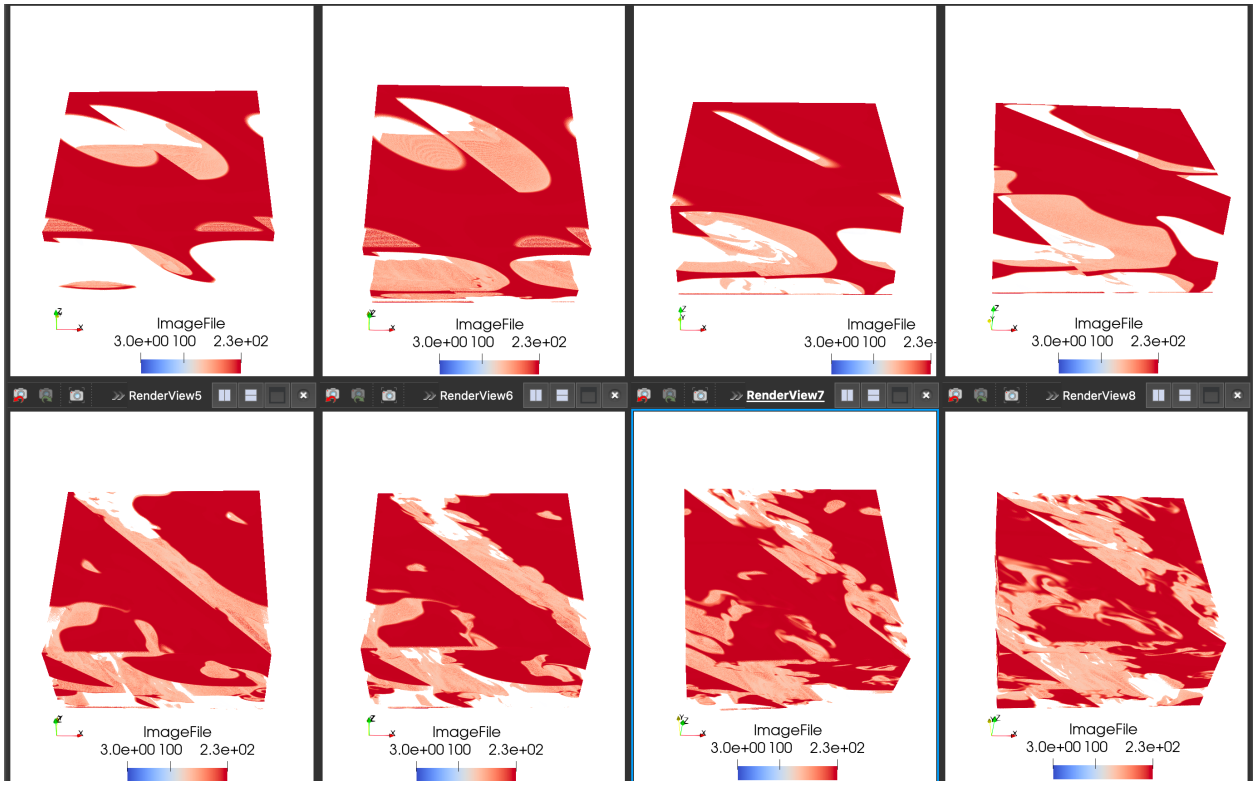


Fig 14 Volume rendering with 1D transfer function making the blue region opacity 0 and red region opacity 1.

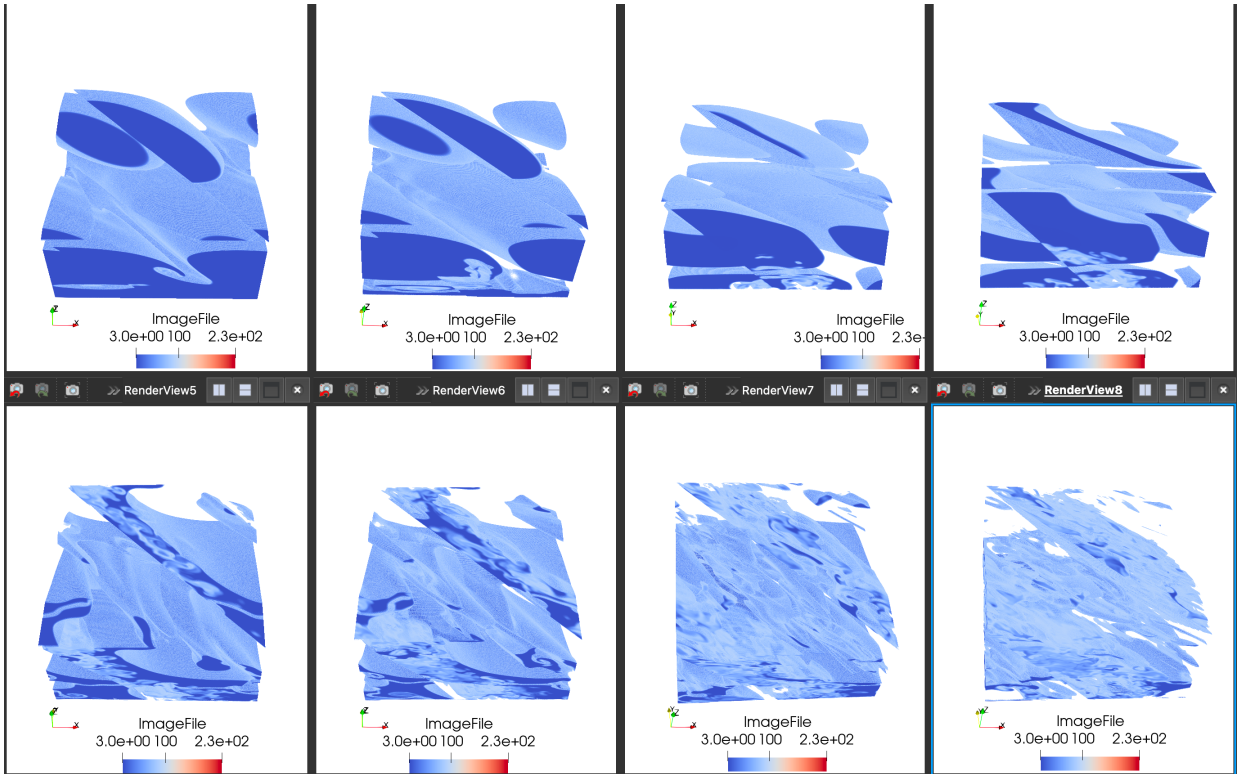


Fig 15 Volume rendering with 1D transfer function making the red region opacity 0 and blue region opacity 1.

Conclusions:

- In this homework I learned about volume rendering and how to use 1D and 2D transfer function to visualize different parts of an image.

- Volume rendering is more powerful than the iso-surface extraction which we used in the last homework. In iso-surface extraction it is difficult to capture different materials having similar scalar value.

- 1D transfer function uses the combination of scalar values, color and opacity to visualize the object. It is tedious to select a proper transfer function, but it is more intuitive.

- 2D transfer function uses the combination scalar values, color, opacity and gradient to visualize the object. It is more flexible but less intuitive.