

CS-530 Project 4 Report

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Task 1

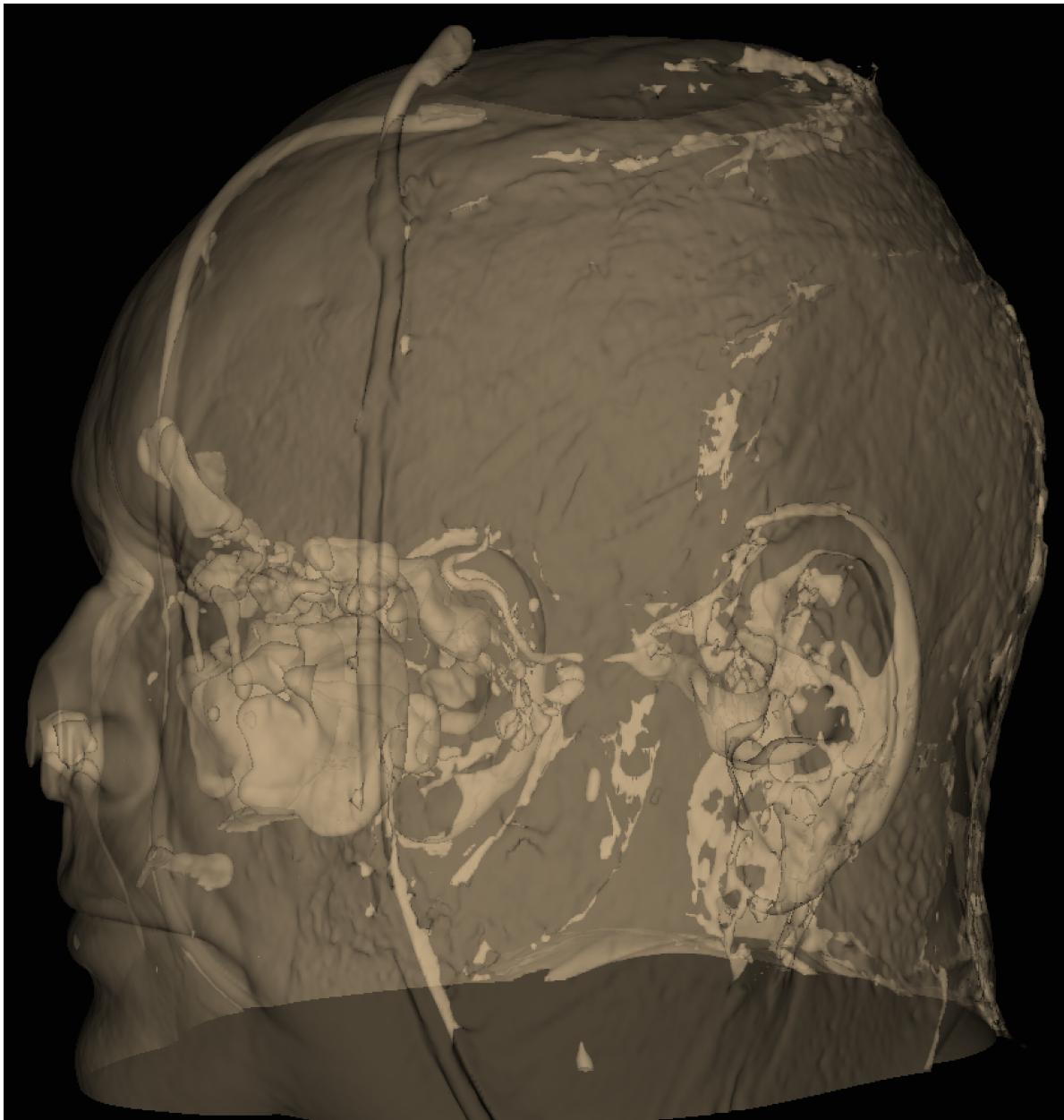


Figure 1.1a head - isovalue 500

This isosurface contains skin, some organs and cartilages of ears, nose.



Figure 1.1b head - isovalue 1158

This isosurface contains the main structure of the skeleton in the head.

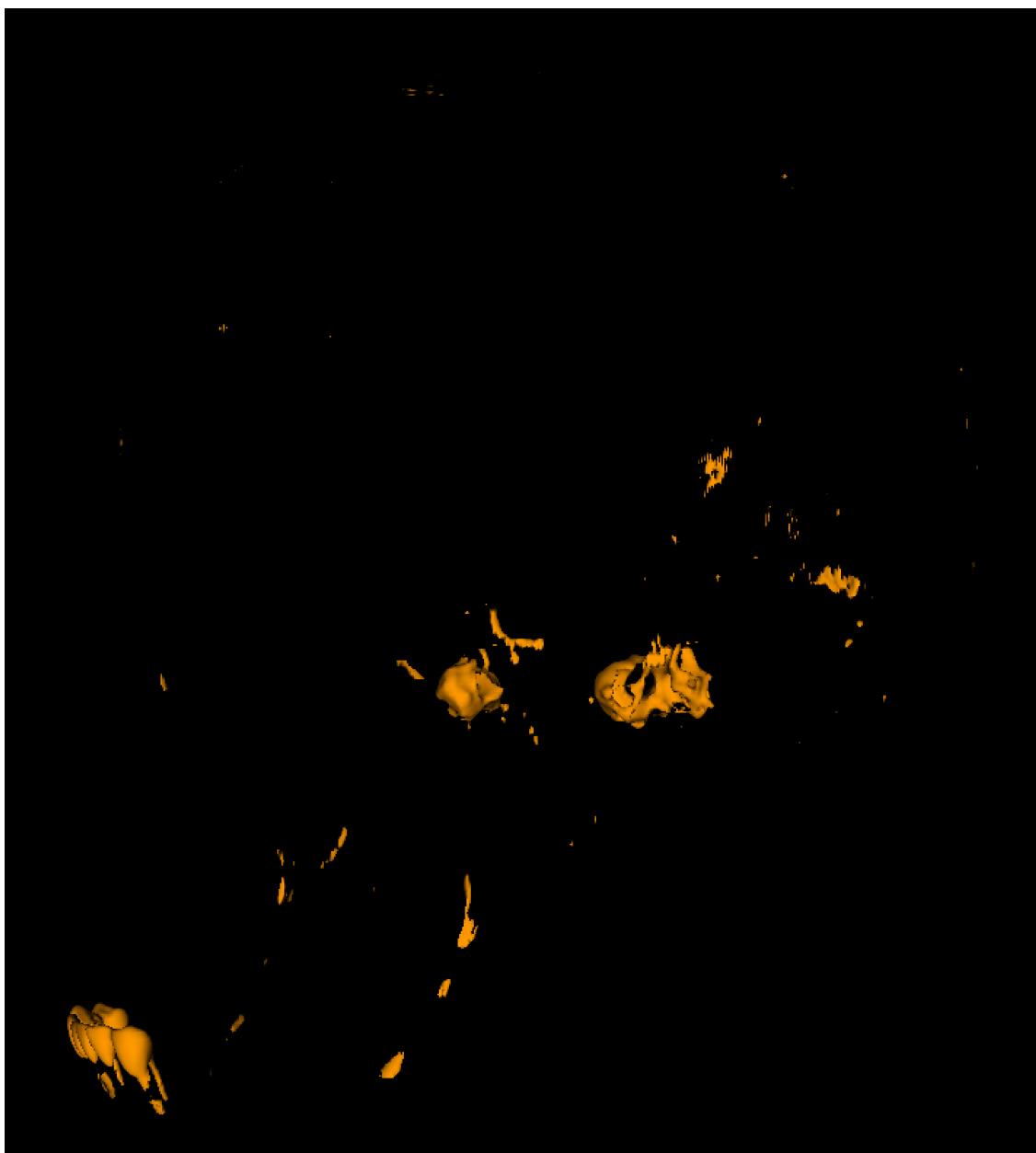


Figure 1.1c head - isovalue 2750

This isosurface does not contain a lot of bones, however, I would like to emphasize the bones with high isovalue, such as teeth and some pieces of bones on the face.

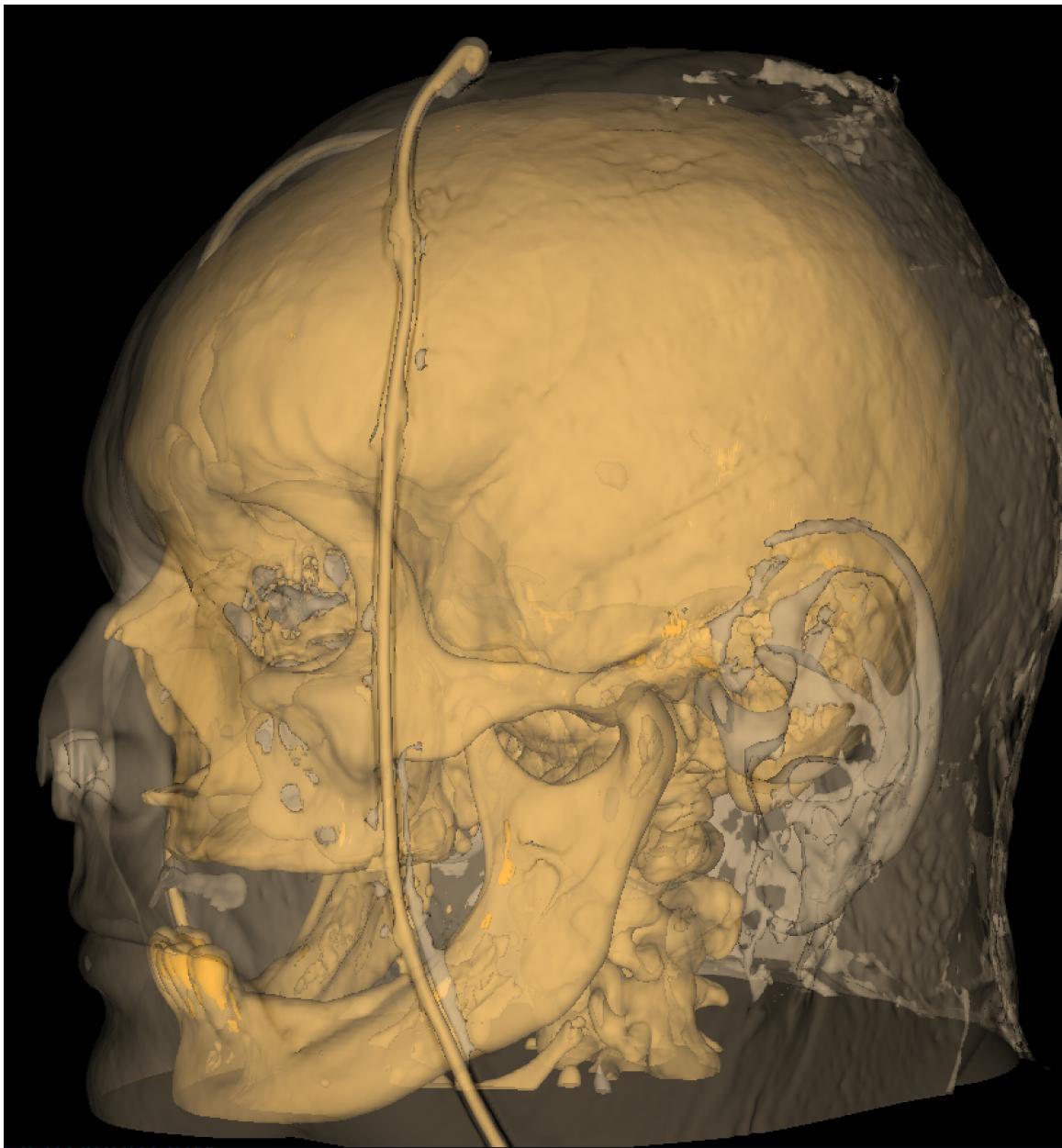


Figure 1.1d head - all isovalue

The combination of all isosurfaces.

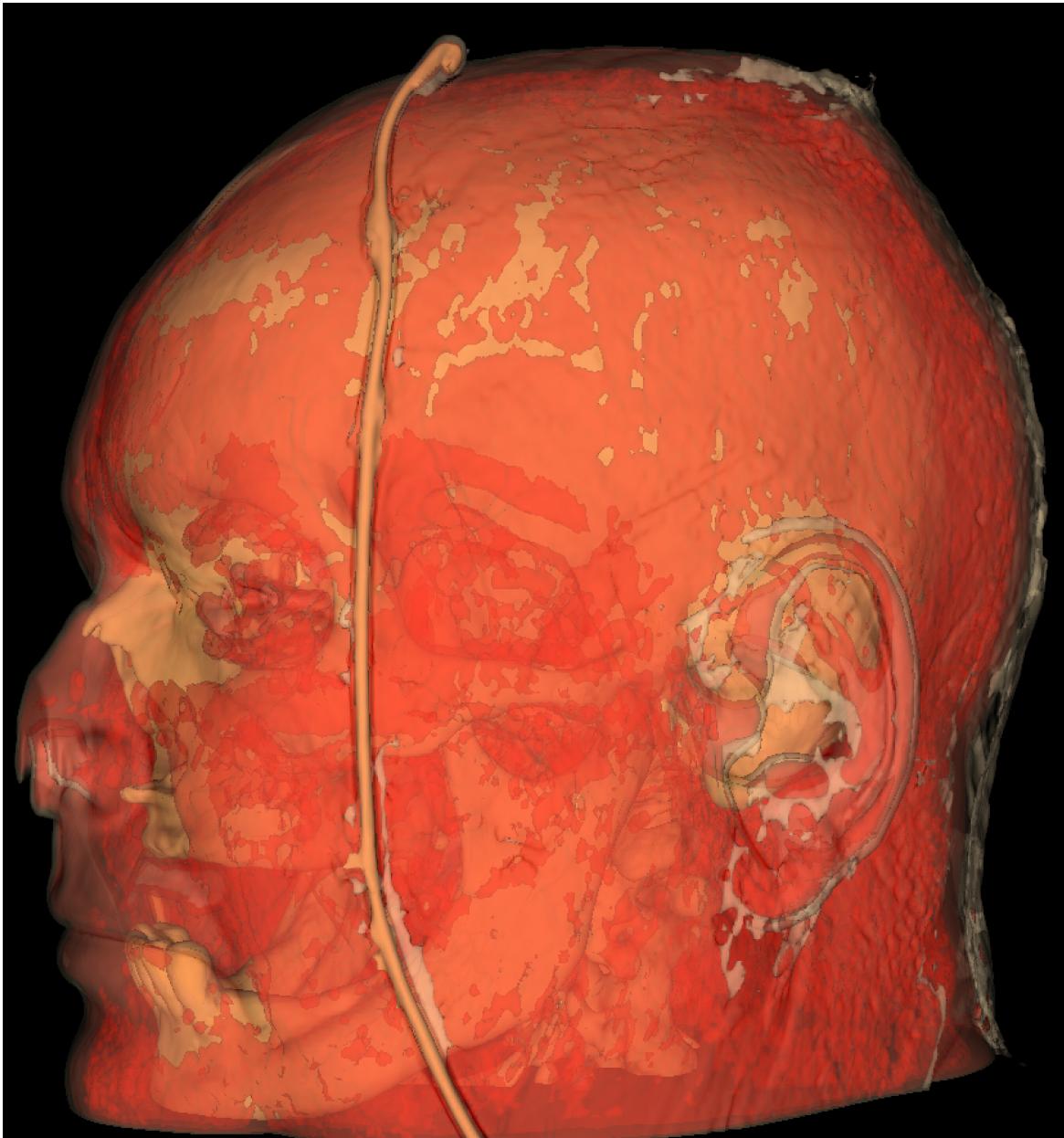
For isovalue 500, the opacity is 0.3.

For isovalue 1158, the opacity is 0.5.

For isovalue 2750 skin, the opacity is 1.

The configuration of opacity values makes the outer isosurface more transparent than the inner isosurface. By observing the image, we can explicitly see the skin, head structure and some bones with high isovalue.

In fact, originally I want to add an isosurface (isovalue 980) with the muscle of the face. However, it performs very bad on my macbook with integrated graphic card. The image is as following:



The differences between isosurfaces became ambiguous. Thus, I decided to remove the muscle isosurface in order to have a more clear image like figure 1.1d.

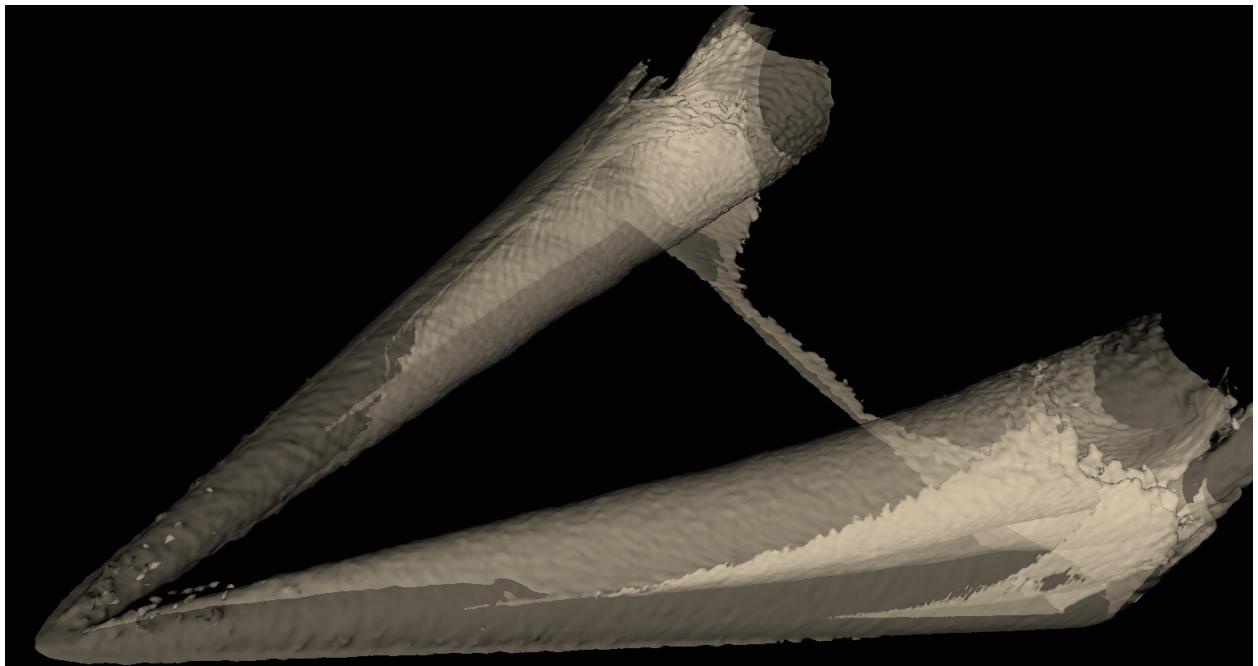


Figure 1.2a Vorticity magnitude - isovalue 3413

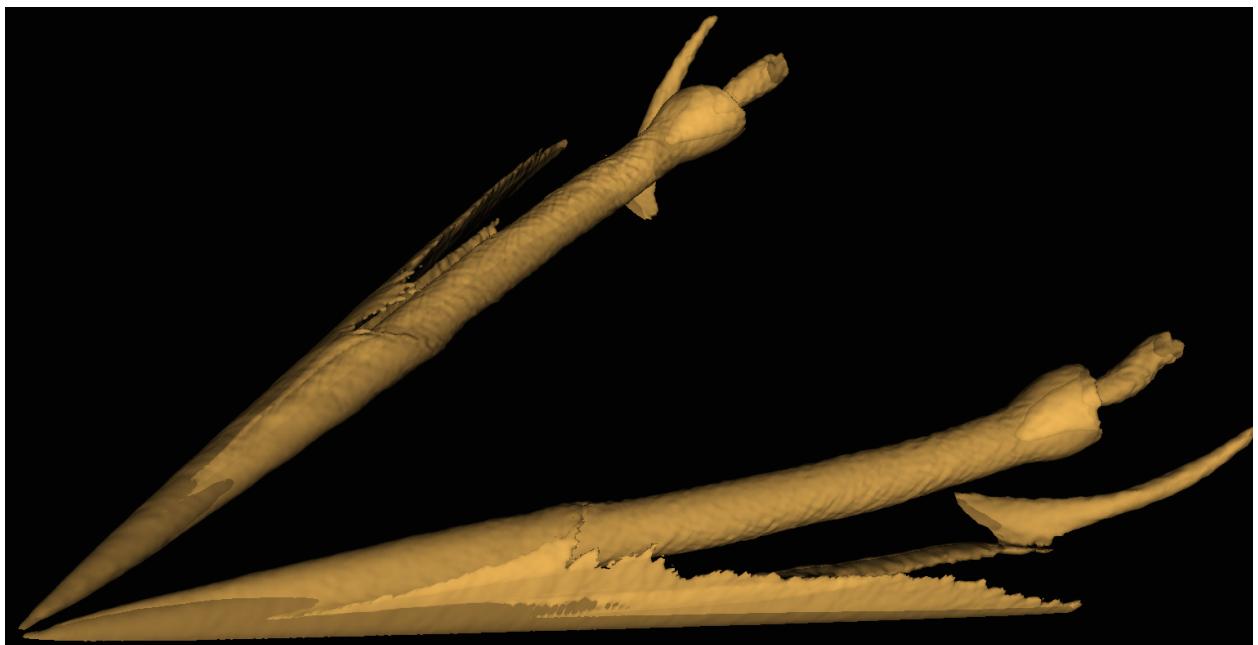


Figure 1.2b Vorticity magnitude - isovalue 18090

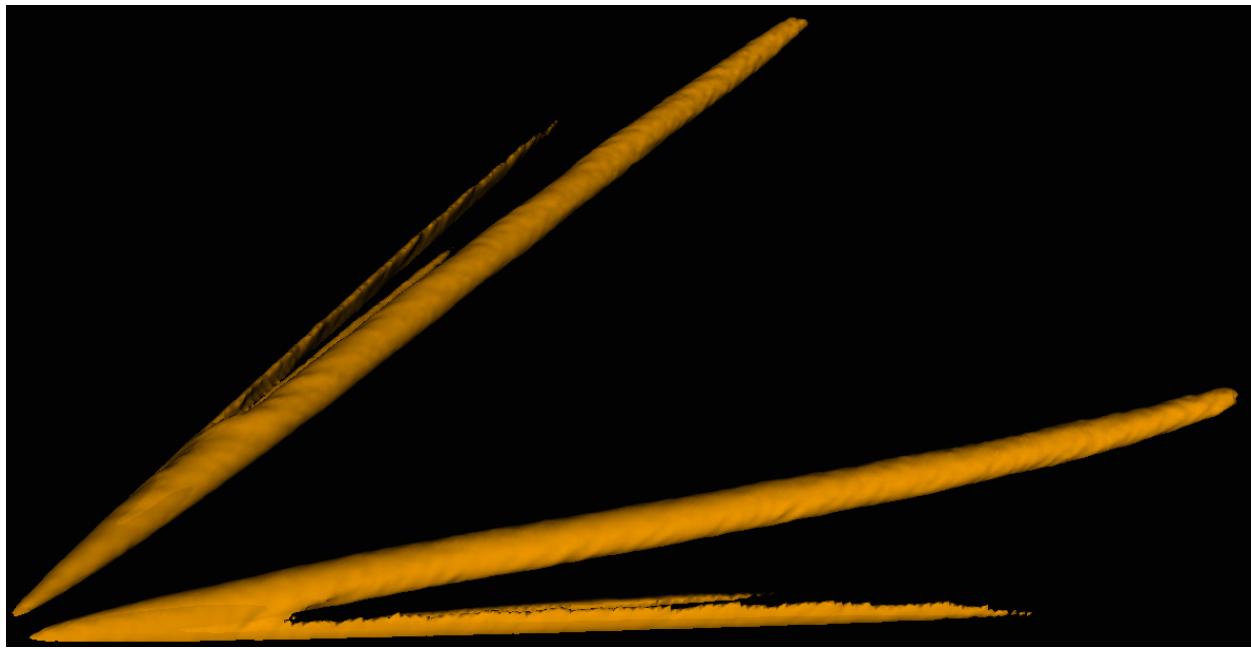


Figure 1.2c Vorticity magnitude - isovalue 41983

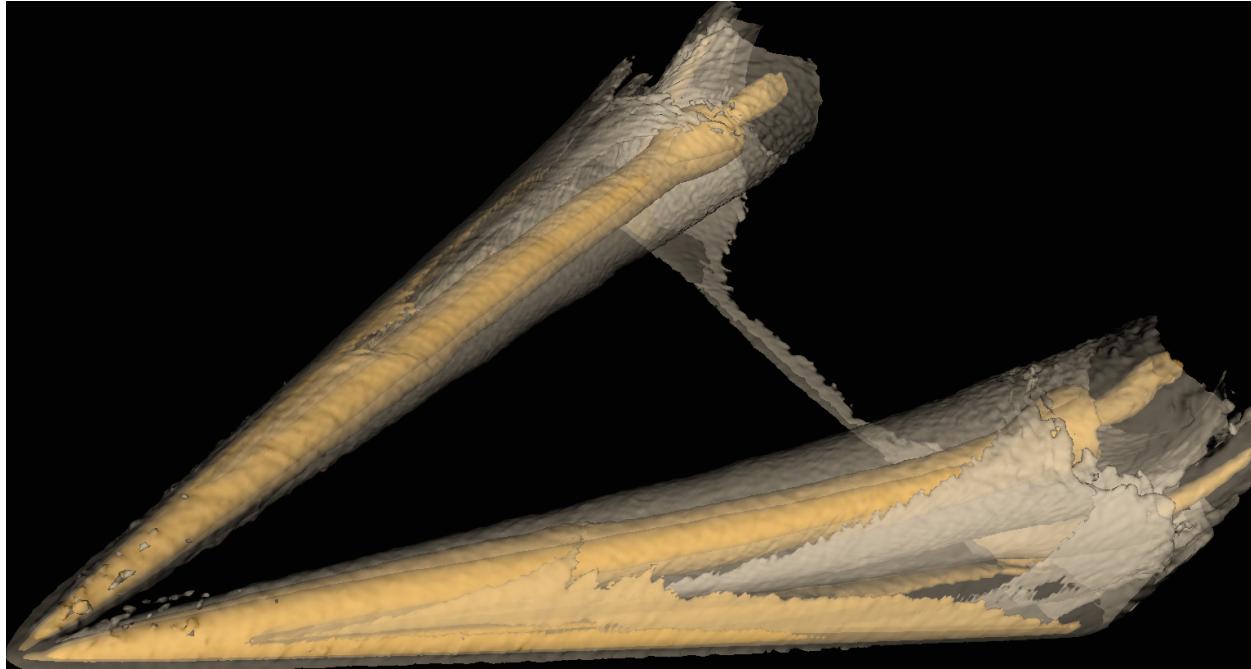


Figure 1.2d Vorticity magnitude - all isovalues

I tried to highlight properties of the vortex breakdown, such as the recirculation bubbles present on each side of the delta wing aircraft. For the opacity values, the configuration is

isovalue 3413 -> 0.4

isovalue 18090 -> 0.6

isovalue 41983 -> 0.9

The configuration of opacity values makes the outer isosurface more transparent than the inner isosurface.

Task 2

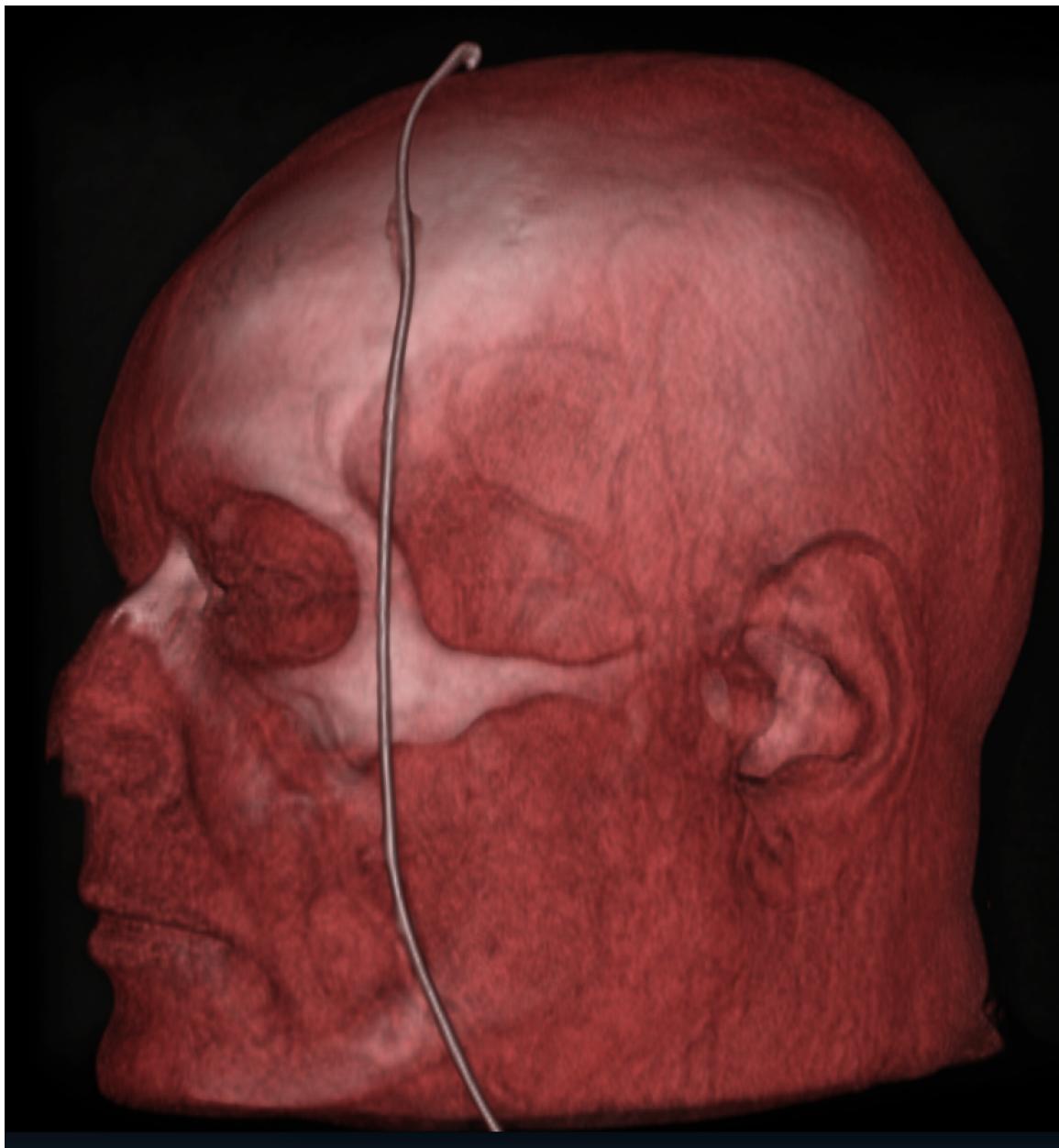


Figure 2.1 head

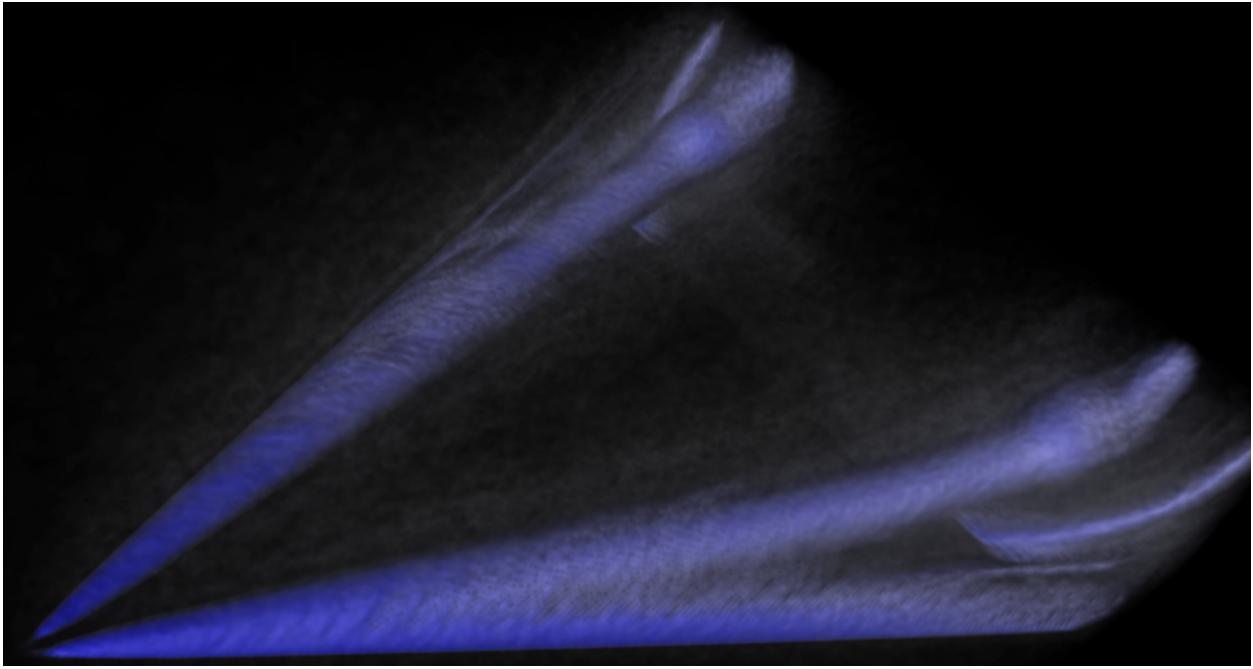


Figure 2.2 Vorticity magnitude

It is difficult to choose the appropriate values for the transfer function.

For the color transfer function of figure 2.1, in order make the image looks like human body, I select the skeleton as white and the skin and muscle as red. In figure 2.2, I simply adjust the saturation of the colors for different layers. Basically it is a blue color map.

The opacity values are very different from the values in task 1. I use `vtkPiecewiseFunction` to try many times and guess better values for each layer. However, for figure 2.2, it is hard in my computer to find good opacity values to perform a better image due to the limitation of graphic card.

In order to have better image quality, I set the sampling distance as 0.1.

Task 3

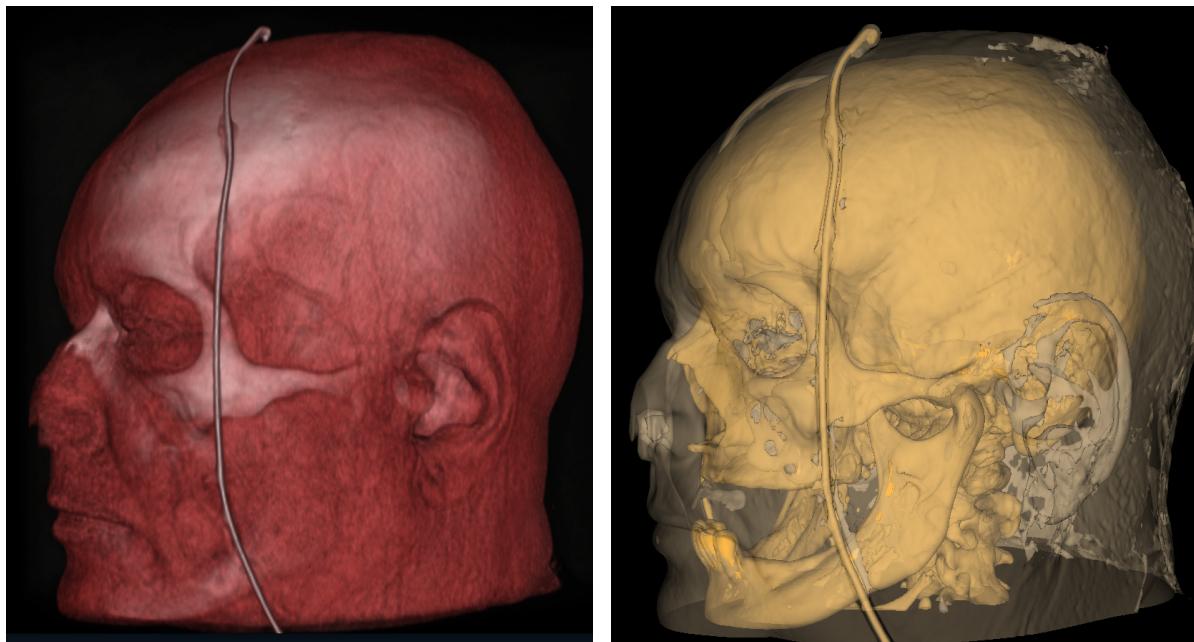


Figure 3.1 head
(left: volume rendering, right: isosurfacing)

In my experiment of the image of head, volume rendering can produce better image which contains more details and looks more natural. However, the image of isosurfacing looks sharper than the image of volume rendering.

Considering the running speed, volume rendering has better performance in my computer. On the other hand, the running time grew almost exponentially when adding more isosurfaces.

In conclusion, I would consider volume rendering is a little bit more effective in this case.

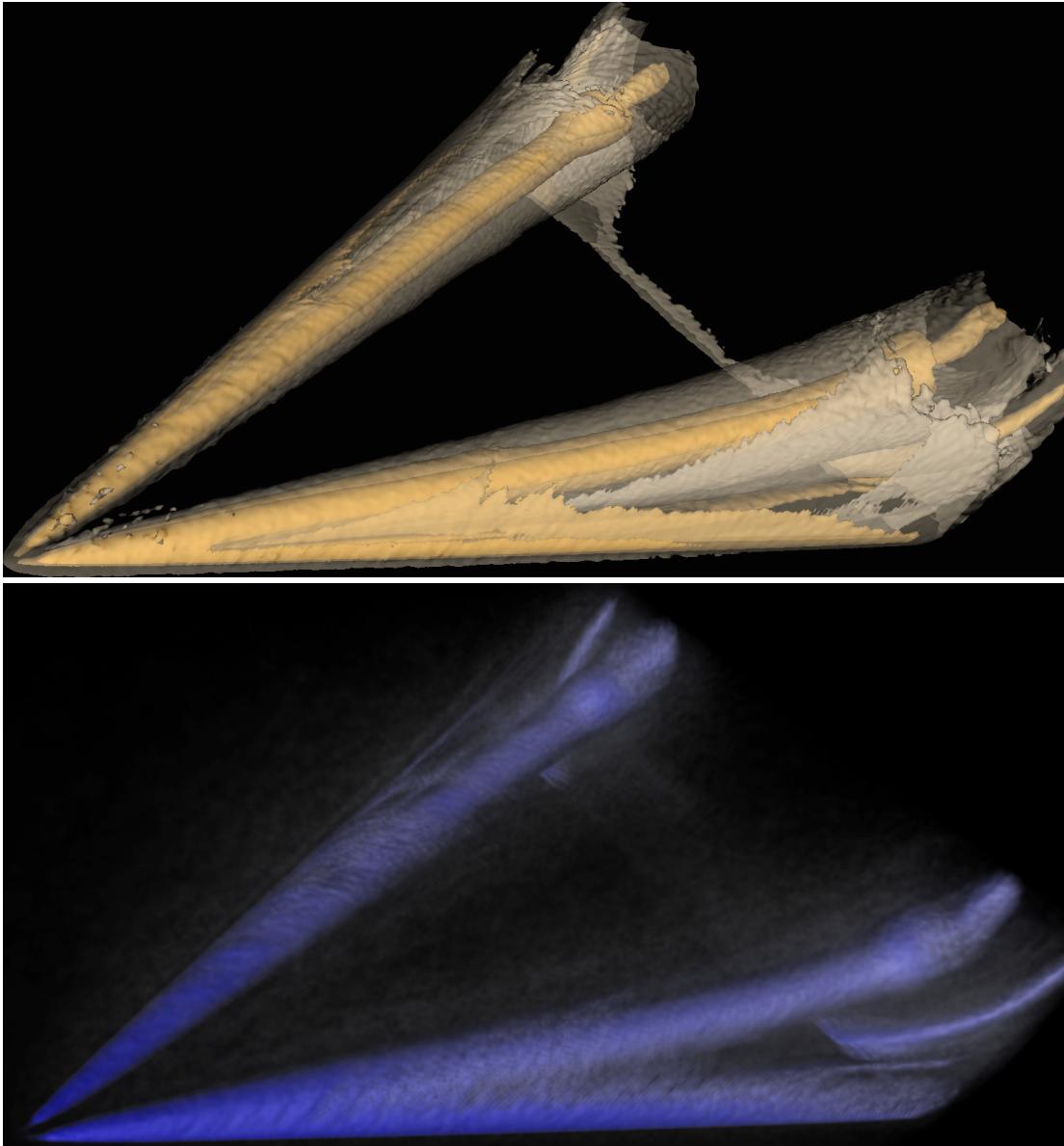


Figure 3.2 vorticity magnitude
(upper: isosurfacing, lower: volume rendering)

In my experiment of the vorticity magnitude, volume rendering still can produce better image which contains more details and looks more natural. Moreover, the image of isosurfacing looks really bad, it's might because the data set is difficult to be separated as different isosurfaces clearly.

About the running speed, it has almost the same results as the previous case.

In conclusion, I would consider volume rendering is much more effective in this case.

Summary Analysis

The pros and cons of volume rendering:

Pros

- Natural representation
 - See figure 2.1. It looks natural and is like real human body.
- Better transparency effects
 - See figure 3.1. The transparency effects perform better than isosurfacing can do.

Cons

- The image is relatively blur
 - See figure 3.1. Isosurfacing can produce sharper images.
- The boundary of the different parts is difficult to be observed
 - See figure 2.1. It is difficult to clearly separate two different layers.