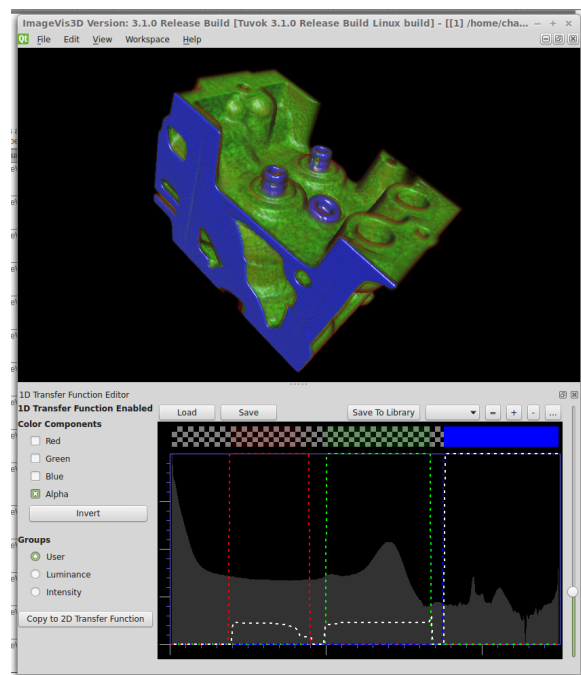
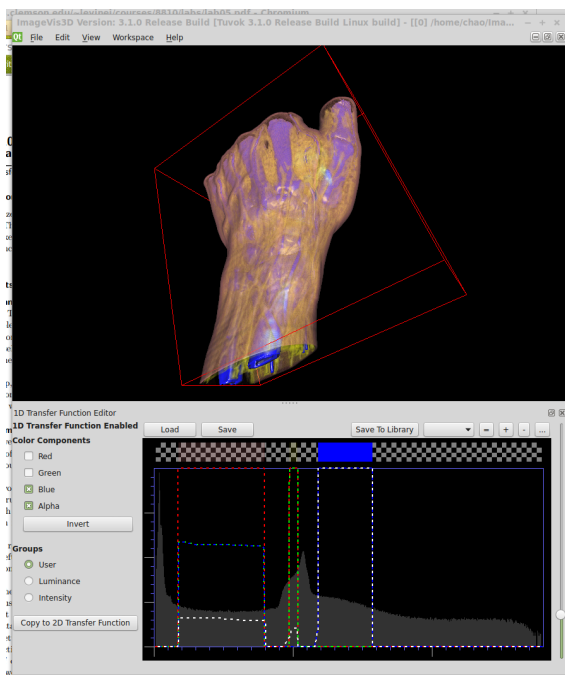


# Lab 5 — Transfer Function Design | CPSC 8810.001 Data Visualization

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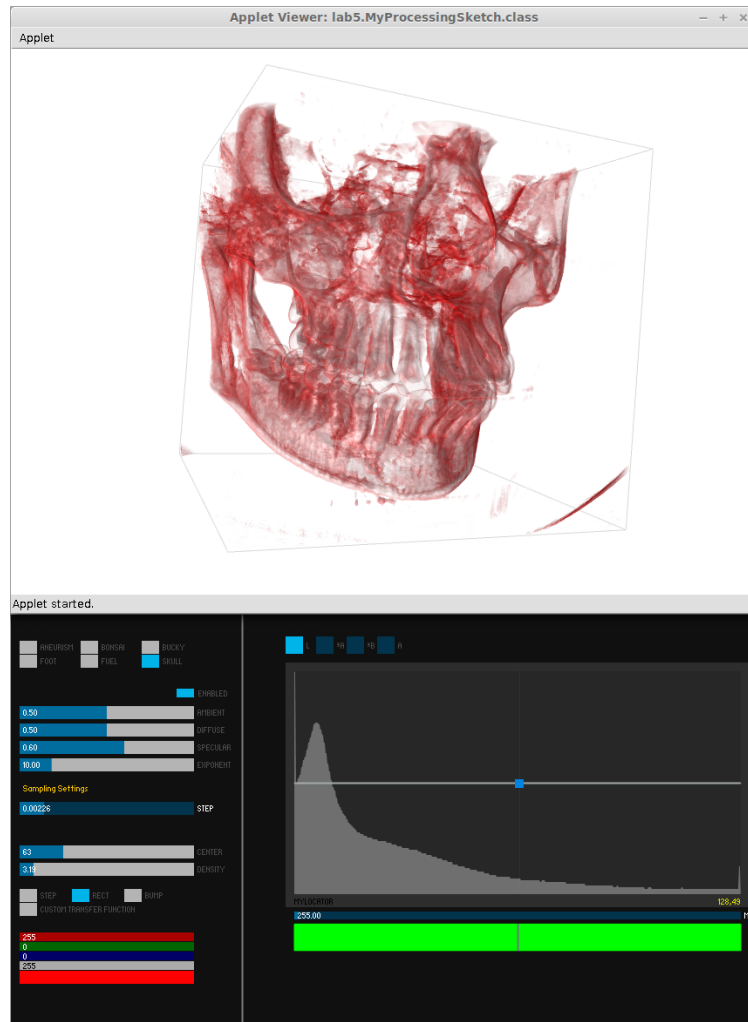
## Understanding Transfer Functions

The Transfer function editor gives a fast and intuitive way to explore volume data. There are several things I like about it. First, the color component editing provides more channels to separate different density values. with the help of alpha, it actually helps to mask out the values you don't need. Second, a reference of original data with a scale adjustment slider let user know to where to pay an attention. Third, exploring a good function may be very time consuming, the ability to save is always a good practice. But the way of drawing curves is not convenient always, a curve editor similar to maya ( which, for example, can do edition on selection) will increase the usability. Also, the RGB color space is not intuitive sometime, more choice could be added.



I chose hand(organic) and engine(inorganic) here. Compare to the engine data, the hand one has more interweaved density, so it's hard to have clear borders. The hand data contains three major density parts, skin, bone and inter flesh; the engine data has two clear parts that glued to each other very tightly.

## Running the Volume Renderer

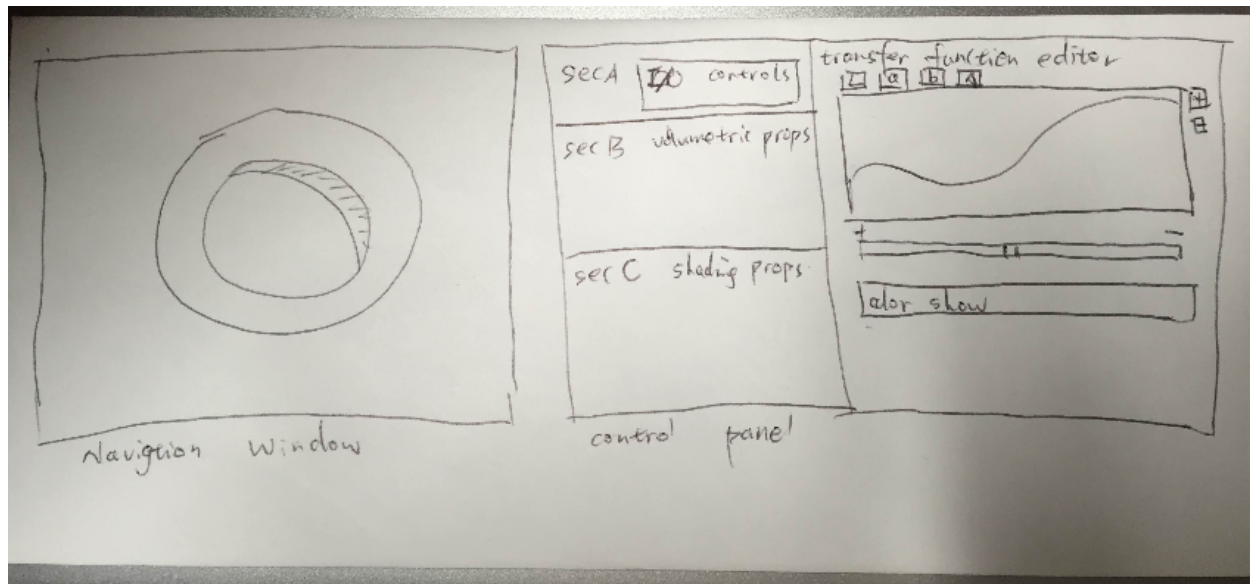


Many of the given volume datas contain noise from scanning, and the major density are relative in lower range of the data. The aneurism data contains the most noise which I think it's quite possible from the actual structure. The bucky data is a computer generated I assume since the histogram of density are very clean and patterned.

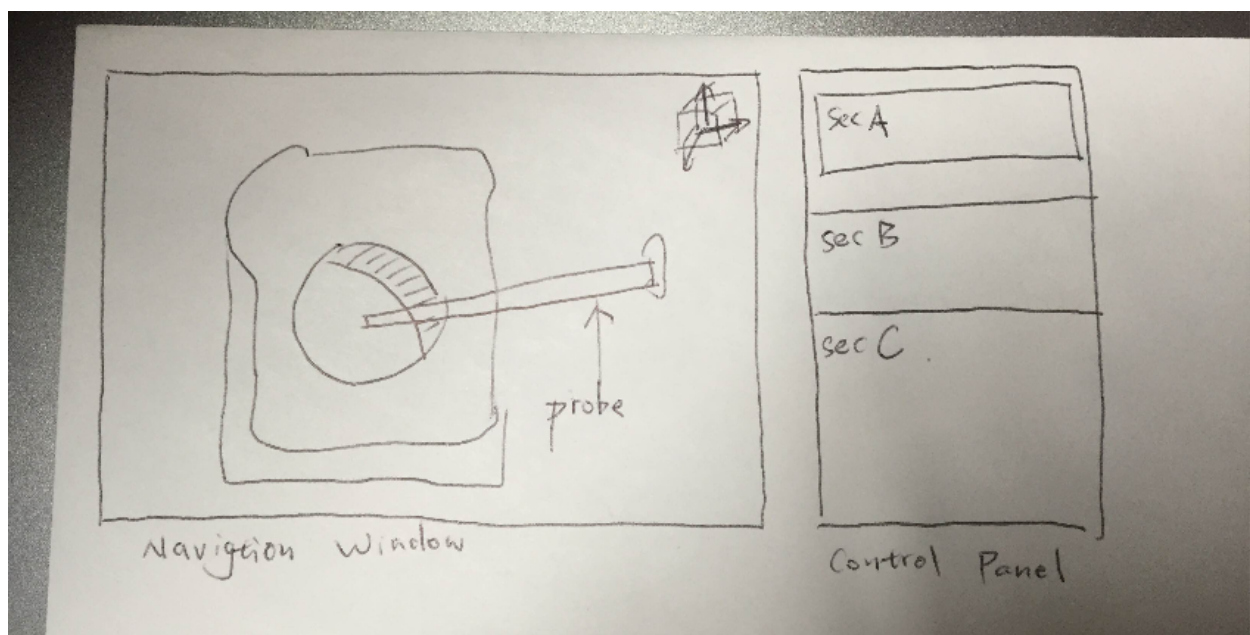
The step function provides a walk through function to explore data. While increasing the center value, you are including more and more data to the rendering buffer. But this one directional inclusion make it impossible to separate data as the 1d transfer function.

One thing I noticed is that, the pattern brought from insufficient sampling step cause difficulty in distinguishing data, so I put it back to the panel. Also, other functions such as rect and bump helps to find interested data value sometimes, so did as well.

## Designing Your Own Transfer Function Widget



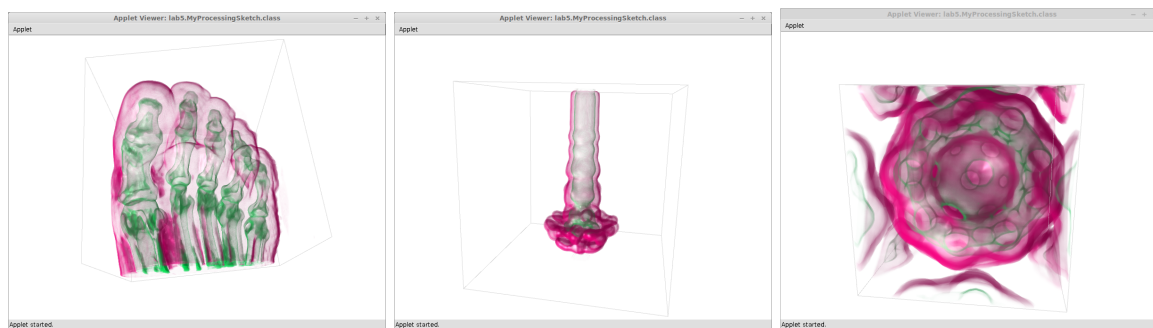
This design is similar to the one provided, a navigation window, a control panel which consists of 4 sections, A - IO functions such as data choosing, B - tweaking panel for volumetric props, C - tweak panel for shading props, D - transfer function editor. In the editor, user can switch between color components, L, \*a, \*b, A for example, and a scroll bar at the bottom that allows user to shift current function around the data. A color bar below to show the corresponding color in the rendering.



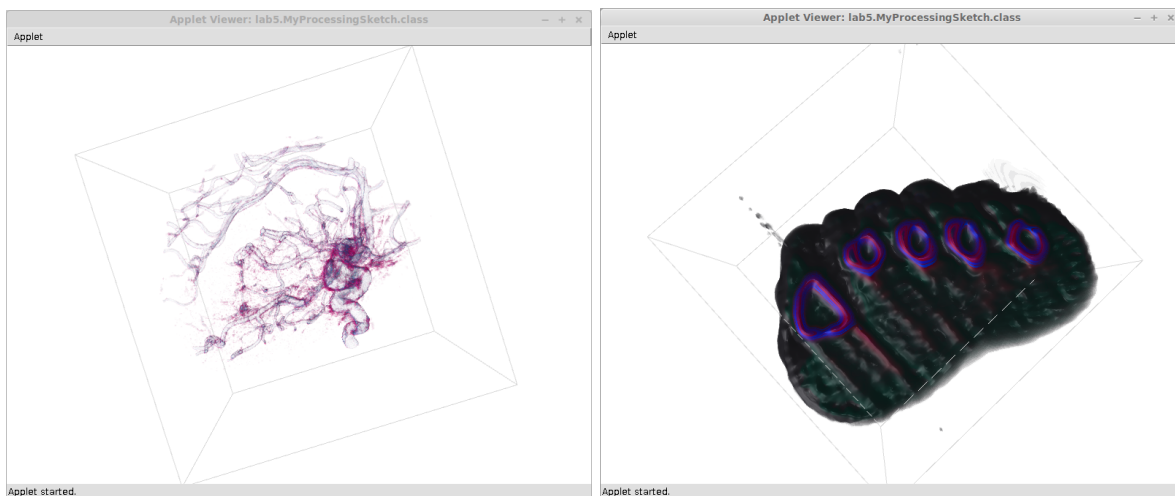
This design uses a different approaching to discover transfer functions. In the navigation window, an interactive probe can be place as needed, then the density value along the probe will be displayed in section A. In secA, user then can create interested data range by selecting the values and assign color. Section B and C are similar to the previous one. This method helps user to find interested values even faster than repeatedly trying in the function editor.

I eventually implemented the first design, mainly because the technique difficulty of the second design.

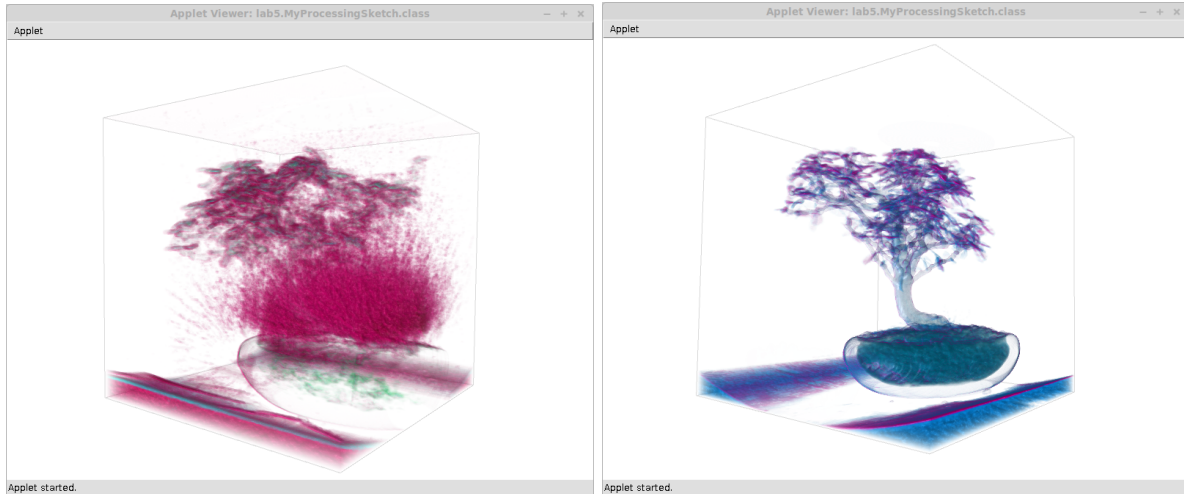
## Finding Good Transfer Functions



One thing I found interesting about the data is, the three data above all share similar interests value, the three images are generated under the same setting for all props.



For the aneurism, carefully tuning helped me to find those high density vessels (I guess) that normally be displayed as other structures. The bones are actually denser in the middle. I'm not sure what are those noise in the bonsai data, it seems like some grass? And from the image below, the blob part should be the soil and the base, they have close density.



### Extra Credit

- I used Lab A four color components in my transfer function editor. One benefit from this color space is similar to use HSV, you can adjust the luminance under one tab, where you need to do more in RGB space. Moreover, Lab offers an easier way to assign opposite colors.  
However, the caveat is obvious here, unlimited range of components makes the color goes unpredictable.
- I added a shift scroll bar to shift the current curve. When you create a curve, you can either use it to scan through the data in alpha channel to find interested values quickly, or use it to test better color combinations.

### Notes

- Since the data we deal with are linear, is there consideration on color space conversion before output to the screen? Asking so because we eventually show it on the screen, a carefully designed conversion may better the displaying.