Physics MRI Research Centre

VisMat

VERSION 3.3

User's Guide

Last Update June 20th, 2016 by Thierry Pelletier

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Preamble

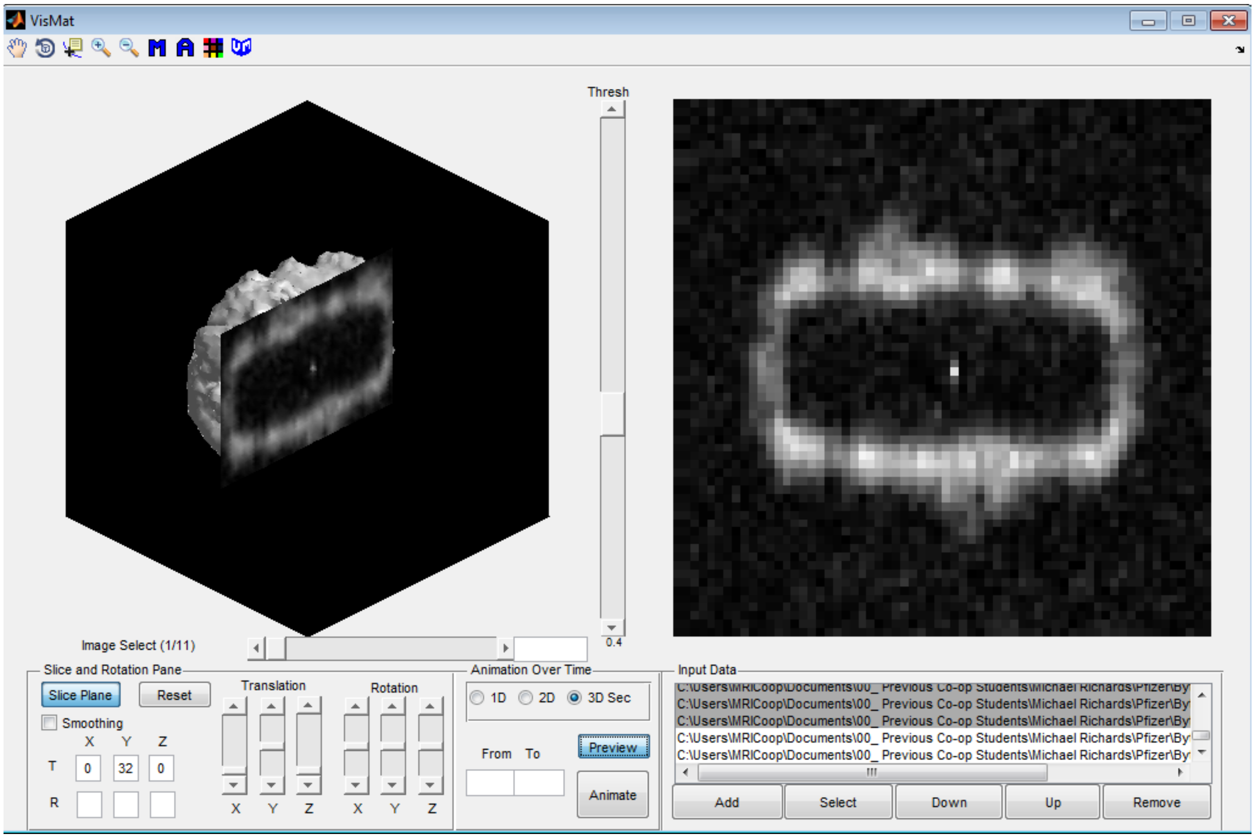
The use of VisMat requires ACCISS – Processed data. When ACCISS produces a file, it places a header on the top section of the file to indicate certain properties. When .dat files are read into VisMat, the header is detected and skipped in the reading process: therefore if no header exists, it will skip a valuable portion of the data.

With your data properly loaded into ACCISS and processed accordingly, Select File on the toolbar and navigate as follows: "**File > Save > Transformed Data > As Byte Data**" (byte is '.dat' format). VisMat will also read ACCISS – created .csv files of the same manner (Select ' As CSV data' instead of BYTE), but take note: if the file is edited in excel or other spreadsheet program it may alter the original save format, and render the file unreadable by VisMat.

Introduction

Scope

VisMat



Functionality Summary

VisMat is currently capable of the following:

- Importing sequences of .csv and .dat files (ACCISS created), 64*64*n in size, where n can vary.
- Creating a 4-D dataset from the files
- Displaying one 3D dataset and rotating it in X,Y and Z (input value or use slider) based on an isosurface rendering (left window)
- Setting threshold value for the isosurface
- Toggling a slice plane on the 3D object which is displayed in the right window
- Translating the slice plane in any orientation orthogonal to an axis (input value or use slider)
- Viewing In-Situ Slice/cut-away volume values
- Reset back to original conditions
- Smooth data through interpolation from 64*64 to 512*512

- Animate 1D horizontally or vertically and save to any location
- Animate 2D either as 64*64 or 512*512
- Animate Cut-away 3D Data

Running VisMat

Requirements

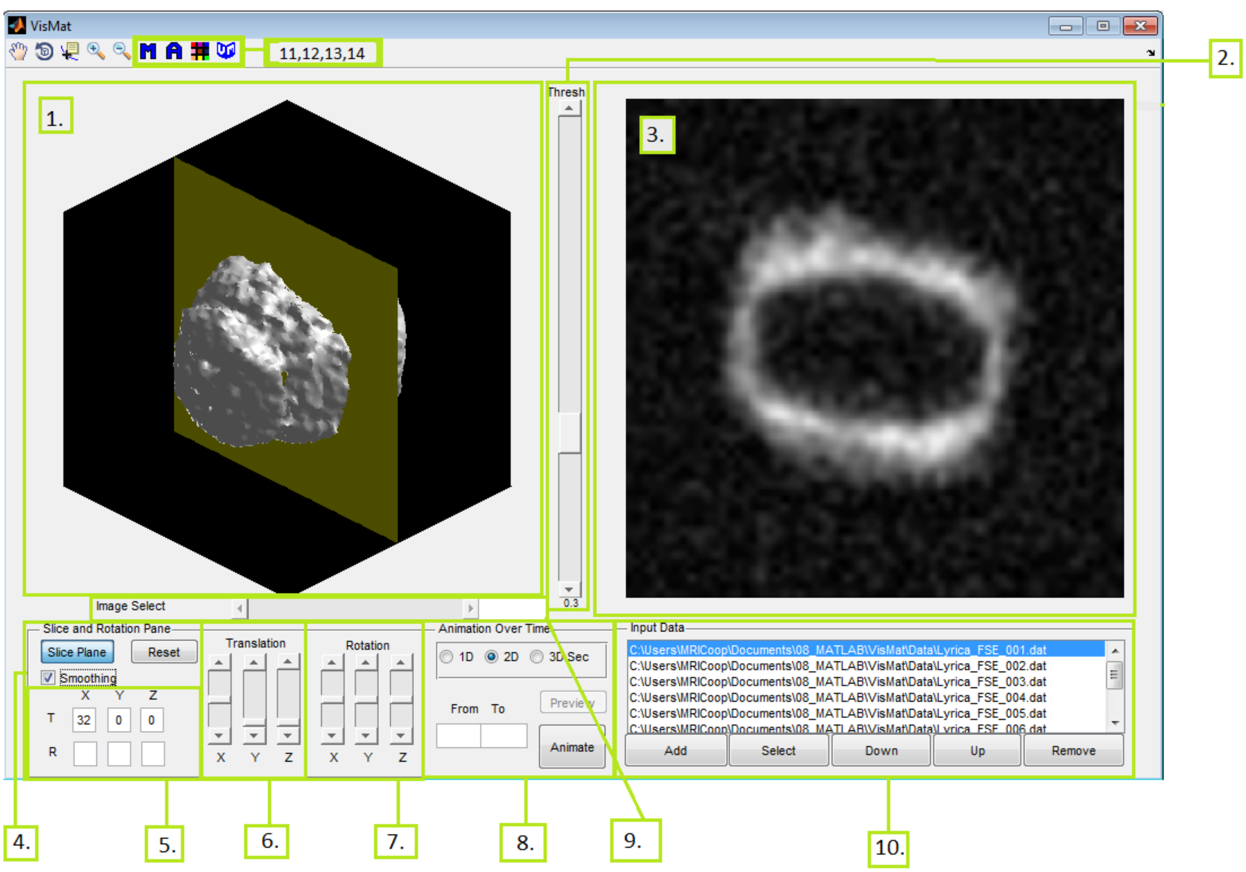
In order to run VisMat, the computer requires the following:

- MatLab (for the .m version)

Using MatLab

1. Open the file VisMat.m in MatLab
2. Select Run
3. If prompted to change folder, select “Change Folder”

The VisMat Interface



1. **<u>3D Viewing Axes:</u>** The area where the currently active 3D dataset is shown, and all rotations / slice plane and its translations are easily shown.
2. **<u>Threshold Slider:</u>** Sets the value used to create the 3D surface in the 3D Viewing axes. Any data values lower than the slider threshold value (displayed at the bottom of the slider) will not be incorporated into the 3D surface.
3. **<u>2D Viewing Axes:</u>** The area where all cross – sections and animation results are displayed.
4. **<u>Slice /Reset Buttons:</u>** the '*Slice Plane*' Button activates the yellow slice plane in the 3D Viewing axes, and enables translation of the plane as well as animation. The '*Reset*' button sets the volume in the 3D Viewing axes back to its original position, and the slice plane back to the originally selected position. The 'Smoothing' checkbox up-scales all output to the 2D Viewing axes (Not AVG Ray or MAX Ray) from 64*64 to 512*512 with interpolation.
5. **<u>Translation / Rotation Input Boxes:</u>** Top row (T) indicates the Slice Plane coordinate (see #6 below), and only becomes activated for use when Slice Plane is on. Bottom Row (R) indicates the Volume rotations incorporated currently onto the dataset on each axis (see #7). By default these box values start at 0 even when blank. To change a value, you can use the slider by increments of 1, or manually change a number and hit enter.
6. **<u>Translation Sliders:</u>** Set the orthogonal plane which is slicing the 3D dataset (NOTE: only one of these sliders will be active at once. The labels X,Y,Z indicate the axis that the plane faces).
7. **<u>Rotation Sliders:</u>** Rotates the solid along the labeled axis. (NOTE: each slider is incorporated into every rotation. If you only alter one slider the other two will be input as 0, indicating no rotation on that axis. This occurs because the original data is rotated each time in order to prevent interpolation blurring.
8. **<u>Animation Over Time Pane:</u>** Upon loading data and enabling the slice plane (clicking the '*Slice Plane*' button), this pane activates. Select either 1D or 2D animation, and insert the range of files you are to animate. Then, clicking '*Animate*' triggers the procedure.
9. **<u>Image Select Slider / Box:</u>** Use this slider to cycle through each 3D block of data in the 4D dataset. The input box allows you to skip ahead to a value by typing it in and pressing enter.
10. **<u>File Selector:</u>** Click 'Add' to load in files into VisMat. Use the '*Up*' or '*Down*' buttons to alter the ordering if necessary, or '*Remove*' to take the selection out of the list. Highlighting the files you want to animate from and clicking the '*Select*' button, loads the arrays they contain into memory.
11. **<u>Toolbar Max Ray:</u>** The Matlab default tools at the top of the window allow you to (from left to right): Grab the image and pan, perform a 3D rotation (with right click options), select a specific data point and get coordinates, Zoom in, and Zoom out. Beyond these, are custom buttons. The '*M*' button is used to display the maximum ray values from each of the 64 coordinates, based on a '*Top-Down*' view (displays in axes as XZ). The values are derived by taking each column of data and determining its highest (maximum) value, and having that value represent the column in a 2-dimensional image (See Photo at the end of user guide, figure 3).

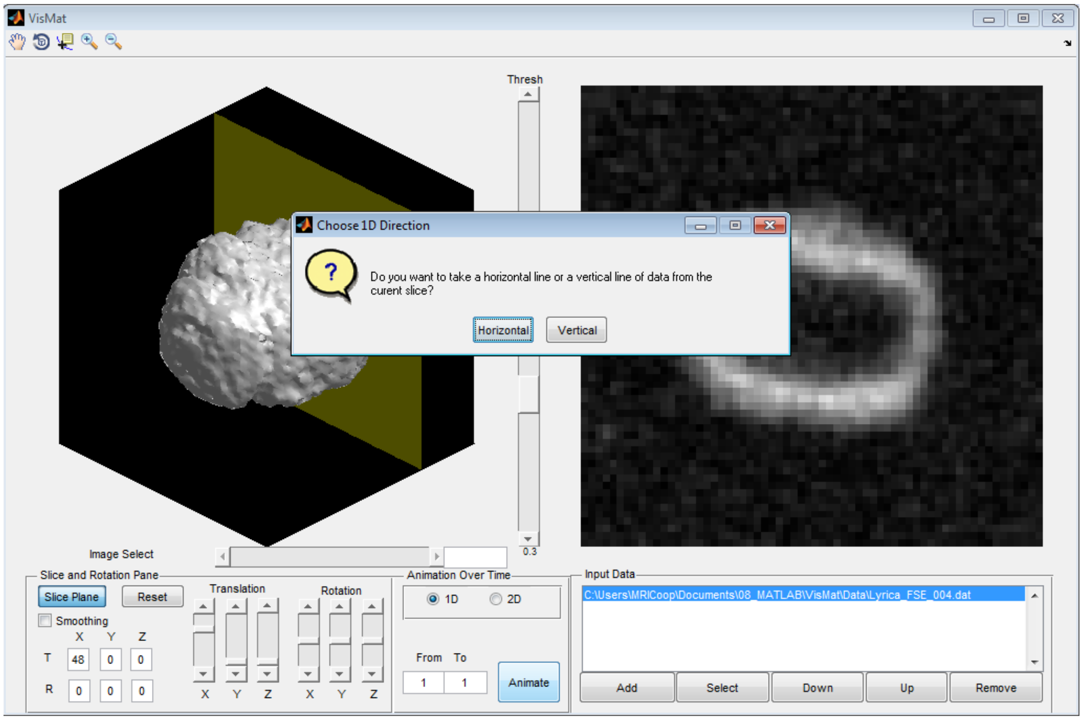
12. **<u>Toolbar Average Ray:</u>** The '*A*' button is used to display the average ray values from each of the 64 coordinates, based on a '*Top-Down*' view (displays in axes as XZ). The values are derived by taking each column of data and determining its average value, and having that value represent the column in a 2-dimensional image (See Photo at the end of user guide, figure 4).
13. **<u>Palette Button</u>** – This allows you to change the colour-map of any currently loaded 2D object (slice, max ray, average ray, or in situ slice). NOTE: this is only for viewing purposes within VisMat. Any changes done to a colour-mapped object will be gone when the object is remade. Animation is grayscale by default, otherwise it matches the current colour-map that has been selected.
14. **<u>Toolbar About button:</u>** This button displays the most recent updates in the currently active program, as well as the version number.

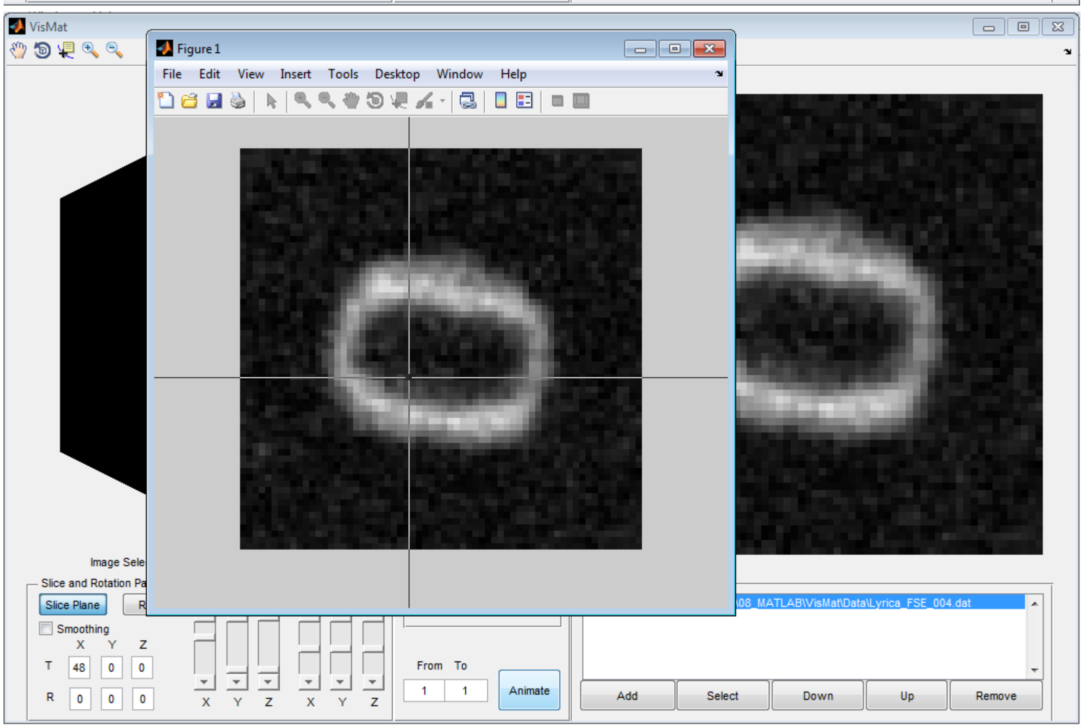
How to use VisMat

General Usage

1. Use the '*Add*' button to select all of the files you wish to add into the series. These files can be both .csv and / or .dat files, and will be loaded into the same series.
2. With some data selected, you can take it out of the loader with the '*Remove*' button, move it up or down in the series with the '*Up*' and '*Down*' buttons, or select the data using the '*Select*' button, which loads the contents of each file into one large 4D dataset. Note that the first block in the series is the top of the file list, second is the second file, and so forth. The '*Select*' button will **ONLY** load files that are highlighted.
3. Once the data is completely loaded into the 4D array, the first block of 3D data (first file in the list) will be loaded into the 3D Viewer pane at a threshold of 0.3. This can be adjusted for your data using the slider (NOTE: the default when select is pressed is always 0.3). Note that the image select slider and its input box are now populated with a fraction, which indicates which image you are viewing out of them all. This can be changed using the slider or manually inputting the value into the box and hitting enter.
4. The slice button / rotational sliders / rotational input boxes become active. You can now rotate the volume into any position using the three rotation sliders, or the three input boxes. When using the input boxes, be sure to hit enter when you type in a value to commit the value to memory.
5. Clicking the '*M*' button on the toolbar will toggle the '*Max Ray*' image (Figure 3) to be put in the 2D Viewer axes. Clicking it again will turn it off (To animate the average ray 2D image for a group of 3D datasets, just type in the '*From*' and '*To*' values, and click '*Animate*'. When it is finished you can export the file as a '.gif' image. If you would like to change the name, **<u>ensure it ends with '.gif'</u>**).

6. Clicking the '*A*' button on the toolbar will toggle the '*Average Ray*' image (Figure 4) to be put in the 2D viewer axes. Clicking it again will turn it off (To animate the average ray 2D image for a group of 3D datasets, just type in the 'From' and 'To' values, and click 'Animate'. When it is finished you can export the file as a '.gif' image. If you would like to change the name, **ensure it ends with '.gif'**).
7. Clicking the 'Slice Plane' button will prompt you with three options for an initial plane. Choosing one will display it on the 3D Viewer's loaded volume. This can be moved by using the newly active translation sliders, or the 'T' input boxes (NOTE: Only one will be active at a time, to keep the plane orthogonal). Clicking the 'Slice Plane button once more, will turn it off.
8. Clicking the 'Slice Plane' button also loads the intersection data of the plane and volume into the 2D Viewer axes as a cross section, as well as enabling the animation functionality. With a cross section visible, you can translate the slice plane through the volume and see each updated cross section in real time, and the rotations update the cross section in real time as well. If the 'Smoothing' check box is enabled, the 2D image will be interpolated to 512*512 giving a smoother appearance.
9. With the cross section you wish to animate in the 2D viewer axes, select either the '*1D*' ,'*2D*' or '*3D Sec*' radio button in the '*Animation Over Time*' pane. In the '*From*' and '*To*' fields, place the range of images you wish to animate (total is shown immediately below the 3D Viewer axes) and click '*Animate*'. If you have selected '*3D Sec*', you have the option to click '*Preview*', which shows you what the cut plane would look like in the 3D Viewer upon animation (See Figure 5).
10. **1D Animation –** When selecting **'***1D*' animation, the pop up asks you if you would like a horizontal or a vertical line of data to be taken from the cross section (first image). After choosing, you are given a separate window and crosshairs to select your line. MAKE SURE YOU CLICK INSIDE THE WINDOW. The animator will not work if the crosshairs do not pick up a valid coordinate from the image. The images will be plotted and saved as frames in the image automatically, and played once through. Once finished, you will be asked if you would like to export the file as a .gif. Select yes, and choose where to save the file.You can leave the default name, or put in one of your own. BE SURE TO END YOUR FILENAME WITH '.gif' OR IT MAY NOT OPERATE PROPERLY.





11. **2D Animation -** The images will be plotted and saved as frames in the image automatically, and played once through. Once finished, you will be asked if you would like to export the file as a .gif. Select yes, and choose where to save the file.You can leave the default name, or put in one of your own. BE SURE TO END YOUR FILENAME WITH '.gif' OR IT MAY NOT OPERATE PROPERLY.

12. **3D Sec Animation –** Works the same as 2D Animation. The images will be plotted within the 3D section, with the boundary of the visible cut pane changing as a result of the outer threshold value. **<u>NOTE:</u>** If you notice that the cut plane is going out into black space arbitrarily in some images, increase your threshold value a few points to reduce the 'Plane jitter'. This occurs because the surfaces created are not perfectly smooth, and a large value exists out beyond the surface during the volume computation.

    Once finished, you will be asked if you would like to export the file as a .gif. Select yes, and choose where to save the file.You can leave the default name, or put in one of your own. BE SURE TO END YOUR FILENAME WITH '.gif' OR IT MAY NOT OPERATE PROPERLY.

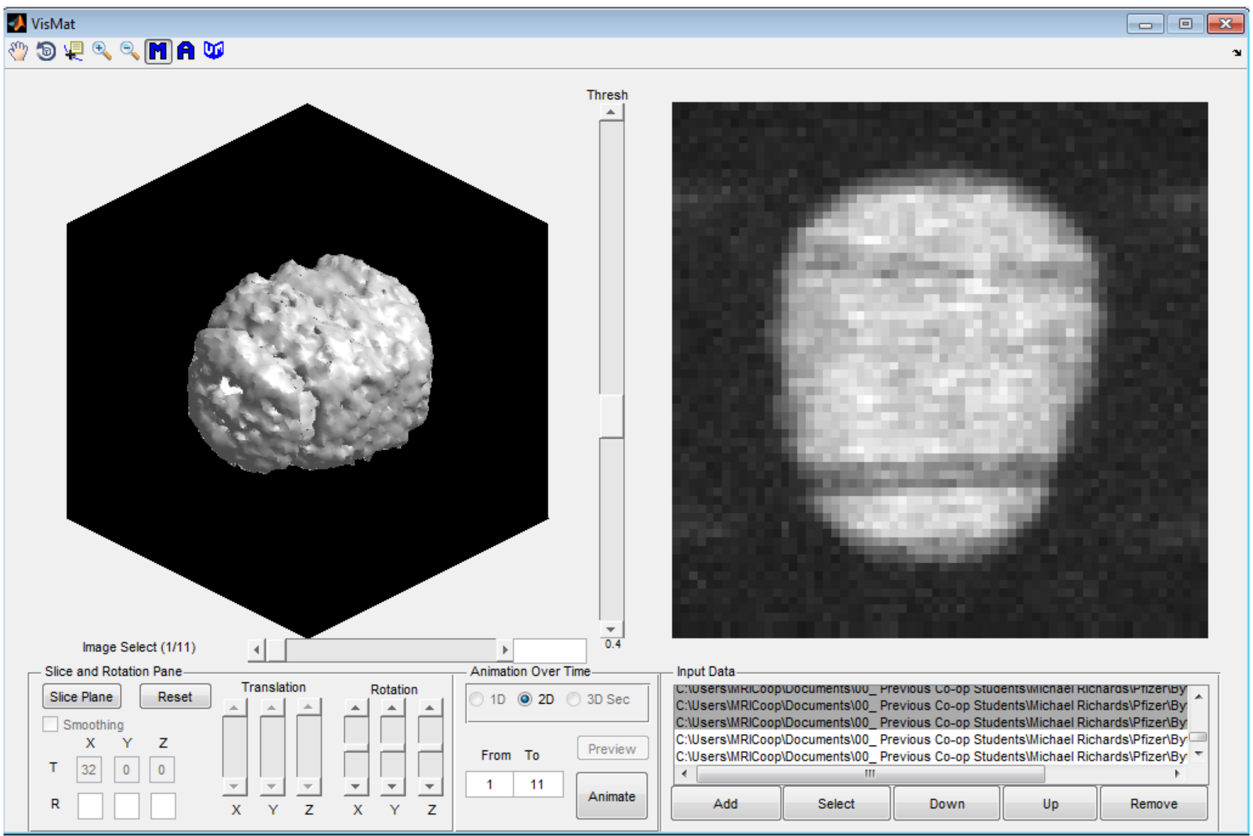


Figure 3. Max Ray button on toolbar has been clicked. The 2D viewer shows a 'Top-Down' View of the Maximum values of each column in the active dataset (3D Viewer). To Orient the 3-D image the same as the 2D one, Select the second tool on the toolbar (Rotate 3D), Right click the 3D data, and select Go to X-Y View. To change the view back, select 'Reset to Original View'.

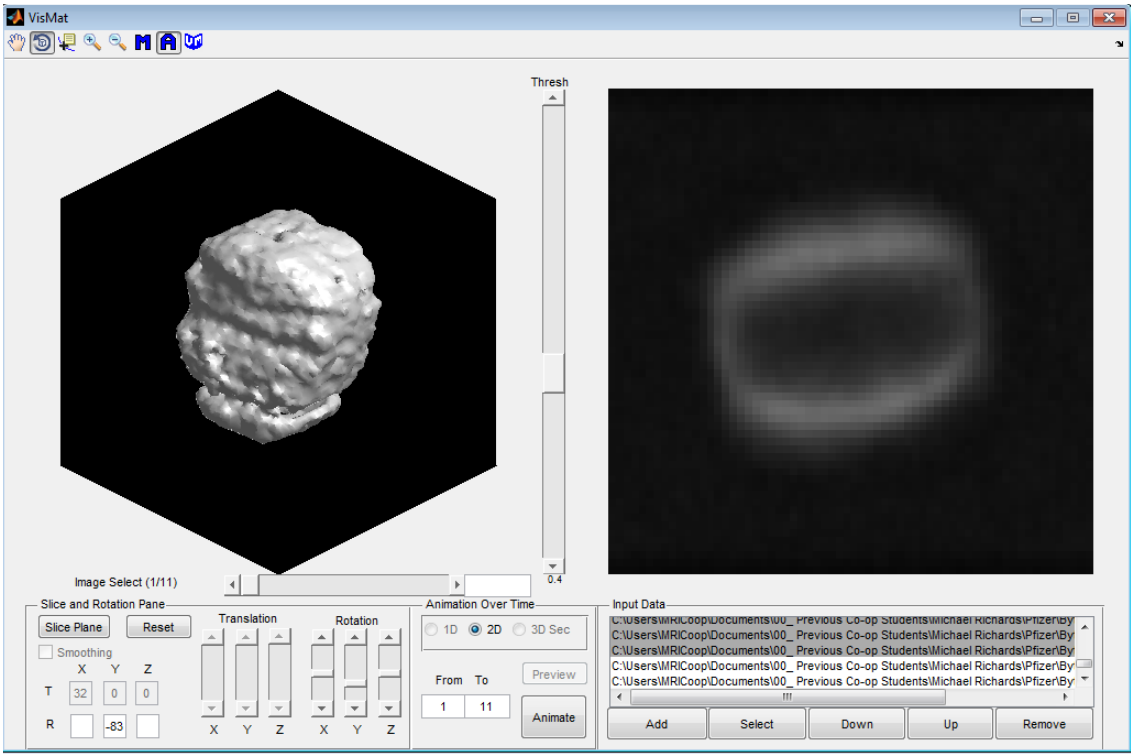


Figure 4. Average Ray button on the toolbar has been clicked. The 2D viewer shows a 'Top-Down' View of the average values of each column in the active dataset (3D Viewer). To Orient the 3-D image the same as the 2D one, Select the second tool on the toolbar (Rotate 3D), Right click the 3D data, and select Go to X-Y View. To change the view back, select 'Reset to Original View'

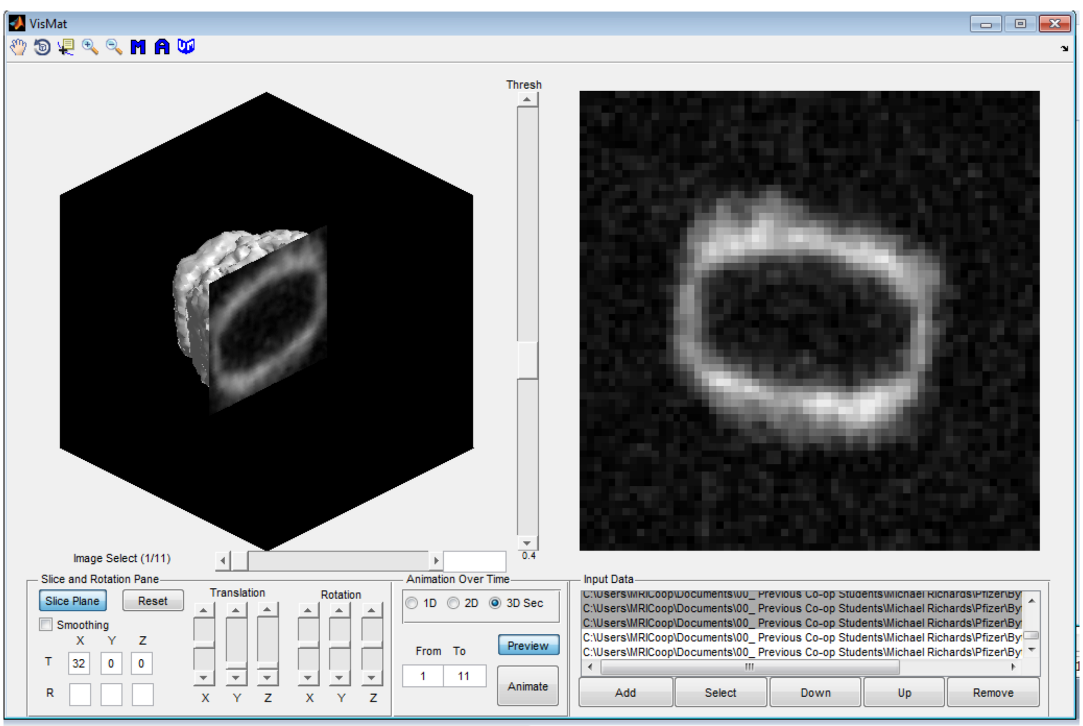


Figure 5 – Preview has been clicked after loading data, and selecting the slice plane. Since the slice plane selected was XZ, the view has been rotated to show the interior (The 3d View plane is like looking at the backside of the 2D View plane). Other slice planes will not rotate the view.

A Note on varying length datasets where z dim > 64

The loading of a dataset whose 3rd dimension is greater than 64 requires some changes to the 3D axes to allow proper viewing. One of these changes involves setting the axes limits to 'auto', to allow for the varying lengths. This is unnecessary with a z <= 64 dataset because the length is finite and static. This will lead to changes in the black space surrounding the data as the program sees fit.

A Second problem is that the dataset is no longer a cube, so when it is rotated outside of the originally processed dimensions, data is cut off in those directions. We were looking at potentially creating a 'dynamic padding' type solution, but this in itself would still require a great deal of processing time and slow down the user experience greatly, and not provide much more functionality.

As it currently stands, VisMat can rotate data along the X axis fine (Think looking at the face of a doorknob as it turns), but not in the Y or Z axes. Most cut planes can still be achieved by using this rotation as well as the three slice types.

The maximum dimension allowed by the program is bottlenecked only by your computers maximum RAM allocation for Matlab, as well as how much can fit in the field of view before it is so small you cannot see any detail. Please find a happy medium on your own in this situation to accommodate a variety of situations.