iTools Tutorial Three



A 3D Multiplanar Viewer

Creating a 3D Multiplaner Viewer

This tutorial assumes the user has a basic understanding of iTools. If you are a beginning iTools user, it is recommended that you first review the tutorial 1: *Using iTools.*

Part 1: Setup

The ability to collect and analyze 3 dimensional data is becoming increasing popular in many areas of science, engineering and medicine. Atmospheric Science, Oceanography, Non-destructive testing and Medical Researcher all have a need to view 3 dimensional data. A useful tool in analyzing 3D volumes is the ability to display and manipulate orthogonal cutting planes of the 3D data. This tutorial will take you through the steps needed to create a simple 3D multiplaner viewer. It utilizes the iVolume and iImage applications.

Begin at the IDL command line by restoring the sample data used in the tutorial. The data is part of the standard IDL installation.

1) RESTORE, demo_filepath('storm25.sav', SUBDIR=['examples','demo','demodata'])

Next, type the command "IVOLUME", and pass in the variable "T".

2) IVOLUME, T

When you hit return, an iVolume window will appear. The data will not be visible until you select the "Render" button.



The desired layout is one view for the 3D visualization and one view each for the 3 image planes. A 2×2 layout is ideal for this. From the main menu,

3) Select Window -> Layout...

4) Set the number of columns and rows to 2. Then hit OK.

🛍 Window Layout		
Dimensions (pixels): Width: 716	Preview	
Height: 512 Layout:	1	2
Gridded Inset Trio-Top	3	4
Columns: 2 Rows: 2		
,	OK	Cancel

5) Once control returns to the main iVolume window select "Render" The resulting window appears below.

IDL iVolume [Untitled*]		- 🗆 🛛
File Edit Insert Operations Window Help		
	- A DOGO	
	✓ Volume	
	Name:	
	Volume	
	Data Char	nnels:
	1	
	Re	ender
251		
20	T Auto-	Render
50 15	Quality	
30 10	Low (text	ures) 💌
2103 102930455	Boundary	
8150 20 20 37:20 4 37:20 6 4 0 402030405050	Solid wall	ls 💌
	Render St	ер
	× 1	
	Y. 1	
	Z. 1	
Click on item to select, or click & drag selection box	[421,503]	

Adding color will make it easier to see features in the data.

- 6) Begin by selecting the volume. A cyan colored bounding box indicates when this occurs.
- 7) Next click the menu selection Window > Visualization Browser. This brings up the iVolume Visualization Browser.

Window		Volume	
i⊸	Name	Volume	
🖃 🖷 Visualization Layer	Description	Volume	1
🖻 🛱 Data Space	Show	True	-
 	Display scale	Select display scale bottom/top	
	Color & opacity table 0	Edit color/opacity Edit	1
	Color & opacity table 1	Edit color/opacity table	
	Subvolume	Edit Subvolume extents	
	Auto render	False	
	Quality	Low (texture maps)	
	Boundary	Solid walls	-
	Boundary transparency	90	-
	Render step X	1	
	Render step Y	1	
	Render step Z	1	
	Extents color	(0,0,0)	-
	Ambient color	[255,255,255]	1

8) Select "Color & Opacity table 0" and press its 'Edit' button to change the color table entry.

(X,Y): (100, 255) [R,G,B,A]: (100, 100, 100, 100) Zoom: ① ① ① Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate Load Predefined
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
(R,G,B,A): (100, 100, 100, 100) Zoom: Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
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Color Space Red Green Blue Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
Edit Mode Freehand Ramp Posterize Invert Smooth Reverse Duplicate
Ramp Posterize Invert Smooth Reverse Duplicate
Smooth Reverse Duplicate
R G B A 🔽 🔽 🔽 Display
OK Cancel

9) Now select "Load Predefined" to display a list of color tables. After making a selection hit OK.

The next step is to begin selecting the 3 orthogonal image planes. From the main menu

10) Select Operations -> Volume -> Image Plane.

This will display the default X image plane as shown below.

IDL iVolume [Untitled*]		
File Edit Insert Operations Window Help		
D 215 <u>0</u> <u>100%</u>	- ALDOGQ	
		Volume Name: Data Channels: Render Quality Low (textures) V Boundary Solid walls V Render Step X. 1 Y. 1 Z.
Translate	[109,510]	

Our goal is to display an image of each of the 3 orthogonal planes in the remaining views of the iVolume display. In order to do this, each image plane must be exported to an iImage tool. From the main menu,

11) Select Operations -> Image Plane -> Launch iImage.

An ilmage window similar to the following should now be displayed.



The image now displayed in the iVolume Image Plane window needs to be copied back to one of the 3 remaining views in iVolume.

- 12) Position the cursor over the image, press the right mouse button to display the context menu. Select "Copy".
- 13) Use of the image plane window is now complete. From this window's menu select File -> Exit to close this window.
- 14) To paste this image into the main iVolume window position and click the mouse in the upper right view and then from the main iVolume window menu select Edit -> Paste Special. The display should now look like the following.



To continue adding image planes steps 10-14 must be repeated for each of the Y and Z planes.

15) Select Operations -> Volume -> Image Plane.

This will display the default X image plane as shown earlier.

- 16) Next select Window -> Visualization Browser.
- 17) The new image plane that was just added is designated "Image Plane 1". From this window select "Image Plane 1" from the Window -> View_1 -> Visualization Layer -> Data Space hierarchy.

IDL iVolume: Visualization Browser		
IDL iVolume: Visualization Browser ✓ Visualization Layer	Name Description Show Opacity control Opacity value Orientation Opacity	Image Plane 1 Image Plane 1 Image Plane True Use opacity table 50 Y
Annotation Layer □ View_2 □ Visualization Layer □ Data Space	Color Bottom color Depth offset Skip zero opacity	(255,255,255) (255,255,255) 1 True
 Image <li< td=""><td>Texture interpolation</td><td>Nearest neighbor</td></li<>	Texture interpolation	Nearest neighbor
Image Plane Orientation	_	

18) Change the "Orientation" property of Image Plane 1 to "Y" as shown below.

Continue with the copy/paste for the "Y" image plane.

19) Select Operations -> Image Plane -> Launch ilmage.

An ilmage window similar to the following should now be displayed.



The image now displayed in the iVolume Image Plane window needs to be copied back to one of the 2 remaining views in iVolume.

20) Position the cursor over the image, press the right mouse button to display the context menu. Select "Copy".

- 21) Use of the image plane window is now complete. From this window's menu select File -> Exit to close this window.
- 22) To paste this image into the main iVolume window position and click the mouse in the lower left view and then from the main iVolume window menu select Edit -> Paste Special. The display should now look like the following.



****** Special Note ******

There is a problem with the Y image plane when displayed. The image is flipped from the original orientation in the data cube. The following steps will correct this problem.

- 23) Select Window -> Visualization Browser.
- 24) From the Browser, select Image under the Window -> View_3 -> Visualization Layer -> Data Space hierarchy.

🛨 👁 Image Plane		Image
🕀 👁 Image Plane 1	Name	Image
ter i € Axes	Description	An Image Visualization
🗄 🖓 Lights	Show	True
Annotation Layer	Image palette	Edit color table
∃ □ View_2	Interpolation	Nearest Neighbor
回一個 Visualization Layer 回一伊 Data Space	Z value	0
E Main Space	Grid units	Not applicable
E Axes	Pixel size (x)	1
Annotation Layer	Pixel size (y)	1
⊒~ 🗖 View_3	Origin (x)	0
🖻 🖷 Visualization Layer	Origin (y)	0
🖻 🗇 Data Space	Unit label	
	Image transpare	ncy 0
السلية Axes مسلك Annotation Layer	Row order	Bottom-to-top

24) Select the "Row order" property and change to "Top-to-bottom". The display will now appear as below.

IDL iVolume [Untitled*]	
File Edit Insert Operations Window Help	
▷☞묘용 ∽ ∽ & ☜ ☜ ◣ ㅎ ♡ 떡 쓰	$100\% \bullet A \setminus \Box \circ \& \emptyset$
	Image RDIs: Image Pixel Location: Pixel Scale: X: Y: Edt Palette Channel: Image Image Max Image Max
alter alt	Max [131.23
Click on item to select, or click & drag selection box	[211,506]

We will now proceed with the final image plane. Again from the main menu,

25) Select Operations -> Volume -> Image Plane.

This will display the default X image plane as shown earlier.

26) Next select Window -> Visualization Browser.

27) The new image plane that was just added is designated "Image Plane 2". From this window select "Image Plane 2" from the Window -> View_1 -> Visualization Layer -> Data Space hierarchy.

🕀 👁 Image Plane 1	~	4	Image Plane 2
🕀 👁 Image Plane 2	Ī	Name	Image Plane 2
i E Axes		Description	Image Plane
庄 🖓 Lights		Show	True
Annotation Layer	_	Opacity control	Use opacity table
⊡ □ View_2 ⊡ □ □ Visualization Layer		Opacity value	50
Err Data Space		Orientation	Z
🕀 🖉 Image		Opacity	1
- F Axes		Color	(255,255,255)
Annotation Layer		Bottom color	(255,255,255)
⊡ □ View_3	=	Depth offset	1
🖃 🖷 Visualization Layer		Skip zero opacity	True
🖻 😰 Data Space		Texture interpolation	Nearest neighbor
🕀 🛷 Image			
E Axes			

28) Change the "Orientation" property of Image Plane 2 to "Z" as shown above.

Continue with the copy/paste for the "Z" image plane.

29) Select Operations -> Image Plane -> Launch iImage.

An ilmage window similar to the following should now be displayed.

IDL Volume Image Plane File Edit Insert Operations Wi	ndow Help		
			■ Image R0Is: □ ○ @ @ Pixel Location: (36, 58) Pixel Value: R: 255 G: 109 B: 28 A: 134 Pixel Scale:
		D	Charnet 0
			Max 255 Min: 0
Click on item to select, or click & drag	selection box	[423,491]	

The image now displayed in the iVolume Image Plane window needs to be copied back to the remaining view in iVolume.

30) Position the cursor over the image, press the right mouse button to display the context menu. Select "Copy".

31) Use of the image plane window is now complete. From this window's menu select File -> Exit to close this window.

32) To paste this image into the main iVolume window position and click the mouse in the lower right view. Then, from the main iVolume window menu select Edit -> Paste Special. The display should now look like the following.



This completes the construction of the multiplanar reconstruction viewer.

Part 2: Features

This hybrid tool gives you all the functionality of the individual tools. For example, select the "Volume" tab on the right side of the display. Now select the upper-left view (the volume). The controls on the Volume tab will now be active. At this time the volume can be manipulated with all the same tools that are in a standard iVolume application. Review the operations available from the main menu.

33) Select Operations ->

Operations such as "Statistics", "Histogram", "Filter" are all available as well as iVolume specific operations as "Volume -> Image Plane", "Volume -> Isosurface" and "Volume -> Interval Volume".



The same applies for any of the 3 image planes that are displayed as part of the Multiplanar ("MPR") tool.

34) Select one of the 3 views that contain an image. Next select the Image tab on the right of the display. Review the operations that are available. Again from the main menu,

35) Select Operations ->.....

Operations such as "Statistics", "Histogram", "Filter" are all available as well as "Surface", "Contour" and "Morph".

Some things to try with the new tool are volume image plane manipulation and image line plot profiles. For the image plane manipulation do the following.

36) Select one of the 3 image planes in the volume. Drag the cursor to move the plane within the stack. Notice how the corresponding image in the other window updates.

37) To create a line plot profile of an image plane, select a plane in one of the three image windows. From the toolbar select the "Line Profile" icon (to the left of the magnifying glass). Draw the profile on the image.

38) In the new iPlot window, select the line profile that was just created on the image in the MPR tool display. Drag this line and see how the profile plot updates.

39) Continue experimenting with all the features available in the tool.

END