VolViewer Manual

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Introduction

VolViewer is a tool developed by Ran Klein at the University of Ottawa Heart Institute to visualize 3D and 4D data sets. The tool provides an interactive GUI which can also be used for cropping the data and selecting subsets of the data. The tool is rewritten in Matlab and is based in concept on Sliceomatic by Eric Ludlam which is available on the Mathworks File Exchange site. Some of the differences between Sliceomatic and VolViewer are:

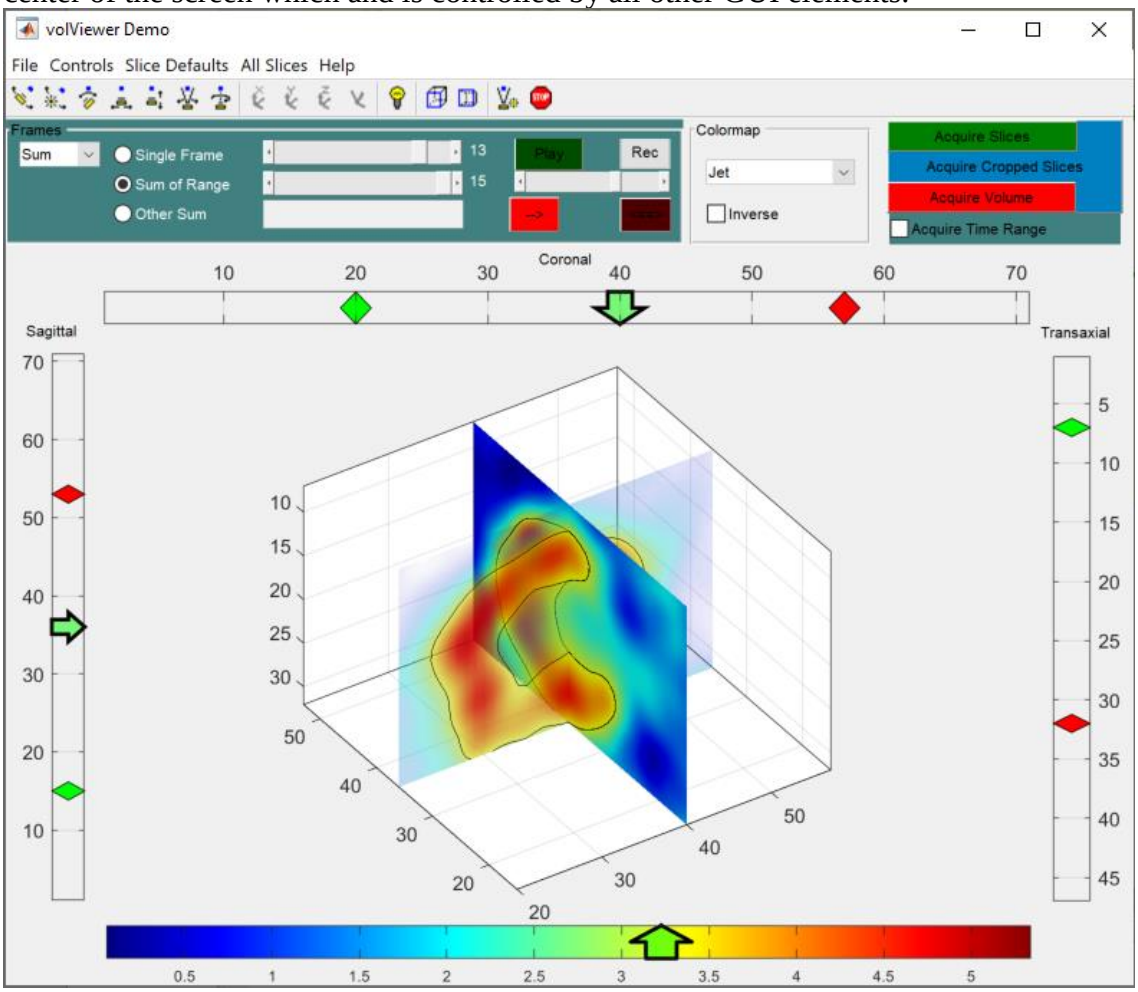
- VolViewer supports 4D data, while Sliceomatic only supports 3D data.
- VolViewer has a flexible function input parameter support which may be used to initialize the GUI.
- VolViewer can return user selected options when the GUI is terminated.
- VolViewer may be used to trigger callbacks when clicking on objects in the main display axis. This feature enables creation of interactive GUIs.
- VolViewer does not support iso-surface and some other advanced graphic functionality that is implemented in Sliceomatic.

In 2019 VolViewer was updated to address compatibility issues with more current version of Matlab. It was tested on Matlab 2017b.

Contents

Interface

The VolViewer GUI is demonstrated in the figure below. The image data display is at the center of the screen which and is controlled by all other GUI elements.



Axis Bars

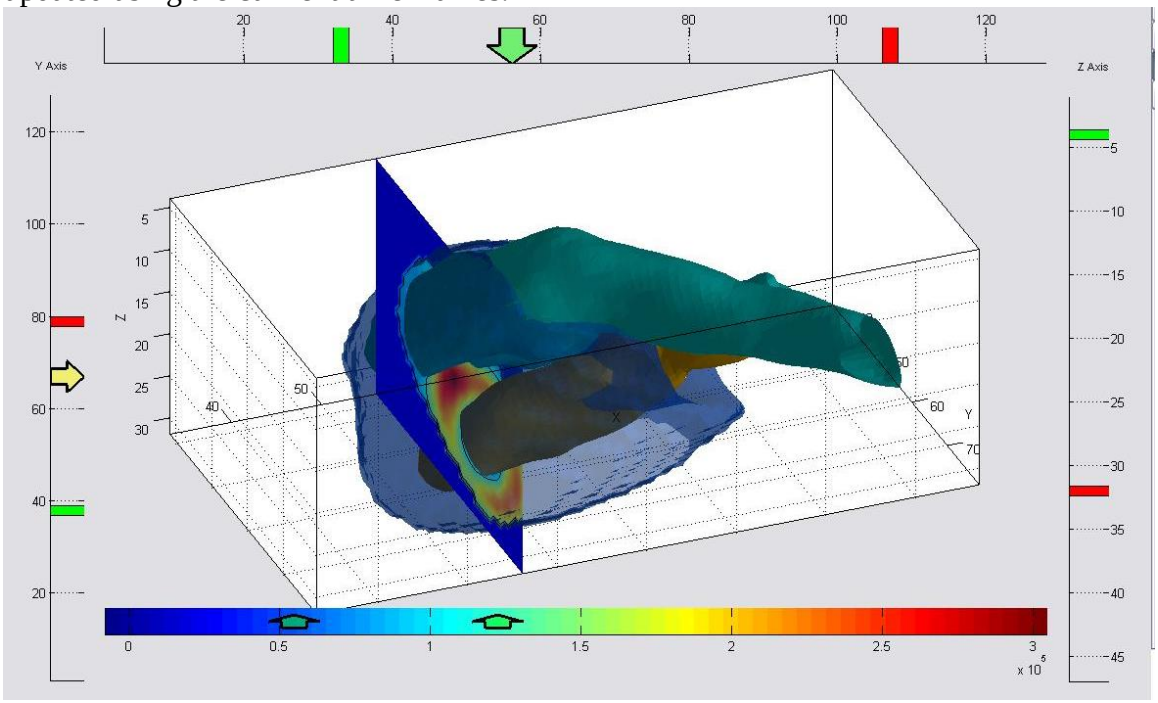
The three axis bars control the slice and cropping on the three respective axes (XYZ) of the data. Each bar may have a slice (indicated by green arrows) associated with it. In addition, each slice has two range bars (green and red) which crop the displayed data. Slices may not be positioned outside of the range bar limits.

The display of each slice may be controlled by right clicking on the slice arrow, which reveals a context menu specific to that slice. Settings may be applied to all slices simultaneously through the All Slices menu at the top of the screen.

A slice may be added by clicking on the corresponding axis bar. A slice may be moved by click-and-drag with the mouse (even between axes). A slice may be deleted through its context menu. Alternatively, a slice may be kept, but removed from the display by controlling its visibility through the context menu.

Color Bar

The color bar allows the user to convert color to numerical intensity. By adding contours on the bar (similar in style and operation to slices in the axis bars), contour lines may be applied to the visible slices in the data display.
Once a contour has been added, a iso-surface may be displayed by right-clicking on the arrow and selection surface from the menu. The surface is not updated when changing time frames; thus enabling to create a surface with a one time frame and viewing slices from another time frame. However, if the contour arrow is moved, the surface will be updated using the currrent time-frames.



Frames

The frames section controls the 4th dimension of the data that is displayed. The data that is displayed is the sum of any combination of 4th dimension frames. The 4th dimension may represent time frames, factors, or any other aspect of the data. The label of the frames may be modified by the input parameters to the call as explained in the "Input Parameters" section.

The user may view either:

- A single frame
- The summary of frames bound within a range specified by both bars.
- A summary of any combination of frames. For this option the user must enter a string in the format specified in the "filter strings" section, described on a later page.

The summary operation can be slected from the operations pulldown menu. All operations are performed on a per pixel basis across the 4th dimension. Operation include: Sum, Average, Weighted average (by frame length), Integrate, and Max.

Color Map

The color map section enables the user to choose the format in which intensity is translated to color. Changes in this section update both the data display and the color bar, but do not affect the data itself. A selection of preconfigured color maps may be chosen from the pull-down list. The color maps may also be inverted using the checkbox.

The selectable color maps are: Petula, Jet, HSV, Hot, Cool, Spring, Summer, Autumn, Winter, Gray, Bone, Copper, Pink, Lines, Prism, Flag and HotMetal,

In addition, a custom option exists, which opens a GUI for customizing the color map.

Main Menu

File Menu

Copy – opens a new window with the display axis and the color bar (if visible) and copies to the clipboard. The display data can then be pasted into other software as a meta-image.
Print – prints the image to a printer.
Save Preferences – saves the default settings (e.g colormap, slice display options).

Control

Camera Toolbar – Toggles the camera toolbar on and off. This toolbar contains functionality to rotate the display data axis.
Tick Labels – toggles the ticks and labels of the axes on and off.
Control Bars – toggles the control bar visibility on and off.
Color Bar - toggles the color bar visibility on and off. The state of the control bar is also translated to the printed and copied images.
Coordinates Mode – Selects the coordinate notation used when acquiring slices using the acquire buttons. Modes are

- Matrix(XYZ)
- Subject (SCT)– Sagittal, Coronal, Transaxial
- Camera (HVSh) – Horizontal, Vertical, Short axis

Slice Defaults

Selects the default color and transparency settings for new slices.

All Slices

Applies color and transparency settings to all existing slices.

Acquire Buttons

When the user presses one of the acquire buttons, the VolViewer is closed and the slice/crop settings are returned to the calling function (if output parameters are specified). The information returned varies depending on the button that was pressed. These buttons include:

- Acquire slices – coordinates of slices being displayed (e.g. ‘X10, Y45, Y102’)
- Acquire volume (cropping) – coordinates of cropped volume (e.g. ‘(1-55,1-71,1-47)’)
- Acquire cropped slices – coordinates of slices and related cropping limits (e.g. ‘X39(21:57,10:47),Z33(1:71,21:57)’)

If the user closes the window using the X button, no slice or volume data is acquired. In addition, the selected time frames may be returned if the Acquire Time Range check-box is checked (e.g. ‘13-15’).

Function Call

Input Parameters

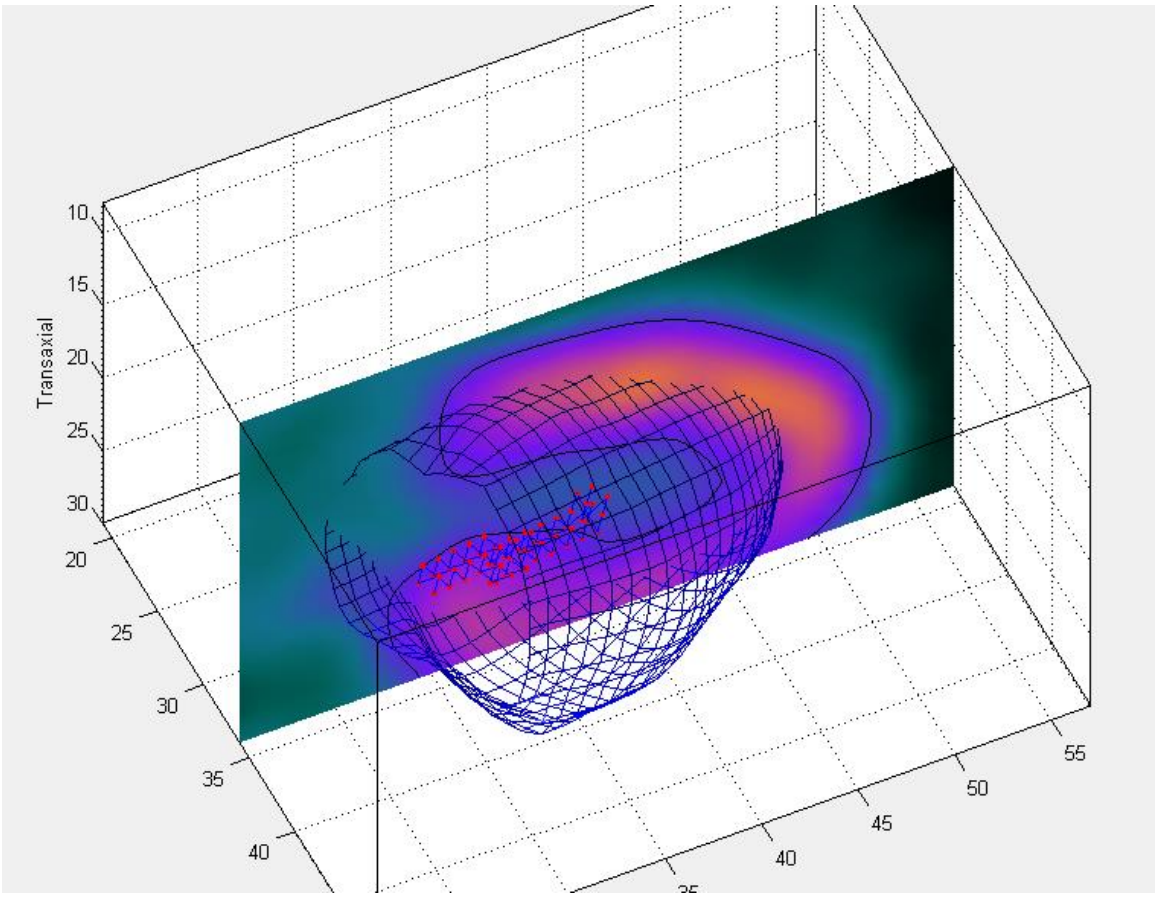
VolViewer(data) - view the data (a 3D/4D matrix) where the 4th dimension is treated as time/frames and the first three as spatial dimensions.

VolViewer(data, subsetstr) - mask string for the slice/volume to display. Defines either a subspace in the volume of data to crop the data and/or slices within the volume that should be displayed at startup. By default, no cropping or slices are applied. Refer to "subset filter strings", below, for more details on the string format.

VolViewer(data, subsetestr, timestr) - also sets the 4th dimension to display. Refer to "filter strings", below, for more details on the string format.

VolViewer(data, subsetstr, timestr, propertie, value, ...) - Pairs of properties and values specific to the VolViewer:
Properties are:

- 'FigureName' - String of the name of the figure.
- 'FigureColor' – Colorspec to set the background color of the figure.
- 'Position' - The position on the screen for the window can be specified in two forms:
    - [x y width height] - in normalized units [0-1].
    - a string in the format supported by the movegui function.
- 'FramePanelTitle' - String of title of the time/frame panel. If not specified, default is 'Time Frames'.
- 'AxisNames' - Cell of strings (3-elemnet) of the names of each of first 3-dimension. Default is {'x-axis','y-axis','z-axis'}.
- 'BlockSliceControl' - Logical value that indicates whether to block or allow control of the slices to those provided by subsetstr. If not specified default is false.
- 'PixelDimensions' - Dimensions of the pixels [dx dy dz] to control the aspect ratio.
- 'Units' - string name of the image units. Default is empty.
- 'TimeUnits' - string name of time units. Default is empty.
- 'ExtraSurface' - A surface, whose contours will be superimposed on the slices. Extra surface is a structure or a cell of structures with the following form:
  struct('X',xdata, 'Y',ydata, 'Z',zdata, 'LineStyle','.r', 'Type','plot') where the X, Y and Z data are the coordinates of the surface in pixel units and can be cells for each time frame or non-cell if common for all time frames, LineStyle is the color and plot styles of the plot and Type:
  - plot - plot individual points at XYZ.
  - mesh - plot lines of the intersection of the surface with the slices.



- 'Time' - The middle frame times.
- 'TimeOp' - Operation to carry out on time frames [{'Sum','Average','Weighted Average','Integrate','Max']
- 'Colorbar' - Logical value that indicates whether to show the color bar or not. If not specified, default is true.
- 'Contours' - Array of scalars of the intensity levels for which contour lines are displayed. If not specified default is contour at zero intensity only.
- 'Colormap' - sets the color map to be used; can be either a string to one of the supported color maps in listed above, or an array defining the color map. If a string is used, it may be preceded by the letter "i" to indicate inversion on the color map order.
- ‘PointerCallback’ - specifies a callback function to execute when user clicks on slices. The function ‘volViewerCoord’ may be used to determine the coordinates of the point of overlap of the mouse pointer and the selected object. See DisplayPixelCurve.m For an example.
- ‘WaitForClose’ – If no output parameters are specified, forces the execution to freeze until the VolViewer is closed. If output parameters do exist, this field is ignored.

Output Parameters

str = VolViewer(...) - returns a subset selection string in the format specified in "subset filter strings", whose contents depend on the slices, crops, and the acquire button pressed. (Nan is returned if the user chooses not to keep the values)

[str, frames] = VolViewer(...) - Also returns the frames selected in the GUI. (Nan if the user chooses not to keep the values)

Filter Strings

This string format describes the time frame selection to be summed for display. The format applies to the third input parameter, which initializes the display; and to the second output parameter, which relates to the user selection.
The string includes a set of comma separated frames, and range of frames following this format:

- N – only time frame N.
- N1-N2 – all frames in the range of N1 and N2 inclusive

Example:

- 1-5,9 - frames 1,2,3,4,5, and 9

Subset Filter Strings

This string format describes cropping and slice selection. In the context of VolViewer this format applies to the second input parameters, which initializes the display; and to the first output parameter, which relates to the user selections.

The string has two possible parts: cropping, and slice selection:

Cropping relates to the entire data set and to the range of XYZ of the dataset to crop. It follows the formatting (XXX,YYY,ZZZ) where XXX, YYY, and ZZZ relate to the range of each dimension. NNN can take the following formats:

- N –keep only slice N.
- N1-N2 or N1:N2 – keep all slice between N1 and N2 inclusive.
- - or : - keep all existing slices.

The slice selection relates to the slices that should be displayed. The format for each slice includes a dimension code and the slice number. The slice numbers must be in the range of the data set and in the range of the cropping of that dimension.

Dimension	**Coordinate Mode**		
	XYZ	**Subject**	**Camera**
1	X	C – Coronal	H – Horizontal
2	Y	S – Sagittal	V – Vertical
3	Z	T – Transaxial	Sh – Short axis

Examples:

- (1-2,3-4,:) - volume with rows 1-2, columns 3-4, and all slices

- X10, S10, H10 - all data in row 10 (Sagittal, horizontal)
- Y5, C5, V5 - all data in column 5 (coronal, vertical)
- Z30, T30, SH30 - all data in slice 30 (transaxial, short-axis)
- (1-40,10:120,:),X10 - rows 1 to 40 cropped, columns 10 to 120, and all slices; and row 10 will be displayed.

- End -