

# FusionViewer User's Guide

—for FusionViewer 1.0.beta

January 8, 2007

## Introduction

FusionViewer is an open source medical image display package developed by [Insightful Corporation](#) and [University of Washington](#). It is designed to improve the physician's ability to interpret the results of combined positron emission tomography (PET) and computed tomography (CT) studies by providing a multi-platform open source display application. As PET/CT combined studies are increasingly being used for the diagnosis, treatment decisions, and follow-up of cancer patients, improving the interpretive value of these studies would directly benefit cancer patients. This software is a display application for validating and improving visualization. It facilitates the quantitative measurements on the fused image series. An effective display of the fused data permits easy viewing of the anatomical information provided by the CT images while simultaneously displaying the functional data provided by PET.

This guide is for FusionViewer 1.0 beta release. The best way to get started is to download the FusionViewer demo and test data set from project website at <http://fusionviewer.sourceforge.net/>. You are also encouraged to join the mailing list at <https://lists.sourceforge.net/lists/listinfo/fusionviewer-users> so that you know what is going on in FusionViewer community.

- **Operating System:** Windows 2000/XP, Mac OS X 10.3.9 or later
- **Java Runtime Environment (JRE):** 1.4 or later
- **Current version:** 1.0 beta
- **License:** [General Public License \(GPL\) \[Version 2\]](#)

## Download

Please visit [http://sourceforge.net/project/showfiles.php?group\\_id=162712](http://sourceforge.net/project/showfiles.php?group_id=162712) to download the application.

*Note: This is a beta release. If you find a bug or have any suggestion, please visit project tracker system at [http://sourceforge.net/tracker/?group\\_id=162712&atid=824874](http://sourceforge.net/tracker/?group_id=162712&atid=824874).*

## Installation

For Mac OS users, unzip the downloaded file. In the unzipped folder, you will find a FusionViewer application icon (FusionViewer.app). Drag it to your hard disk.

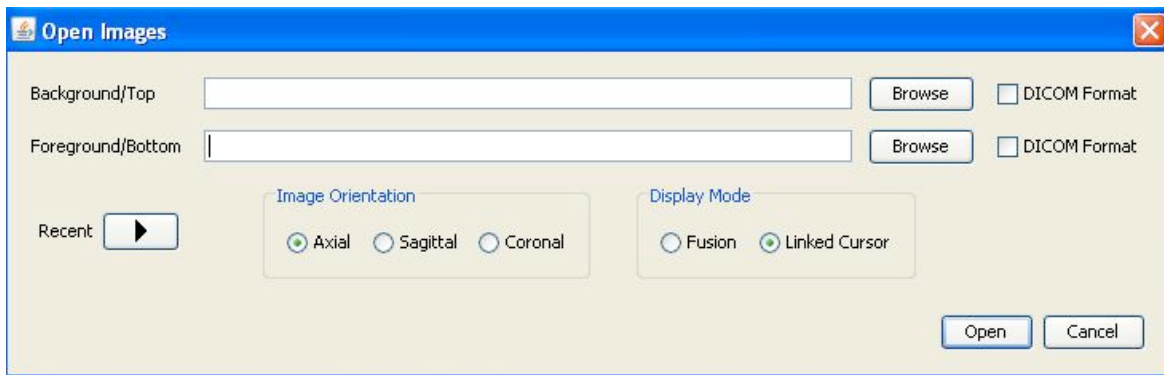


For Windows users, unzip downloaded file. In the unzipped folder, you will find an executable file called “FusionViewer Setup”, double click the executable file to install FusionViewer into your system.

**Note:** *JRE1.6 is recommended to run FusionViewer. If there is no JRE or old version of JRE installed in your system, you can download the corresponding JRE installer (Mac OS or Windows) from the project download site from Sourceforge.net at ([http://sourceforge.net/project/showfiles.php?group\\_id=162712](http://sourceforge.net/project/showfiles.php?group_id=162712)). Alternatively, you can get it from <http://www.apple.com> or <http://java.sun.com/>.*

## Opening Image Files

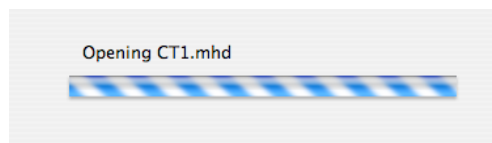
To run FusionViewer, double-click FusionViewer.app file (in Mac OS) or Start Menu→FusionViewer folder→FusionViewer (in Windows). The following dialog box will be displayed.



You can type in the paths to the images or click the Browse buttons to interactively choose the image files. The recent popup menu shows the file history containing up to five pairs of files that have been recently opened.

- **To display a single image file: specify a Background field only (leave Foreground blank).**
- **To display a pair of image files: specify both Background and Foreground files.**
- **The Display Mode controls the screen layout that initially appears for image pairs. The modes are described in the next section.**

After clicking the 'Open' button the image loading process starts.



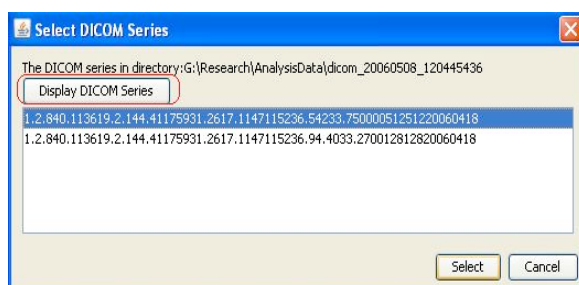
Loading large image series (e.g. whole-body CT series) is time consuming. It takes ~45sec to load two MetaIO image series with total size of 200MB.

**Tip:** *If you want to open 2 files in the same directory, you can save time by copying and pasting the file path for the second file before clicking Browse.*

## Supported File Types

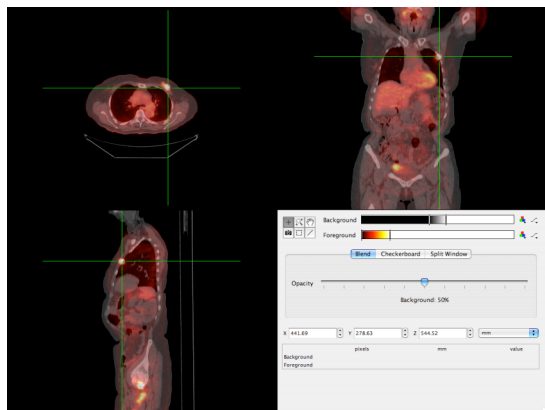
FusionViewer can read the following file types: PNG, TIFF, JPEG, BMP, Interfile, MetaIO, and DICOM. If you have a raw image or a raw image with a header, you may be able to import the image by constructing a MetaIO header file. See the following URL for more information: <http://www.itk.org/Wiki/MetaIO>.

For Beta version, FusionViewer application can read DICOM images directly. To do so, browse to the folder that contains one or more DICOM series by clicking “Browse” button. Then click the “DICOM format” check box, new window will pop-up allowing you to select the images with the same series unique identifier (UID).

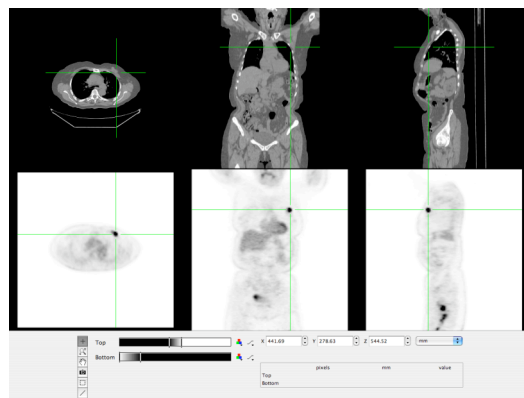


## Main Window

The appearance of the main window will vary depending on whether you have opened 2D or 3D images and whether you have opened a single image or a pair of images. By default, we open a pair of PET/ CT images. For fusion display mode, the fusion mode window has axial, coronal, and sagittal views shown in the upper left, upper right, and lower left corners of the window. Linked cursor mode shows the axial, coronal, and sagittal views for one image along the top of the window and the same views for the other image along the bottom of the window. In both modes, the green crosshairs are locked to the same physical location in all views.








Fusion Mode



Linked Cursor Mode

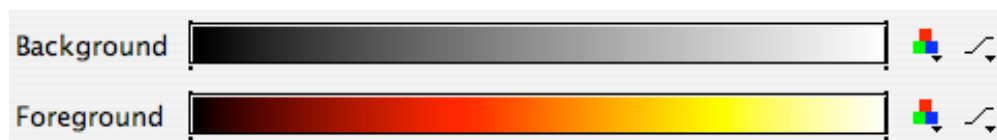
## Image Toolbar


The active tool controls the function of the left mouse button.


Tool	Usage	Shortcut
+	Click to move the 3D cursor	
	Click and drag towards the top of the screen to zoom in. Click and drag towards the bottom to zoom out	Option/Alt-left click
	Click and drag to scroll the view when zoomed in	Right-click
	Click on a view to copy its contents to the clipboard	
	Draw a rectangle ROI on the image to get the statistical data of that region	
	Draw a line on the surface of an image to get the length and the profile of the line	

## Image Controls

The image window, level, and color map are set using the following controls.



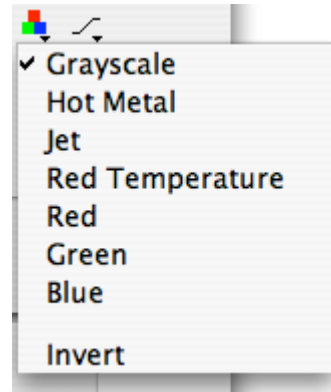
To change the color map, click the  icon to the right of the color scale. If the last item in the menu, Invert, is selected, the color map will be inverted (i.e., grayscale will go from white to black instead of from black to white). Select Invert again to return the color map to its original state.

To adjust the window and level, click and drag the vertical bars at the ends of the color scale. To adjust the level, click and drag in the middle of the color scale. While the window and level are being adjusted, the numerical window and level values are displayed in a floating window. A set of window and level presets is available from the  icon to the right of the color scale for CT images (default set as Background).

**Note:** Window and level presets should only be applied to CT image and not a PET image. If you accidentally do so, you can reset Window/Level for PET image by dragging the vertical bars to maximum range.



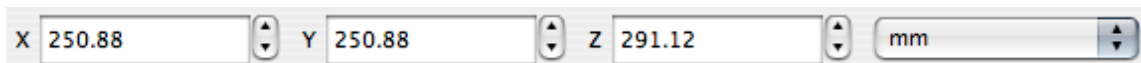
Window and level presets menu



Color maps menu

### ***Navigation Controls and Pixel Information***

The location of the 3D cursor, as shown by the green cross-hairs on top of the image, is also displayed in this set of controls. You can type in a set of cursor coordinates here. To switch the units from millimeters to pixels, use the menu on the right-hand side.



The position of the mouse is shown in the panel below. In contrast to the navigation panel above, the mouse position is shown regardless of whether a mouse button has been clicked. The position in image pixels and millimeters is shown along with the value of the pixel underneath the mouse pointer.

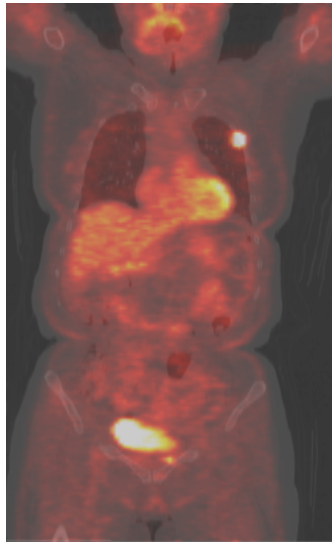
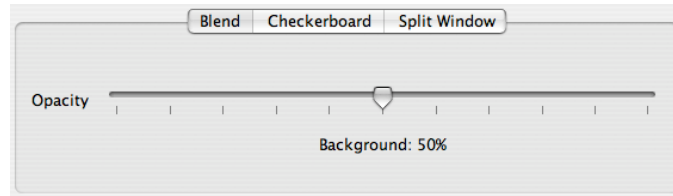
	pixels	mm	value
Background	291 256 106		50
Foreground	73 64 106	284.96 250.88 450.77	9027.8

### ***Fusion Controls***

When viewing a pair of images in fusion mode, you can choose the fusion rendering mode by selecting one of the following tabs: Blend (default), Checkerboard, or Split Window.

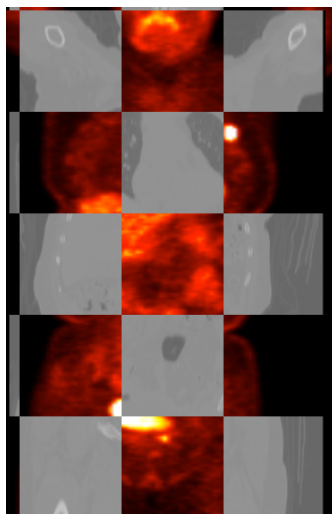
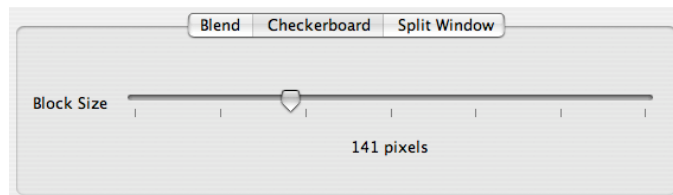
#### ***Blend (default)***

In Blend (i.e. alpha blend) mode, the Background image is multiplied by the percentage chosen with the Opacity slider ( $\alpha$ ). The Foreground image is multiplied by  $(1 - \alpha)$  and the two images are added together for display.



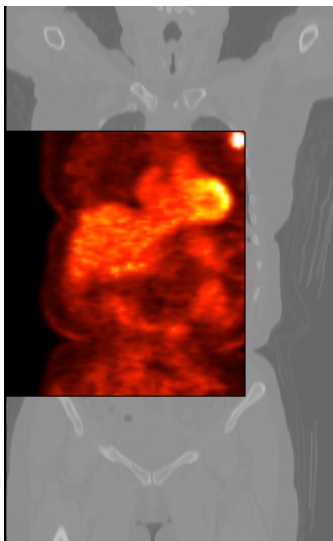
### ***Checkerboard***

In Checkerboard mode, the image is divided into squares of the size chosen with the Block Size slider. Alternate squares show the Background and Foreground images.

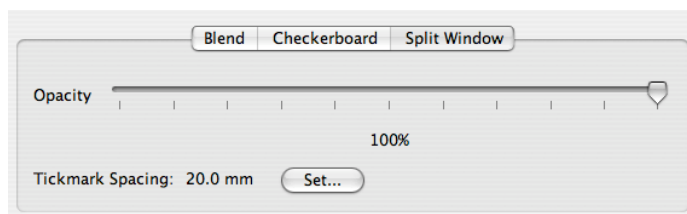


## ***Split Window***

In Split Window mode, the Foreground image is displayed in a rectangle as shown below. The size of the rectangle can be changed by clicking and dragging on the boundary. Clicking and dragging in the middle of the rectangle will move the entire rectangle.



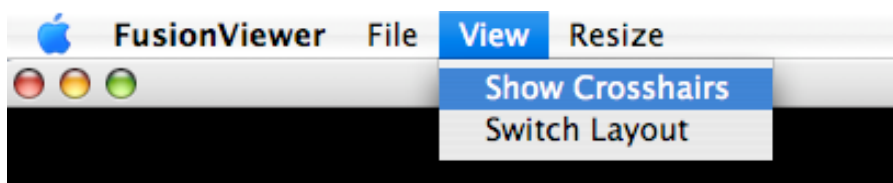
To change the spacing, click the Set button. The opacity of the rectangle is controlled by the Opacity slider. The effect is similar to the Blend mode, except that it is localized within the rectangle.



## **View Menu**

The View menu contains the following commands.

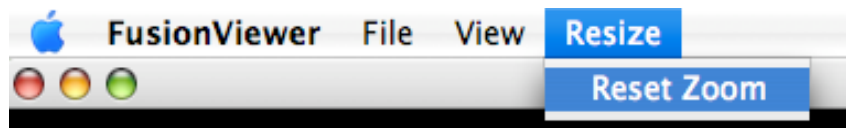
- |                 |   |
|-----------------|---|
| Show Crosshairs | Toggle whether the green crosshairs are visible.        |
| Switch Layout   | Switch between fusion and linked cursor window layouts. |



## Resize Menu

The View menu contains the following commands. These functionalities will be added in final/future release.

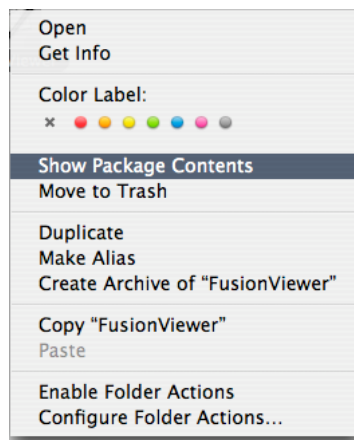
Reset Zoom	Set the zoom for each view to be the same. The images are zoomed so that none require scrolling.
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## Customization

In the program installation directory, there is a Data subdirectory. Color maps and window/level presets are read from XML files in this directory when the application is launched.

**Note:** For Mac OS X, control-click on the FusionViewer icon in the Finder and select Show Package Contents. Go to the Data folder inside Contents/Resources/Java.



## Color Maps

Colormaps.xml contains a list of files in the Colormaps subdirectory that are loaded into the color maps popup menu. Each color map file is a text file that starts with the name of the color map on the first line. Each triplet of numbers defines the red, green, and blue values for each entry in the color map, starting at 0 for the line after the name. The numbers can be separated by spaces, tabs, and carriage returns. The red, green, and blue values can range from 0 to 255.

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- A set of colormap files in the Colormaps directory
      listed in the order in which they should be displayed. -->
<colormaps>
  <file isRamp="false">Hotmetal.txt</file>
  <file isRamp="false">Jet.txt</file>
  <file isRamp="true">RedTemperature.txt</file>
  <file isRamp="true">Red.txt</file>
  <file isRamp="true">Green.txt</file>
  <file isRamp="true">Blue.txt</file>
</colormaps>

```

Colormaps.xml file

Hot Metal		
0	0	0
3	0	0
5	0	0
8	0	0

First few lines of Hotmetal.txt file

### ***Window and Level Presets***

WindowLevelPresets.xml defines the items in the window and level popup menu. XML elements in this file define a name and its associated window and level settings. Each setting tag is a menu item with the window and level specified in its nested window and level tags.

```

<?xml version="1.0" encoding="UTF-8"?>
<windowLevelSettings>
  <setting name="Default">
    <window>700</window>
    <level>35</level>
  </setting>
  <setting name="Abdomen">
    <window>350</window>
    <level>50</level>
  </setting>
  <setting name="Bone">
    <window>2500</window>
    <level>500</level>
  </setting>

```

First few lines of WindowLevelPresets.xml file

## Short-Cuts

*Note:* On Mac OS X, the short-cut key is the Command/Apple key instead of Control.

Control-O	Open a set of images
Control-1	Switch to top-most tool in the toolbar
Control-2	Switch to second tool from the top in the toolbar
Control-3	Switch to third tool from the top in the toolbar