A guide to SalsaJ

SalsaJ is free, student-friendly software developed originally for the European Hands-On Universe (EU-HOU) project. It is designed to be easy to install and use. It allows students to display, analyse, and explore real astronomical images and other data in the same way that professional astronomers do, making the same kind of discoveries that lead to true excitement about science. The flexibility of the SalsaJ tool enables students and teachers to extend the exercises with their own observations.

SalsaJ is **multi-platform and multi-lingual**: It has been translated into many languages: English, French, Spanish, Italian, Polish, Greek, Portuguese, Swedish, Northern Sami, Arabic, Chinese.

This guide gives step-by-step instructions on how to use SalsaJ to carry out basic data analysis on astronomical data files.

Plotting profiles:

1. Launch SalsaJ

2. Open your image file by selecting **File > Open**

3. If needed, rotate the image:
   Process > Rotate >

This submenu contains commands that rotate the active image or stack.

4. Play with the colour tables for the image:
   Image > Lookup Tables >

This submenu contains a selection of color lookup tables that can be applied to grayscale images to produce false-color images.

5. Zoom in/out of the image using the magnifying glass and the left/right mouse button

6. Look at the x, y and intensity values on the menu bar of SalsaJ

7. Zoom out of the image and choose the line tool

8. Draw a line across the area of interest in your image by clicking on the image and left clicking your mouse button.

Keep the mouse button pressed while you drag the line across the image.

To then plot the profile, go to:
   **Analyse > Plot profile**

A second window will appear with the results of your plot - this is a two-dimensional graph of the intensities of pixels along the line you have drawn within the image. The x-axis represents distance along the line and the y-axis is the pixel intensity.
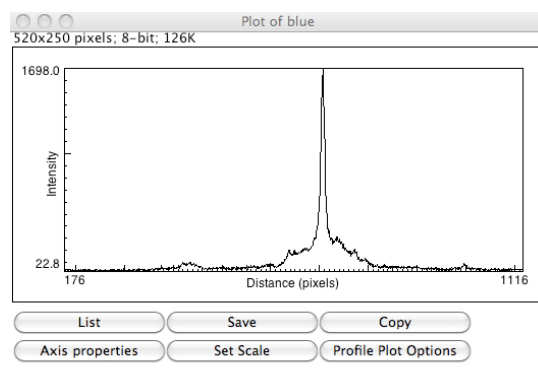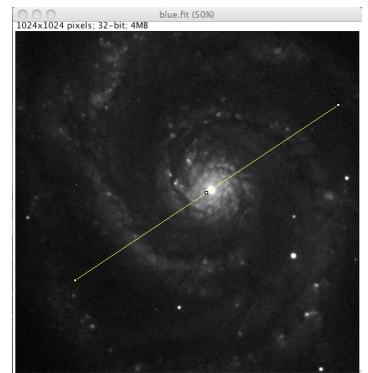
Making animations:

1. Open the files you wish to use for your animation:
   File > Open

2. Change the brightness/contrast of your images:
   Image > Adjust... > Brightness/Contrast

This tool can be used to interactively alter the brightness and contrast of the active image. With 8-bit images, brightness and contrast are changed by updating the image's look-up table (LUT), so pixel values are unchanged. With 16-bit and 32-bit images, the display is updated by changing the mapping from pixel values to 8-bit display values, so pixel pixel values are also unchanged. Brightness and contrast of RGB images are changed by modifying the pixel values.
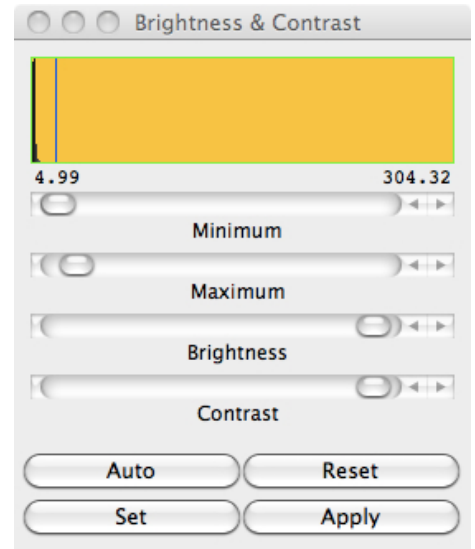
The plot at the top of the window, which is superimposed on the image's histogram, shows how pixel values are mapped to 8- bit (0-255) display values. The two numbers under the plot are the minimum and maximum displayed pixel values. These two values define the display range, or "window".

SalsaJ displays images by linearly mapping pixel values in the display range to display values in the range 0-255. Pixels with a value less than the minimum are displayed as black and those with a value greater than the maximum are displayed as white.

There are four sliders:
- **Minimum** and **Maximum** control the lower and upper limits of the display range
- **Brightness** increases or decreases image brightness by moving the display range.
- **Contrast** increases or decreases contrast by varying the width of the display range. The narrower the display range, the higher the contrast.

If you click on **Auto**, SalsaJ will automatically optimize the brightness and contrast based on an analysis of the image's histogram. Create a selection, and the entire image will be optimized based on an analysis of the selection. The optimization is done by allowing a small percentage of pixels in the image to become saturated (displayed as black or white). Each additional click on **Auto** increases the number of saturated pixels and thus the amount of optimization.
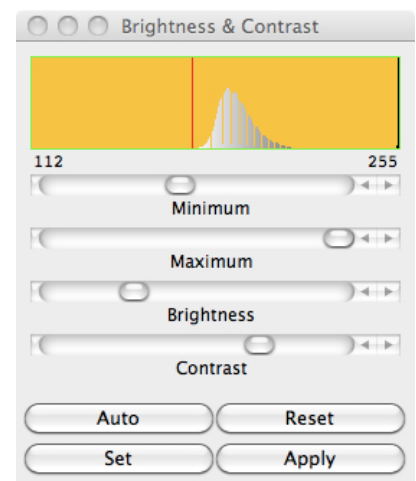
Click on **Reset** to restore the original brightness and contrast settings. The display range is set to the full pixel value range of the image.
Click on **Set** to enter the minimum and maximum display range values in a dialog box.

Click on **Apply** to apply the current display range mapping function to the pixel data.

3. Tile your windows:
   Window > Tile

4. Convert your images to a stack:
   Image > Stacks > Images to Stack

This creates a new stack consisting of all images currently displayed in separate windows. The images must all be the same type and size.

5. Play your animation:
   **Image > Stacks > Start Animation**

This animates the active stack by repeatedly displaying its slices (frames) in sequence. Use **Image > Stacks > Stop Animation**, or click with the mouse, to stop.

You can manually run through the animation by dragging the slide across at the bottom of the stack.

6. Adjust the animation speed:
   Image > Stacks > Animation Options

This specifies the animation speed. More than one stack can be animated at a time.
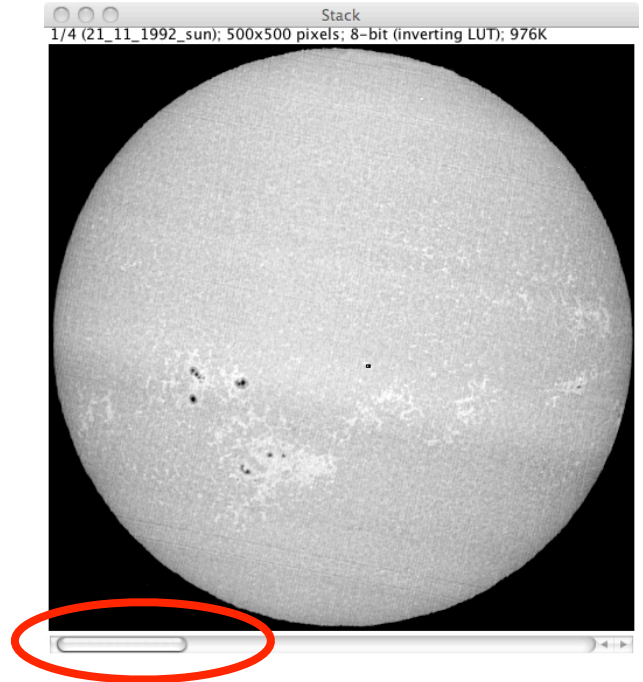
Making colour images:

1. Open your images:
    File>Open

In the dialog box that opens, find where you have saved your files. Then, using the Ctrl key, select the images you want to open, then click the **open** button.

Each image will be loaded into SalsaJ in individual windows.

2. In order to make working with these images easier, you can tile them by clicking on **Window>Tile**

3. Next, adjust the brightness and contrast of the image to make the overall image darker or lighter.
    Image>Adjust>Brightness/Contrast

4. Repeat this procedure for your other two images.

5. Now convert the greyscale images to RGB images:
    Image>Type>RGB Colour

This converts the image to 32-bit RGB color. The active image must be grayscale, 8-bit Color, or an RGB (red, green, blue) or HSB (hue, saturation and brightness) stack.
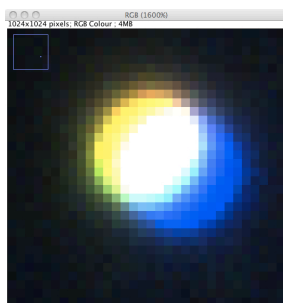
Repeat this for all 3 images.

6. To create your colour image from the 3 files, go to:
    Image>Color>RGB Merge...

A window will appear from which you should select which images correspond to each colour. Click **Ok** to produce your colour image.
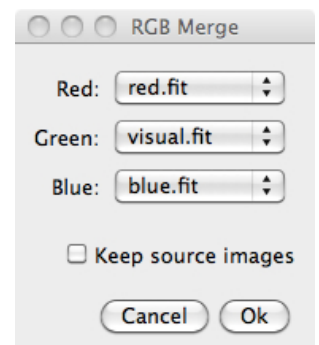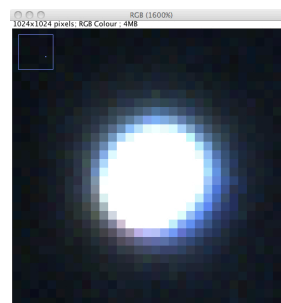
Aligning

If your images are not aligned, follow steps 7-8. If they are aligned, then go to step 10.

Example of a misaligned image   Example of an aligned image

7. Go to **Plugins>Align R/G/B Planes**.

The **Align RGB** box will appear.

8. Using the zoom tool , zoom into a single star in the image. This will help when aligning your image.

9. In the **Align RGB** box go to the **Plane** drop down menu and select the colour layer you wish to move. Click on the **Up**, **Down**, **Left** and **Right** buttons to move the selected layer until all 3 layers are aligned.
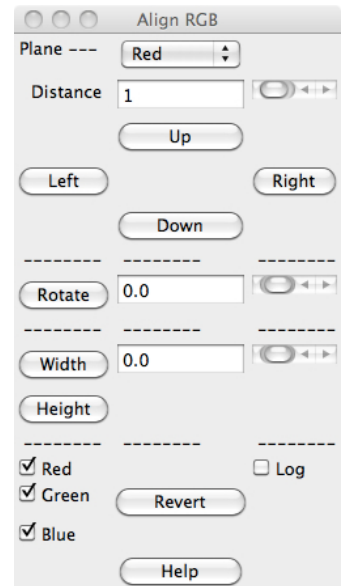
Cosmetics

There are more adjustments you can make towards your image.

10. You can adjust the Colour Balance by going to
    Image>Adjust>Color Balance

Select the colour layer you wish to adjust from the drop down menu at the bottom of the window. Then use the sliders to adjust the properties of the layer. You must click the Apply button for each change to remain.

You can also adjust the image as a whole by selecting **R/G/B** from the drop down menu.

Saving Your Image

11. Finally, you can save your image by going to:
    File>Save As

From this menu you will be given several formats to save your image in. TIFF and JPEG are common formats for images, with JPEGs often being smaller and more convenient for sharing on the Internet.

Navigate to a location on your computer where you want to save your image and click **Save**.

**<u>Measuring lengths:</u>**

1. Open your image file:

> **File > Open**

2. If you need to make the area that you are measuring clearer, invert your image:

> **Edit > Invert**

This creates a reversed image, similar to a photographic negative, of the entire image or selection.

3. Select the line tool and draw a line all the way across the edge of the image, ensuring that you cover all the pixels. By drawing this line, you are making a line selection that corresponds to a known distance (you must know the number of pixels in the image - this is given above the image), which can in turn be used to set the spatial scale of the image so that measurement results can be presented in calibrated units.
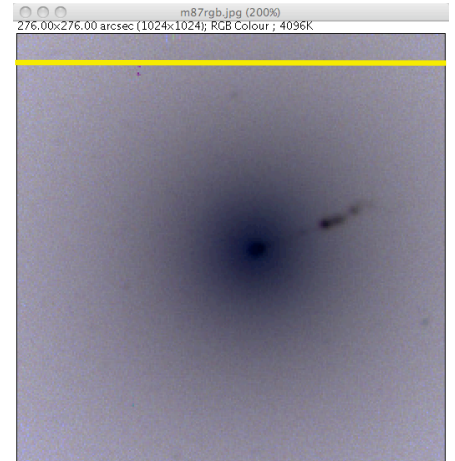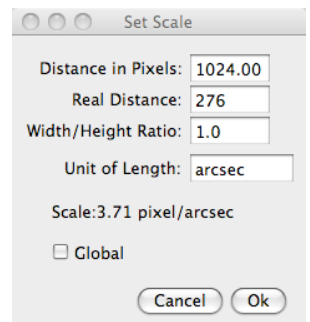
When drawing this line, ensure you start at the edge of the image (e.g. x=0) and that it is a straight horizontal or vertical line (angle = 0.00 or 90)
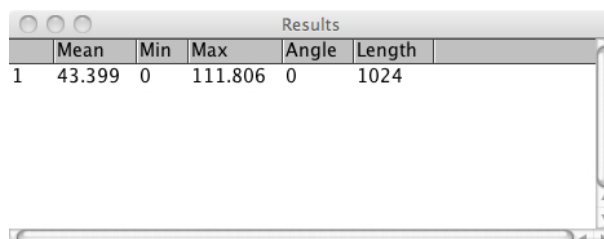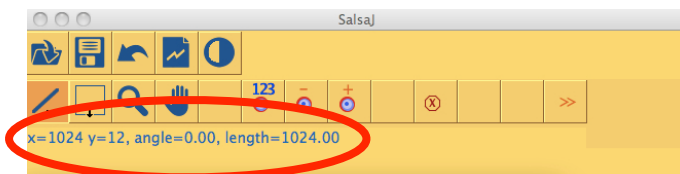

4. Go to **Analyse > Set Scale..**.

A pop-up window will appear. Input the values as found from your image, into the relevant boxes in the window, (an example for an image 1024x1024 pixels square is shown on the right), and click **OK**.

5. Select the Zoom tool and zoom into the region of the image which contains the region of interest by left clicking on the image.

6. Select the line tool once again and draw a line extending across the region of interest.

7. Go to **Analyse > Measure**. A pop-up **Results** window should appear. If it does not, go to **Window > Results** and it should appear. The '**Length**' value given in this window is the length of the jet in the units specified in step 5.

	Mean	Min	Max	Angle	Length	
1	43.399	0	111.806	0	1024	
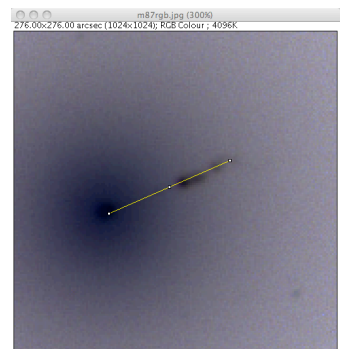
Photometry:

Photometry is the determination of the flux of light emitted by a star. It is calculated by correcting the integrated values of the pixels by the value of the sky background. This value can be related to the star intensity selection as is shown below.

1. Open your image file:

   File>Open

2. Adjust the brightness & contrast of the image if needed.

3. Go to **Analyse>Photometry Settings**.

A new window will appear in which you can either choose to allow SalsaJ to automatically determine the centre and radius of the selected star and a suitable sky area, or you can force the coordinates and radius of the star, and the value of the sky background. At this point, follow the guide for the educational project you are undertaking to see what method is recommended.
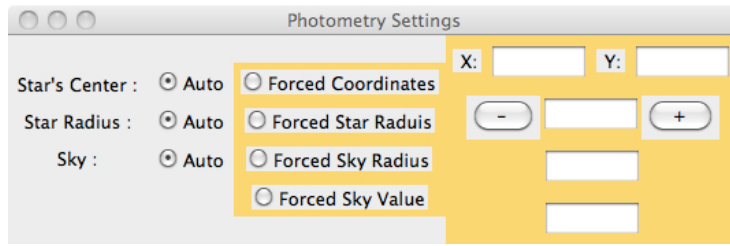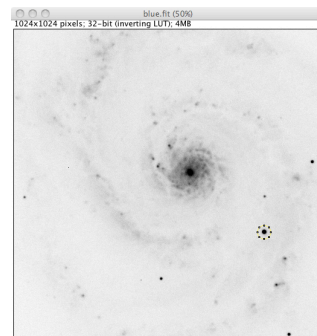

4. After setting the photometry parameters, go to:

   Analyse>Photometry

Another empty window will then appear.
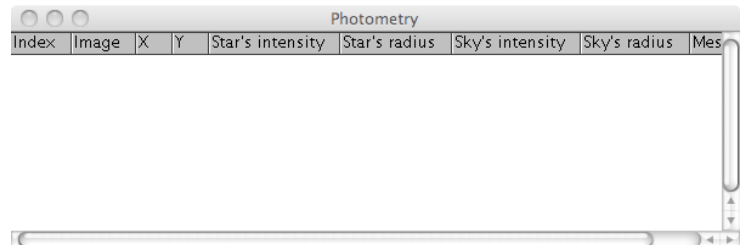
5. Click on the star of interest in your image. A circle of radius as specified in step 3 will be drawn on the image. The measured intensity and position values will also appear in the pop-up 'Photometry' window.

6. The magnitude of the star can be calculated by using simple mathematics. For more detail on this, please refer to the relevant educational resource.

Index	Image	X	Y	Star's intensity	Star's radius	Sky's intensity	Sky's radius
1	blue.fit	829	670	266569	22	57	33