



Image Enhancement using DStretch

Visit <http://www.DStretch.com> for more info.

Email DStretch@prodigy.net for the plugin.

DStretch was created by Jon Harman.

DStretch is a digital imaging tool created for the enhancement of rock art images. It can make pictographs visible that are nearly invisible to the naked eye. It needs a hue difference to do its enhancement and so works best on pictographs, especially faint red or yellow pictographs. It works on color RGB images, the format used by consumer digital cameras. It is based on Java and will run on PC's, Mac's and Linux.

Installation

DStretch is a plugin to the imaging program ImageJ (available for free from <http://rsb.info.nih.gov/ij/>). Install ImageJ first then get the DStretch plugin file DStretch_.zip by email from dstretch@prodigy.net. A \$50 contribution is required for the DStretch plugin. There is a PayPal Donate button on the DStretch.com homepage. Put the plugin file into the ImageJ Plugins directory. When you next start ImageJ DStretch menu items will appear in the Plugins menu. To start DStretch choose Plugins->DStretch->DStretch...Run.

Digital photography tips

1. Camera: Bigger sensor is better, DSLR's are good. Lens makes a difference.
2. Megapixels: Higher is not necessarily better, but use all you have (See 6.)
3. Best format is tiff or raw. If you use jpeg use the highest quality setting.
4. Use the lowest ISO setting available on your camera. Don't use auto ISO.
5. Use flash in low light settings (rockshelters). Avoid direct sun.
6. If shooting jpegs use the highest camera resolution setting (highest megapixels).
Later use a computer to reduce the resolution and save with highest jpeg quality.

Digital imaging tools

Get a program to use for browsing your images. There is a new Browse command in DStretch that can be used to browse a directory of photos. For windows I also recommend Irfanview (www.irfanview.com) or FastStone (www.faststone.org). They are small and fast and allow you to easily browse images in a directory. It is possible to make ImageJ the default editor for these programs. DStretch can do many of the common images enhancements, but I also use Paint Shop Pro and Gimp.

Using DStretch

Enhancement names

DStretch does its enhancement using colorspaces. It names the enhancements after the colorspace used. The colorspaces have names like LDS, LAB, LRE, RGB, YBK, and others. Different colorspaces produce different results. The alphabet soup can be confusing at first so this handout explains which colorspaces give best results on which types of rock art.

Running the plugin

Start ImageJ. Open the image file using the File->Open menu item or drag the file onto ImageJ. Then choose the Plugins->DStretch->DStretch...run menu item. A copy of the image will appear with the DStretch panel underneath. That panel has a scale field, a number of colored buttons with colorspace names, plus some other buttons. To do an enhancement first choose a scale then click on a colorspace button. The default scale (15) and the LDS button are good starting points. For red pictographs LRE, YRE, or CRGB work well. The Plugins->DStretch->DStretch...one menu item is similar to the ...run menu item but puts the DStretch panel under the image without making a copy. Before or after doing an enhancement, the Auto Contrast button can be used to optimize the image contrast. This sometimes improves the image, sometimes not. Press the Reset button to get back to the original image. Save the result by clicking on the Save button. This saves the enhancement as a jpeg file. To save as a tiff file use the ImageJ File->Save menu command. DStretch names the saved image by adding the colorspace name. You can change this name in the save dialog.

Choosing DStretch enhancements

The enhancement buttons in the initial GUI are the ones I use most often. LDS and LAB are good all-around enhancements with LDS enhancing yellows better. LRE works very well on faint red pictographs. CRGB also does very well on reds but produces some wild colors. YYE can work well to make faint yellow paint more visible. YBK can do well on black pigments, which is a difficult task for DStretch. YRD and YRE work well on reds. YRD gives a more pleasing overall enhancement while YRE (like LRE) focuses on reds only.

More enhancements

The More button brings up a new GUI of enhancements that I use less often. There are often enhancement twins, one with an "L", one with a "Y". Examples are LDS and YDS, LRE and YRE, LBK and YBK, LYE and YYE, etc. The "L" enhancements are less affected by noise and jpeg artifacts and can give sharper looking results with more pleasing colors. I don't always prefer the "L" enhancements however, exceptions are YYE, YBK and YRD. RGB is the colorspace first used by the original decorrelation stretch algorithm. Other standard colorspaces that DStretch uses are LAB and YUV. For more info hover your mouse over a button for a tool tip. The Back button takes you to the original GUI.

YXX and LXX Buttons

I created most of the enhancements by manipulating colorspace. You can do this yourself by adjusting the multipliers in the dialog displayed by the YXX and LXX buttons. The dialog also shows multipliers that I have used to get various colorspace. Start with these then modify to find new enhancements. Once you get an enhancement that you like, save the matrix. (After saving the image a dialog will appear asking to save the matrix.) Reading that matrix before a new stretch will set the multipliers to those you chose previously.

Flat Button

This button accesses a routine that flattens the illumination across an image. It can be useful in images where the rock art is partly in shadow. It can also flatten out non-uniform flash illumination. If you use it before enhancement it can affect the colors and quality of the enhancements. If used after the colors are better preserved.

Save Button

This button saves the current image as a jpeg. Quality is determined by the ImageJ jpeg quality default. This number appears at the top of the save dialogue. To change it use the ImageJ Edit->Options->Input/Output... menu item or switch to Expert mode and use the Save Jpeg button. In that mode there is a dialogue that asks for the number. I use 75 for jpeg quality when saving enhancements that will not need to be further enhanced.

ColFix Button

This button tones down the wild colors created by some enhancements. It does this by reducing saturation and eliminating cyan hues..

AdjCol Button

This button can be used to make adjustments to the colors in the image. There are several choices. Grayscale will change into Grayscale mode in which the enhancement results are automatically converted to grayscale. Choose it again to cancel this mode. It can be very illuminating to compare enhancements in Grayscale mode. ColAdjust can either alter the saturation, cyan hue, or smooth the colors. Reducing the saturation (by say .5) can tame the sometimes wild colors produced by DStretch. Setting the saturation to 1 but the cyan to 0 can eliminate the cyan cast in some LRE enhancements. Do this after a stretch. AdjTemp changes the color cast temperature of the image. ColSmooth can help visualization in noisy images. Use AdjTemp after the stretch, smoothing before the stretch.

CB Button

This button performs a color balance routine that can help when color in the background of the paintings interferes with visualization or with DStretch enhancements. Hit this button before you do a stretch.

Matrix Button

After doing a stretch use the Matrix button to save the matrix and colorspace in a text file for future use. This can be used to apply the same DStretch to several images for more consistent color enhancement. Before doing a stretch use the Matrix button to read in a previously saved matrix and do an enhancement based on that matrix.

Cycle Button

Viewing different enhancements sequentially can help uncover faint paintings. This button cycles through the enhancements that you choose using the check boxes. You must hit the red Stop button to exit. Try it in Grayscale mode. You can also cycle through hue shifts.

Xplor Button

This is another way to try to find unique enhancements for difficult color problems. Four matrices (YRD, YBK, YRE, and YYE) are calculated for the current image. The sliders allow custom mixing of the matrix values to achieve intermediate or extrapolated results. The AdjCol button is in this panel since Grayscale Mode can be useful when judging the results.

Expert

DStretch originally came with a rather complicated user interface that I used when developing the program. It has many special tools that I have found useful in enhancing rock art images. To switch to Expert mode just click the button. This can be done at any time. To go back to the main panel, click on the Main Panel button. More colorspaces and more types of enhancement are available in Expert mode. There are two panels available: Expert and Hue Mask. For more information on the Expert panel and the Hue Mask panel use the help button. A special Hue Mask help message is given when the Hue Mask panel is up. Many of the buttons (scale, auto contrast, help, CRGB) are the same in Expert mode as in main panel. In Expert mode to do a stretch choose the scale, colorspace, and matrix then hit the DStretch button.

Area Selection

ImageJ has the ability to draw an area selection on the image using rectangles, ellipses, and freehand drawing. If an area selection (also called an ROI) is present the decorrelation stretch will be based on that area, but applied to the entire image. Use this to exclude extraneous parts of the image (say green bushes near a panel) that can affect the enhancement. If you have used an ROI then the save dialogue will ask you if you want to save it. It will save it in a file with the extension “.roi”. If you open that file using the ImageJ->Open menu the ROI will be placed on the current image.

Batch Mode

Choose this DStretch menu item to run DStretch on all the files in a directory. The output will go to a second directory. After you choose the two directories you choose the enhancement(s) and output format. There are four slots for enhancements, but only one colorspace enhancement should be chosen (i.e. LDS, YRE, etc), other (non-colorspace)

enhancements can be added either before or after. For instance auto contrast might be chosen before then flatten and hue shift after the colorspace enhancement. The output file names will reflect the enhancements chosen.