

Layering Image Contrast

Bring out the faintest details in your images with this powerful *Photoshop* technique.

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THE EVER-INCREASING quality of amateur astrophotos creates a conundrum for imagers. Since there are so many great pictures to look at, many people invest only a few seconds looking at an image unless something hooks their attention, reels them in, and provides incentive to linger.

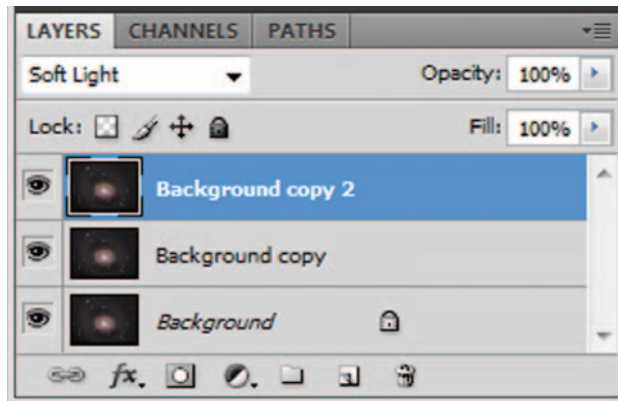
Three essential image ingredients for capturing a person's attention are color, clarity, and contrast. Each tends to overlap the other, but when carefully managed together, they enable the astrophotographer to produce truly memorable pictures.

Of the three, contrast is perhaps the most important because it involves the viewer's ability to distinguish between an object and its background. The human eye is more sensitive to changes in contrast than luminance. Controlling contrast in astronomical images is challenging because of their large brightness range.

Light intensity (pixel values) of an astronomical image can be plotted as a graph called a histogram that shows us the amount of information recorded in the bright, faint, and dark regions of the image. Most of the interesting information is often in the faint region, where our eyes

Left: Extracting faint detail from CCD images can prove a daunting task for today's astrophotographers. Author R. Jay GaBany uses a powerful technique he calls Layered Contrast Stretching (LCS) to bring out faint structures buried in his images. The original view of M74 at left displays a basic, non-linear stretch, whereas the right half uses LCS layers to enhance the fainter areas. All images are courtesy of the author.

Right: Enhancing your photos using LCS requires image layers and masks. After creating two layer copies of an image, you change the layer blending mode of the top layer from Normal to Soft Light and the middle layer from Normal to Screen. The Screen layer doubles brightness values of the lower layer, while Soft Light increases contrast and color saturation.



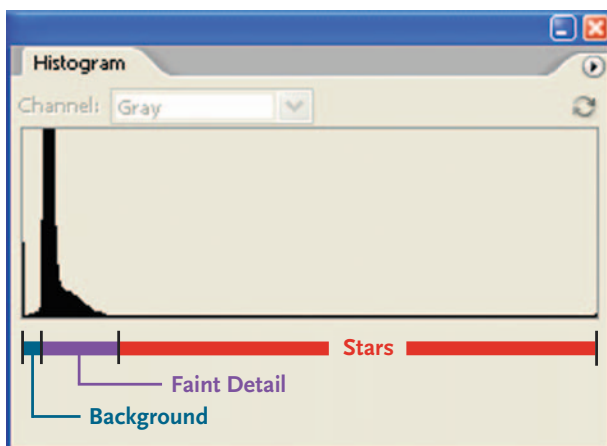
are most sensitive to contrast variances. Unfortunately, this also tends to be the noisiest area of an image.

Images with a sufficient signal-to-noise ratio have the greatest contrast potential. Many astrophotographers mistakenly think the principal benefit of longer exposures is the ability to capture fainter objects, and there is some truth to this. However, the biggest reward of long exposures is the increased signal-to-noise ratio because it improves contrast in the faintest areas.

Excellent calibration frames, particularly flats, are also critical for producing compelling pictures because of their impact on the data's signal-to-noise ratio. A good flat will help to distinguish faint structures from the background sky that would otherwise be masked by noise or mistaken as brightness gradients.

Stretching Out the Truth

Digital images store light intensity values based on the number of photons striking each pixel of the imaging chip. The value for a pixel that receives 200 photons will



Astronomical objects have a large ranges of brightnesses, so virtually all deep-sky astrophotos require nonlinear stretching to show the entire extent of the subject. This histogram plots the intensity of various components of a typical nebula image before any processing. Everything to the right of the peak represents the brightest information in the image, primarily stars.

be twice that of a pixel collecting only 100. As a result, a significant portion of the faintest information captured by the camera's sensor is squeezed into a small portion of the histogram that has to be rescaled or stretched. You can do this with tools such as Digital Development (DDP), found in many astronomical image-processing programs. But these tools offer only limited control of the entire image. My personal reliance on these one-stop histogram-stretching algorithms waned several years ago in favor of a more hands-on technique I use in *Adobe Photoshop*.

While there are several methods for making global contrast adjustments in *Photoshop*, I find that the Curves and Levels tools provide more control than DDP, plus the application has other less-obvious functions that enable even greater control. But once I'm done uniformly stretching the entire image, it's time to dig into specific regions to accentuate contrasts and give my images that extra hook to hold the observer's attention.

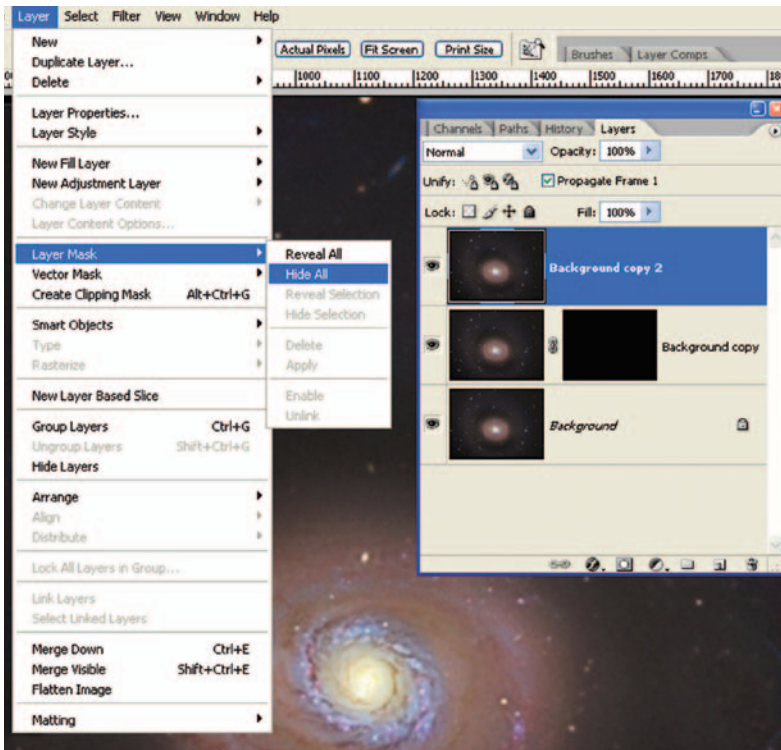
Layered Contrast Stretching

Several years ago I began using a technique I call Layered Contrast Stretching (LCS). It is highly effective for managing subtle contrast variances and increasing the intensity difference between faint structures and their background. The approach also enables me to enhance images at any post-calibration stage. It's important to note that this technique shouldn't be used on images intended for scientific research.

LCS leverages *Photoshop's* ability to blend multiple images in layers. Typically an altered version of the astrophoto is placed into a layer on top of the original picture, then the two images are proportionately mixed.

I manage the proportional control of the mix by adjusting the opacity of the layer and by using masks that hide or reveal selected portions of the layered picture. These functions are the most powerful tools for managing contrast and producing pictures with rich color and good clarity because they offer virtually infinite control of the blending process.

Here's how you do it. Open an image you've previously stretched. Also display the Layers window (Window/



Layer) and keep it open throughout the process. Next, copy the picture (Layer/Duplicate Layer) twice to create two additional layers. At this point, there will be three identical layers. Next, change the top layer blending mode to Soft Light and the middle layer to Screen. Soft Light adds sharp contrast to the image's histogram and increases color saturation without adding noise, whereas Screen essentially doubles the brightness value of the image's tonal curve.

Selectively blending the two layers with the background image requires that a layer mask be added to each copied layers, as shown here. These masks initially hide the effect of their respective layers on the background image.

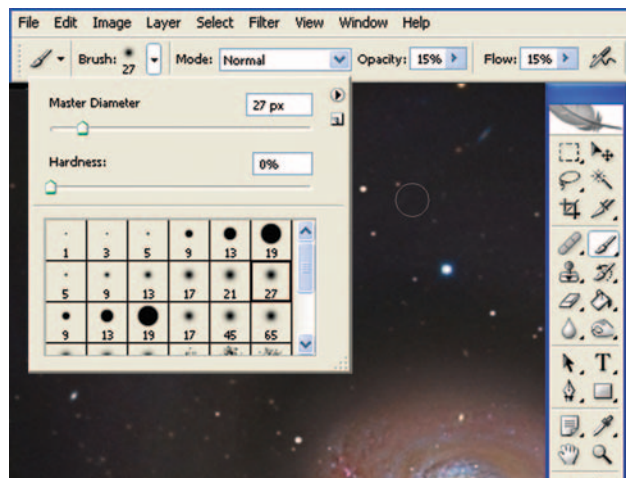
Next, add layer masks to the top and middle layer (Layer/Layer Mask/Hide All). At this point, only the image in the bottom layer, known as the Background, will be visible. Now it's time to begin blending the top and middle layer images into the bottom image.

Select the paint brush from the Tools Palette, making sure its foreground color is set to white. Set its hardness to 0% and its opacity and flow to 15%. Find an area of your image that contains a low-contrast structure and adjust the size of the paint brush so that its diameter approximates or is slightly larger than the structure's size.

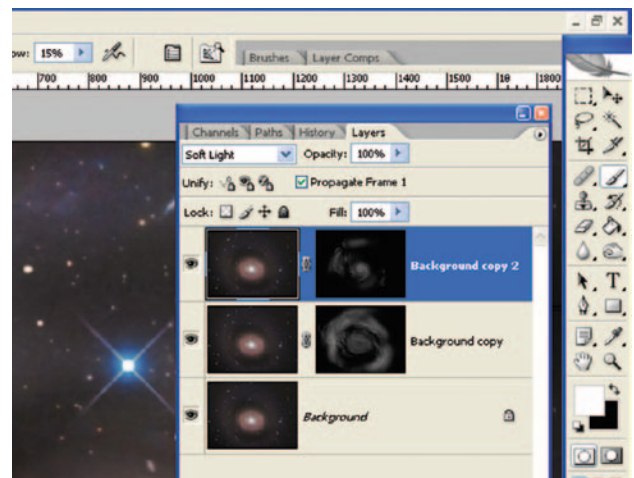
If the area of low contrast is faint compared to the surrounding region, select the Screen layer mask, and simply paint over that region of the picture with the brush. If the area is brighter than the surrounding region, select the upper Soft Light layer mask.

You may not notice much difference with the first stroke of the paintbrush, but repeating the stroke several times will start to visibly change the image. You can often get a good feel for the changes made by blinking the layer off and on (clicking the "eye" box to the left of the layer thumbnail).

As you paint, you are blending that portion of the Screen or Soft Light layer with the original image visible in the Background layer. Because your brush is soft, the amount of blending varies within the brush stroke itself. At the center of the brush stroke, the opacity is 15% but this drops off considerably toward the edges of the brush,



Painting the masks with the Paint Brush tool allows imagers to selectively blend the layers. Because we want to build our blending mask slowly, we should lower the brush's opacity and flow settings. The brush radius (displayed as a circle) should also be adjusted to cover the width of the area you'd like to enhance.



Soft Light and Screen blending layers add distinctly different enhancements to your image. Paint on the Screen layer mask (middle layer) in areas you want to brighten, such as faint nebulae. Paint on the Soft Light mask (top layer) in areas where additional contrast is required, such as in the inner core of galaxies.

resulting in a “feathering” effect. While each individual brush stroke produces relatively insignificant changes, the changes imparted by additional brush strokes accumulate in a somewhat random manner.

This technique makes it difficult for the user to “paint” a structure into the final image where none previously existed. It also enables us to exaggerate the contrast around the structure and thus make it more evident.

If a structure appears too bright using the Screen layer mask, paint on the Soft Light layer mask to darken it. The picture will benefit from simultaneous strokes to both layer masks, too. The Soft Light layer is also useful to darken dim structures such as threads of dark dust seen in distant galaxies.

You can also introduce other layers to enhance contrast using LCS. An Overlay layer is like Soft Light on steroids, so use an even lower opacity brush when masking it in. Linear Dodge and Linear Burn layers will have a dramatic effect on contrast, so I apply these sparingly

and with brush settings of only 5% or less. Interestingly, Color dodge and Color burn are also effective, even on monochrome images. Although it’s considered a sharpening tool, the High Pass filter (Filter/Other/High Pass) is a wonderful method for enhancing subtle contrast. I use it sparingly and rarely exceed a radius setting of 7 pixels.

LCS is extremely powerful for increasing the contrast of faint structures. Often an inspection of the image using *Photoshop’s* Equalize function (Image/Adjustments/Equalize) will help identify where dim regions are located so you can target them for enhancement using this technique.

I frequently revisit my old images to see if LCS can improve my earlier results. It can increase the impact of a picture and make the wonders of the universe more evident for casual viewers. ♦

R. Jay GaBany is the recipient of the American Astronomical Society’s 2011 Chambliss Amateur Achievement Award (S&T: April 2011, page 18).



LCS works on any deep-sky astrophoto. The author processed this image of M20 with LCS to enhance both the outer reflection nebula and the dark lanes within the core.