



Ely Photographic
Club

NOISE & SHARPNESS

Exposure Triangle

The exposure triangle shows the three things that affect exposure, Shutter Speed, Aperture and ISO. However, they usually show these as a straight-line situation when it's not really that way.

It is a balance between the three settings to have the correct exposure, but some mix of settings may be better than others and this will often depend on your make and model of camera.

Modern cameras are mostly ISO invariant. ISO invariance is a property of your camera's sensor. If your camera sensor is perfectly ISO invariant, there is no penalty in noise if you brighten a photo in post-production rather than increasing your ISO in-camera. They are functionally the same but as you may see that may not be quite correct and there are differences.

This may be due to the fact that the loss of Dynamic Range is not a straight line and often has a step in it. As is explained later.

Most modern cameras automatically adjust the settings to suit. For example, if you are in shutter speed mode, with an ISO of 100, then the camera will adjust the aperture to suit.

Even in manual mode you can set variable ISO so whatever shutter speed and Aperture you select the camera will adjust the ISO to provide a reasonable result.

Obviously, you can deliberately underexpose or overexpose to get a particular look.

However, if you underexpose and then try to recover to the correct exposure noise can appear. It can be all over the image but usually worse in the shadow areas and backgrounds.

This can happen in nature or sports photography when you need a fast shutter speed of say 1/2000 second to freeze the action, a mid-range aperture of say f6.3 or 7.1 to balance the subject being sharp (given the very narrow depth of field of long telephoto lenses) but you want the background to be out of focus, this results in the ISO being pushed up too far, which depending on the light can result in noise.

Noise can also appear in shadow areas even on landscape or portrait images due to the restriction on the dynamic range of the camera when taking the shot. This can often be recovered in post but then the noise appears.

Noise is usually most apparent in smooth areas such as the sky or in shadow areas such as rocks or dense foliage.

Then it's how best to remove this noise, but first let's look at several images to show the effect of various Aperture, Shutter Speed & ISO settings.

To test the situation, I carried out some test photos. In the first set I used 0.8 seconds shutter speed & ISO 100 for the whole set with apertures of 1 stop apart f4; f5.6; f8; f11; f16; f22

In the second set I used 0.8 seconds shutter speed & an aperture of f22 and then changed the ISO by 1 stop starting at 3200; 1600; 800; 400; 200; 100

Then by using the exposure slider to add exposure I checked the result.

The progression altering the aperture seems to be reasonably linear, whereas the progression using the ISO is not and this is shown in the EDR v ISO chart I looked at from DXOMark which shows that for the camera I used it's not a straight line but has a step up at ISO 250 which turns back down again at ISO 320.

So, for the best dynamic range with this camera I should use ISO 100 or 320 but anything up to ISO 600 should still give a reasonable result, any ISO higher than that and I'm going to reduce the dynamic range and probably have noise in the image.

In this test I added the stops of exposure to bring the brightness to approximately the same level up to the 5 stops max in Lightroom Classic and the brightness matched the first image. The noise visible was as follows, with the lower value being the less noise:-

1st Set; 0.8 second shutter speed and ISO 100; Changing aperture (Straight line exposure increase in Lightroom Classic)

F4	0/10	No noise
F5.6	0/10	No noise
F8	1/10	First hint of noise
F11	2/10	Slight noise visible
F16	4/10	Quite a lot of noise
F22	6/10	Very bad noise including colour noise

2nd Set; 0.8 second shutter speed and f22; Changing ISO (More than 1 stop of exposure in Lightroom Classic required to get the same brightness at each step)

ISO 3600	3/10	Slight noise
ISO 1600	5/10	Moderate amount of noise
ISO 800	5/10	Moderate amount of noise
ISO 400	5/10	Moderate amount of noise
ISO 200	6/10	Quite a lot of noise including colour noise
ISO 100	8/10	Extremely bad noise including colour noise

Interesting results but as you would expect using ISO 100 with a suitable aperture gave the best results. It also appears you can go to f11 and increase the exposure in LRC by 3 stops to get a better result than using say ISO 400 or 800 and trying to increase the exposure later.

However ISO 3600 did give a reasonable performance and only needed a slight increase in exposure in Lightroom Classic. It was only when trying to pull back the exposure on the incorrect ISO settings when the noise became a real problem.

Obviously you would not use some of these settings in practice as you cannot see the subject, once you are more than 3 stops out of optimum.

What does this all mean. Well I think it means use ISO 100 to 400 as much as possible and change the aperture or shutter speed as appropriate. If you cannot achieve the result you want for example a high shutter speed for moving subjects or a suitable depth of field then go as far as you can with aperture and shutter speed settings and then use higher ISO values.

Removing noise

Now we can look at the various ways to reduce / remove noise and at the same time possibly blurring the background and / or sharpening the subject.

Lightroom / Lightroom Classic

The basic method is a balance between removing noise and adding sharpness.

The default sharpness setting is 40. You can increase this but do it sparingly but if you can see noise in the image remove this first otherwise you will simply sharpen the noise.

Sharpening increases the contrast around edges, so you don't want this to happen to the noise. Holding down the Alt key when moving the slider shows a black and white view, which can help with seeing the contrast.

The Radius and Detail sliders can be used to tweak the result but adding or deducting the border to edges.

You can use the masking slider to reduce where the sharpening will be applied. Hold down the Alt key as you move the slider to see a black & white view and the white areas are those being sharpened.

The Luminance default is 0. Hold Alt to see a black & white mask of the area being affected.

The default Details slider is 50 but greyed out until you add some luminance reduction. You can use this to try to bring back some detail.

The Contrast slider may be able to add some detail back.

If there isn't very much noise this method can be sufficient, but it will always be a balance between noise reduction and sharpness.

The more successful method, when there is quite a lot of noise does involve a trip over to Photoshop. This is also good for blurring backgrounds.

This works best on a subject that is textured such as a bird with brown plumage that can have some noise that isn't obvious, but the background shows the noise.

Create two digital copies (this is so the original is unaffected just in case you want to try something else, I know Lightroom Classic is non-destructive but it's just easier to have a completely original image).

On the first copy image reduce the noise a little and add some sharpness to get the subject as good as you can. Don't worry about the background at this stage.

On the 2nd copy reduce the sharpness to zero and add a lot of noise reduction. You can even go all the way to the right with the slider if you want to. This will lose all the detail in the image, and everything will be blurred / like a painting.

Select both photos left clicking on the first one and Ctrl left clicking on the second. Then right click on them and select Edit as layers in Photoshop, which is at the bottom of the pop out menu.

In Photoshop make sure the fully noise reduced image is on the bottom.

Then on the top image, select the subject using the object selection tool. Then click on Select & Mask to open up the selection panel. Reduce the radius by 1 px which helps avoid halos and artifacts.

Select output as a selection. This is then retained when you add a mask to the layer.

Then on the top layer add a mask by clicking on the mask icon on the bottom right and ensure the subject is white on the mask (i.e. you can see the subject on this layer in the white area and you can see the layer below in the black areas of the mask, if not invert the mask using Ctrl + I).

This will all mean that the image you can see on screen will be the subject reasonably sharp with a little noise with a very soft noise free background.

If there is still some noise visible in the image you can play around with the mask with various opacity black brushes to see a little more of the bottom layer to reduce the noise to taste.

To add a final twist, you could make a stamp visible layer (Shift+Ctrl+Alt+E) (basically a flattened layer which retains the layers below) and this will be a new layer on the top of the layers.

Then if there is still too much noise on the subject you can use Photoshop noise reduction on this layer or even better if you have it run something like Topaz Denoise AI on this layer.

Then if there are any halos or artifacts you can deal with them by adding a mask to this layer and / or reducing the opacity or just add a new transparent layer and work on the halos and artifacts on this new layer.

Photoshop

There are some noise reduction and sharpening tools in Photoshop, and I do use them occasionally, but I tend to use the Topaz products more often. I find the Photoshop noise reduction not as effective as Topaz Denoise AI.

The Photoshop sharpening is ok especially Smart Sharpen but again in my opinion not quite as good as the sharpening in Denoise AI.

Topaz

The two main products are Denoise AI and Sharpen AI although Gigapixel does have some sharpening and noise reduction sliders.

I generally use Denoise AI and then Sharpen AI if I feel some areas need a little bit more sharpening.

Personally, I don't think Gigapixel deals with noise or sharpening quite as well as Denoise AI.

It is possible to use these products from Lightroom Classic, but I prefer to do it from Photoshop as the layers and clone tools provide more flexibility and tidying up options as the sharpening methods can cause halos, artifacts, etc that may need some work.

With both Denoise AI and Sharpen AI care is needed not to overdo the sharpening, especially with Sharpen AI.

I generally find the Denoise AI sharpening is ok, but I still will reduce the opacity a little on this layer back in Photoshop just to take the intensity away.

With Sharpen AI I usually try the various options on Auto and then select the option that's best, and whatever the Auto amount that shown is, I pull back the slider to use half of this before I accept it.

Then when back in Photoshop from Sharpen AI, I invert the mask and only pick out selected areas with a white brush adjusting the opacity of the brush and the layer as required.

If you see any halos or artifacts, then remove them using the clone stamp tool and the appropriate blend mode.

You can use all three products directly from the RAW image and Topaz suggests this is the way to use them. When opening these products from within Lightroom or Photoshop the RAW option is greyed out.

To do this you must open the software from the desktop (i.e. from outside Lightroom Classic or Photoshop), then find and load the original RAW file from your hard disk.

You can right click on the image and select "Show in Explorer" from the pop up menu.

You can now open up the Topaz product and drag the photo in.

Now the RAW option is available. You can use it as normal. Once finished you can save in various file types such as Adobe DNG. The file is saved in the original folder on your computer.

Then to carry out any further edits you have to go into Lightroom and in the Library module go to the Library menu and select Synchronize Folder. This will add any new photos to the folder.

Unfortunately, it opens the image on its own and then you must find the folder in the list and click on it and all the photos in the folder will appear with the new photo with the same name with -DeNoiseAI-raw.dng added.

You can then carry out further edits as normal. Is the result that much better to make up for these extra steps only you can tell, but it's a shame you can't just go from Lightroom Classic with the unedited RAW file as you can with the Lightroom Classic file but at the moment Lightroom Classic only allows the "With Lightroom Edits" even though there aren't any.