Digital

A monthly column by Harry

As I mentioned in a previous column for beginning photographers, photographic exposure is a compromise between the various camera settings. There is another compromise, “signal to noise ratio”, that is involved in the *design* of the camera. Of course, generally, we can't control this, except by buying another camera, but understanding some of the issues involved helps improve our photography.

Why do some digital pictures come out blotchy or “noisy”?

Even in complete darkness, a live digital sensor will become activated, i.e. behave as if some light had reached it. Some of the activation comes from exotic sources like cosmic rays but mostly it is due to random movements of electrons in the sensor. In everyday terms, it's a bit like standing on a shallow beach near the water's edge. As the waves lap on the beach, they come near your feet but you don't get wet. However, if a boat goes by, then the wake causes bigger waves and your feet get wet. The wake of the boat is like light entering the camera and your feet on the beach are like the camera sensor. Your feet stay dry until the boat's wake comes along. Similarly, a camera sensor stays “dark” until light comes along.

So far, so good. However, we all know that if we stand too close to the water's edge then sooner or later a freak wave will reach our feet. If we face away from the shore, we wouldn't know if our feet got wet because of a boat going by or just by a random freak wave. In the same way, a pixel in a camera sensor can be “lit” either by a real ray of light or by a random electronic freak. The effect of real light is known as the signal received by the pixel and the random freaks are known as noise.

To get a good photograph, we need lots of signal and very little noise. The ratio of signal to noise, or of real events to freak events, is called the “signal to noise” ratio. A high signal to noise ratio indicates a high picture quality. The noise is most noticeable in under-exposed parts of the image.

The best way to achieve a high signal to noise ratio is to take pictures in bright sunlight, or strong flash or studio lighting. What if we don't have bright light? Sometimes, we can increase the amount of light with a reflector or fill-in flash. If this is not possible, then we may be able to increase the aperture of the lens, to allow more light through.

What can we do to reduce the noise? Noise accumulates over the time that the shutter is open. So, a short exposure time favours low noise. We can achieve shorter exposure time by increasing the sensitivity of the sensor, i.e. the ISO setting. Unfortunately, increasing the ISO setting also increases the noise level because random freak electronic events are more frequent. It's a bit like standing closer to the edge of the water – we can detect a smaller wake but our feet will get wet accidentally more often. All cameras will be more noisy at high ISO but the point at which this becomes objectionable will vary between camera models.

In summary, for low noise use a low ISO and a short exposure time. But make sure the image is not under-exposed. Slightly over-exposed images work better in digital cameras.

Computer programs have noise filters that can be effective but, generally, they reduce the detail in the image at the same time as reducing the noise. Significant noise reduction without image degradation can be achieved by taking multiple identical exposures and averaging them in the computer. The average of four such exposures will have half the noise of any one such exposure; the average of 16 will have one quarter the noise and so on. Combining images with different exposures (HDR) can also effectively reduce noise in a high contrast image, without loss of detail.

If you are thinking about a new camera, the noise level is one of the most critical factors to look out for if you want to take more than midday snapshots.