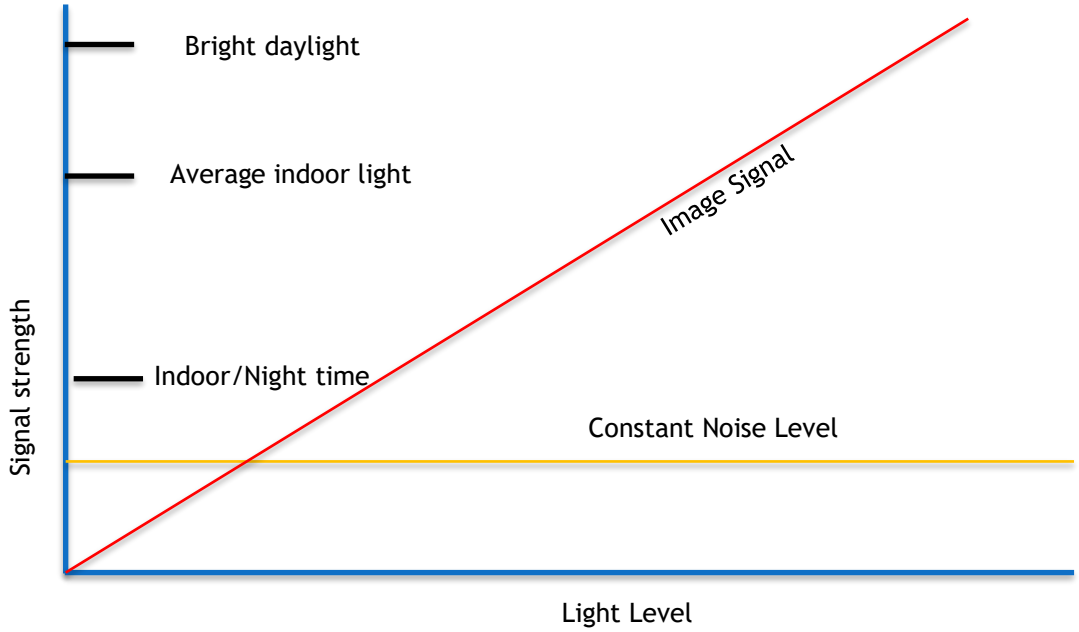
Graham's Photoblog Newsletter

For Week Ending 30th January 2021

ISO and Image Noise

Anyone who has owned a digital camera for a while will be familiar with the concept of image noise.
It's that grainy look that spoils pictures in low light conditions with high ISO settings.
But what is image noise, where does it come from and what can be done to prevent it?
All electronic devices generate noise. This noise comes from a variety of sources.
Some of it is generated by the imperfections of the electronic components, or as a by-product of their normal operation.
For instance, capacitors generate a small amount of noise as they charge and discharge.
Electronic components can also be affected by environmental noise, such as the electromagnetic fields that constantly surround us such as wireless radio frequency sources.
Electronic circuit noise can be minimised by superior manufacturing and by rigorous quality control. Unfortunately some cheaper brands, or even budget models from better known brands, may use components of low quality which is why these types of camera generally produce noisier images than the more expensive models.
The main source of image noise in a camera is the sensor itself and in most cases this is unavoidable.
The individual pixels on a digital camera sensor are incredibly small , especially with high resolution compact camera sensors. Most compact camera sensors have over 16 million individual photocells crammed into area less than 30 square millimetres .
These pixels are so small that in low light conditions they may only be collecting a few thousand photons (individual light "particles") during an exposure, so the level of electrical signal produced by the pixel can be affected by random statistical fluctuations in this photon density .
This is the main reason that physically larger sensors are much better than smaller ones.
The individual pixels are larger and collect proportionately more light (photons) during the exposure producing an inherently higher signal to noise ratio.
The level of noise produced by the sensor, and other components in the camera, is usually constant and at a fairly low level. When taking photographs in good light the level of signal vastly outweighs the level of noise, in other words the signal to noise ratio is very high, and consequently noise isn't a problem.

The problems start when shooting in low light, as the level of signal drops near to the constant noise level, producing a lower signal to noise ratio. At extremely low light levels the signal may be entirely drowned out by the noise. This problem is made worse when shooting at higher ISO settings.
When we set a higher sensitivity we are increasing the amount by which the signals from the sensor are amplified, and unfortunately the noise gets amplified as well.



If the signal to noise ratio is already very low then this just produces most noise without improving the image. This is why high ISO images are always more noisy than ones taken at lower settings.
Another type of sensor noise can also be a problem when using exposures longer than a couple of seconds.
Sometimes the pixels that make up the sensor may not all respond to light to an equal degree, causing single pixels to appear very bright or very dark. The charge build-up over a longer exposure makes this problem more noticeable.
Since the position of these “dead” or “hot pixels” is fairly constant from one frame to the next this noise is remedied by applying a filter during the image processing. Most modern cameras do this automatically, but it can be a problem on older models.
Panasonic cameras use this “dark frame” subtraction process for image exposures longer than one second.
It can be a significant problem if you exposure runs into many seconds as you cannot begin the next exposure until this “dark frame” time elapses. Some cameras allow you to turn off this function, however you will end up with an image containing these lighter, or darker, pixels exacerbating the image noise.
Cameras reduce image noise by smoothing filters applied during JPEG image processing.
The most common use is a median filter. This works by comparing each pixel to the one surrounding it, and if it has a brightness that is different from its neighbours then it is replaced by a new pixel with the average value of the nearby pixels. This eliminates the noise effects but it also reduces detail and contrast.
Some cameras allow you to change the amount of image noise reduction in the photo styles setting of the camera. By reducing this image noise reduction to minus two or minus five (depending upon camera) then you will effectively turn off this image processing option and may improve the reproduction of finer detail but at the expense of a little more image noise.
In some cameras a another type of noise reduction is employed and they call this pixel binning.
Although this is less widely used in more recent digital cameras. In this process the signals from groups of four 9 or even 16 adjacent pixels are grouped together into what's called a “super pixel”.
This has the effect of increasing that signal to noise ratio, but of course it also reduces the effective resolution of the image.
It increases the signal to noise ratio however it reduces the quality of the image.

DSLR's and full-frame mirrorless cameras have a major advantage in this area, since they have physically larger sensors.
Compact sensor and mobile phone technology continues to improve both in image processing and in sensor design. We will undoubtedly see further advances in the future, but for now image processing is something we have to accept.

Take a look at the enlarged image above. It was captured with the Panasonic Lumix FZ 1000 mark II with an ISO setting of 3200. It had the noise reduction in the photo style set to -5. There is a lot of detail in the image however there is also a level of noise seen in the image. There is a technique that can be applied when capturing images like this to reduce the amount of noise in these images. It can really only be applied to still images weather is no movement in the frame otherwise these would appear as ghosts in the final image. The process is to use what is called a median filter applied to a set of images captured at the same time. This is normally achieved by using the burst mode with the camera set up on a tripod or, if held used with a shutter speed that prevent camera shake. There are two programmes that I have found that can employ this technique but I'm sure the others. One is a Photoshop CC and the other is Affinity Photo.

The resulting image when processes using the stack & median filter method in Photoshop

The same image processed in Affinty Photo

When using Photoshop it is necessary to import the images and then create a stack with the option to automatically align the images and then using the stack option with it set to median .

With Affinity Photo, not only is this a cheaper program (once off payment versus month subscription) but it also much easier as you only need to import the files as a new stack and the median filter is automatically applied for you. I created two tutorials on YouTube if you are interested in trying out these methods.

link to Affinity focus tutorial link to Photoshop CC tutorial

How to extract still images from your video files

I was asked by a subscriber how to extract a still frame from a video clip which had been shot some time ago. If the file is on your SD card then you can do this in-camera or use the Photofunstudio software for Panasonic cameras. If your video clips are stored on your hard drive then it may be necessary to use a video editor to enable you to extract a still frame. If you just need a fairly decent image for social media etc then the simplest method is to use a video player, pause the clip at the point that you want the image to be captured from and then use a screen capture program sized to the window of your video player.

I use the Quicktime player quite a lot for my screenshots used in these newsletters etc. If you need higher resolution images then the capture from your video editor is probably the way to go.

On a “mac” computer iMovie is the default video editor program and this can be used to capture a still frame from the video clip at either the video clip resolution, 720,1080 or 4K resolution or you can “upscale” the lower resolutions to 4K if you need a higher (8M) resolution file.

The heron image above was captured from a 4K video clip using iMovie and an enlarged view below.

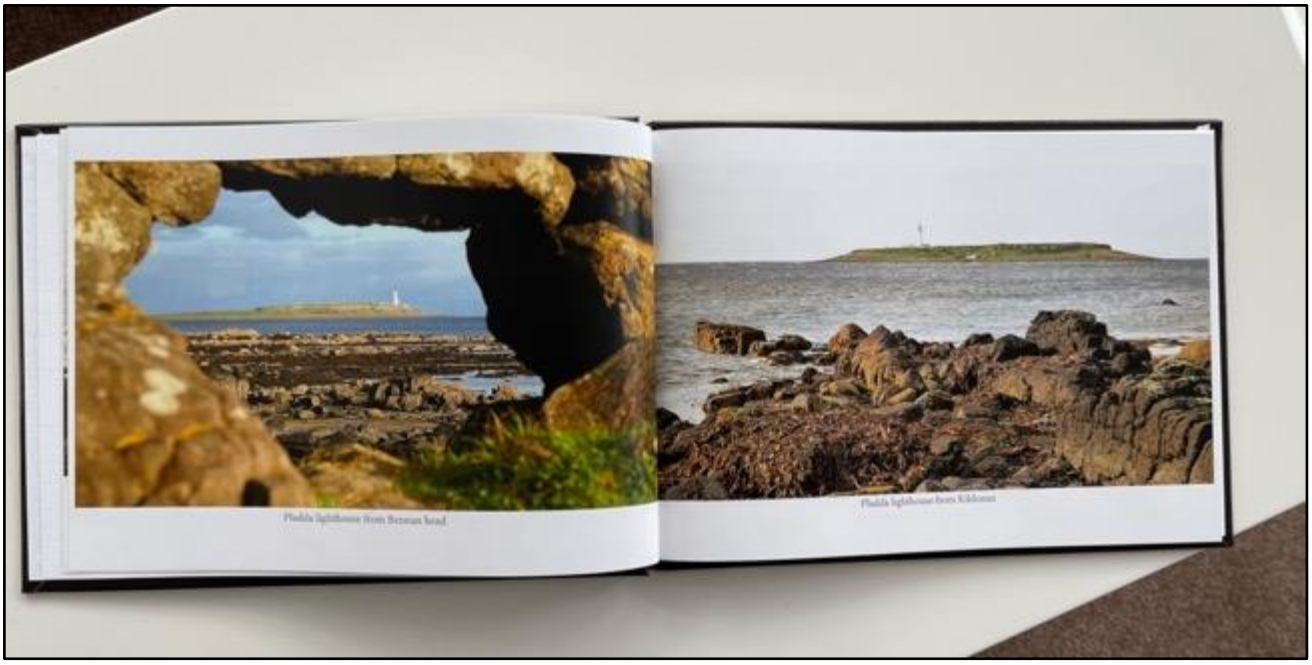
This image was extracted from 1080p video and the one below was extracted with the time line at 4K

an enlarged view of the upscaled 4K image

The image from the 1080p timeline is 1920x1080 pixels and the one extracted from the timeline, set as a 4K project, is 3840 x 2160 pixels. As you can see from the third image it allows more enlargement without much loss of quality. The images can be adjusted in the video editor or afterwards in a image editing program if you want to make any adjustments to brightness/contrast/saturation/sharpness etc.

This image was extracted using iMovie from a 4K video file which allowed me to choose the exact time that the waves broke on the rocks. If you know that your video is going to be used for stills extraction the it is important to set an appropriate shutter speed when capturing the video. Normally would use the 180 degrees shutter rule, which sets a shutter speed equal to twice the frame rate of the video. This gives a natural and fluid looking motion, however for extraction of stills from a video file this would lead to subject motion blur so it's important to use a shutter speed which is much higher to arrest the motion.

Using this technique extraction from my drone aerial shots allows different perspective shots



I've also been able to extract images from video clips and used the images included in some of the hard backed photobooks that I have had printed at A4 page size.

Do I consider this "cheating"? Absolutely not! There is as much skill needed in composing and capturing video files as there is still images. Video does allow you to select a precise moment in time – something that even burst mode shooting does not allow.

Even images from 4K smartphone video is perfectly acceptable – iPhone 12 Pro Max image extracted above. I created an instructional video using iMovie as it does have a few "quirks" if you want to upscale video etc.

How to extract images from video clips with iMovie

How to use a “light tent” for capturing shiny objects

Quite a few years ago I bought a very cheap “pop-up” light tent similar to the image below

The backdrop sheets are made from a material that creases easily. Even after resorting to ironing the backdrops, they still have serious folds in them which clearly show up on pictures.

The velcro fasteners are misaligned and poorly stitched. When I tried to attach a backdrop, it quickly became obvious that the velcro fasteners on the backdrops didn't line up with their counterparts on the tent.

They are about 1" off, meaning you can only attach the backdrops by about 10% of each fastener and they frequently detach. They are also completely misaligned on the door sheet.

It was a total disaster and it ended up stored in a cupboard – almost forgotten.

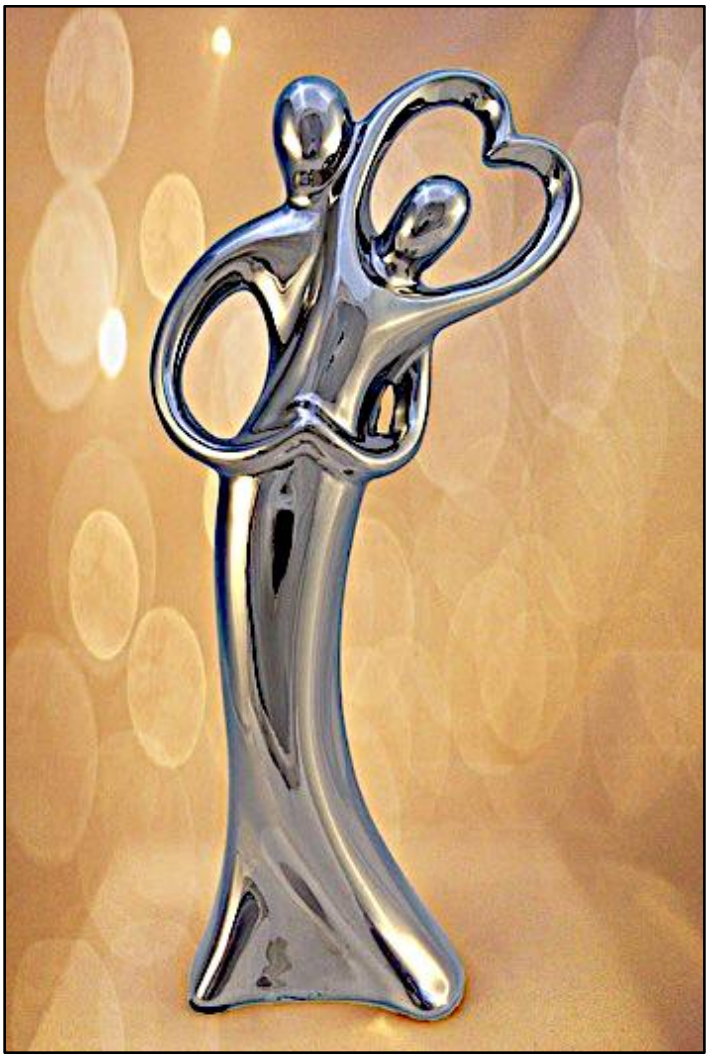
With the current wave of restrictions placed upon us for travel etc., I decided that I would challenge myself in taking some indoor photo shots of a very shiny metallic statuette. To do this I realised I would need to use a light tent as the highly reflective surface would reflect everything in my room including the studio lights, the tripod, the camera, and even me behind it. So I set about trying to capture the image with as little equipment as possible so as to show you just what can be achieved. I used two small table lamps from IKEA fitted with five Watt LED bulbs as the main light sources. In then placed I placed the statuette in the light tent, after first thoroughly cleaning it to remove any fingerprints. I positioned the light sources on either side to create flat lighting but later readjusted them to reveal the outline of the figurine to be shown with a little more detail. I use the FZ200 for this as I find the FZ200 an ideal camera for close up work.

The set up that I used in the “studio”

I had to adjust the height of the statuette in the tent to allow the camera to capture the image without distortion as the camera needed to be parallel with the subject to prevent this.

Looking at the images there was a small black area of the image which was the reflection of the camera in the bright metallic surface however there's no way to overcome this apart from retouching this in your final image editing programme.

As there Is a vast expanse of white in the image it's important to use positive exposure value compensation to prevent the image from being under exposed.



The image out of the "light tent" and then superimposed on a suitable backdrop to add some interest.

I then went on to try and photograph one of my model sports cars which is in a black livery.

I have had difficulties in photographing these models in the past as trying to get an even illumination yet reveal the contours is quite difficult. In this setup I used the light tent again but to form the contour lighting I used a photographic "light wand" to allow me to position the light contours on the model just where I needed them.

Again, even with the black paint of the model is was necessary to use positive exposure value compensation.

Using the "light wand" to be able to add the accent lighting that I wanted on the cars contours.

The model sports car after adding the accent light along the body contour with the light wand.

Given perhaps a larger tent (maybe 32 inch by 32 inch) and some LED light panels the effects could be quite effective using this technique if you have lots of articles that you want to capture for say insurance purposes, sale of auction sites or just capturing some better images where reflections on the subject may detract from the desired effect. Again I have produced a YouTube tutorial for those who may be interested.

Using a light tent to photograph shiny objects

Snow in North, again.

Last week we had another snow storm. In recent years, 5 to be exact, we have had little snow during the whole of the winter months. I know this for a fact because I bought my Suzuki S-Cross 4 wheel drive car after we had a bad winter and my previous car the Suzuki Swift Sport was a nightmare to drive in snowy conditions. I changed to the Honda Civic Sport 5 door fifteen months ago and, thanks to our lockdown, have not had to drive anywhere in it with snow on the road. Anyway last week we had a very cold night followed by a light snowfall just around dawn. I braved the elements and walked to a local woodland for my permitted "exercise" – I just happened to have my Canon 5D mk IV with me!

Monitoring Recorded Audio on Panasonic Lumix Cameras

Recording good audio is critical when shooting video. With the top end cameras like the FZ2000/2500 G9 etc you have a headphone port which allows you to check the sound levels are right and that there are no obvious outside noises which would be a distraction. But what if you camera doesn't have a monitoring port?

Well this article is for you. I will explain some of the ways that you can verify the audio quality before it goes into the mic input port of your camera. It doesn't give you 100% assurance that the camera will not have a perfect audio track (there could be mic plug connection issues, camera pre-amp induced noise etc.,) but does give you the addition of a backup audio rack if you use a separate audio recorder or your smartphone.

Lets' look at some of these options.

Let's start with my top recommendation.

Using an external audio recorder (Zoom models are good) which has the option to input an external mic and have an earphone/headphone port that you can monitor the recording.

Not only does this give you a mic pre-amp that is arguably better than the in-camera one but also gives you the option to also record the audio with the recorder. In the event that the camera audio levels were wrong or you had a bad connection this track can replace the audio track in your video if you synchronise it to the original track and then delete the original track.

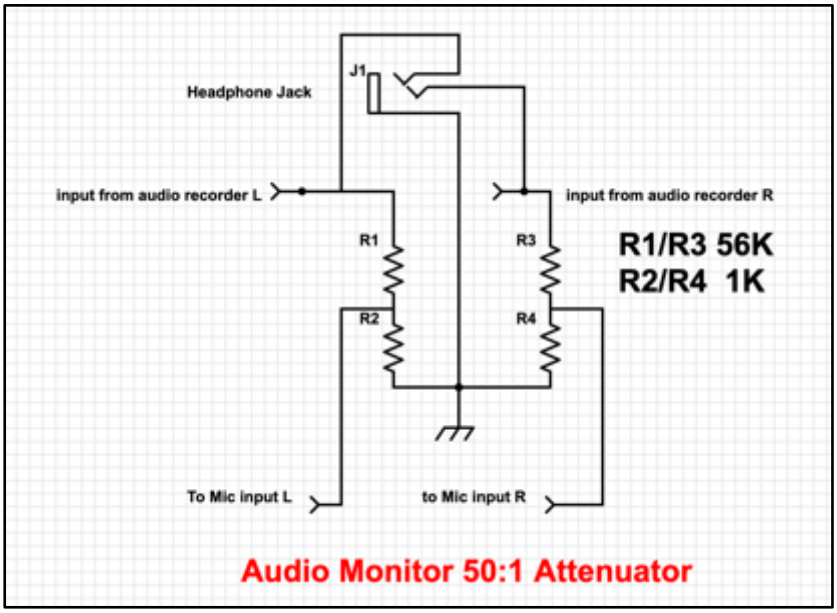
(Note) Some of the recorders don't have an option for applying mic bias power for electret condenser mics and you may have to use self-powered mics. The Tascam DR-40 doesn't have this option (that I have found anyway) and I use either a XLR mic or a self-powered electret condenser mic when using this device.

My Olympus model (LS-12) is basically a dictation machine however it does have the option for mic bias power but cannot be used with XLR balanced mic systems.

So if you use this system either just to monitor the audio or provide a redundancy audio track as well there are a few things that you need to consider. I have seen people use this idea on YouTube and use a headphone splitter cable on the earphone output. One lead goes to the headphone and the other is taken to the camera mic input. Whilst it can be argued that this works the level of distortion will be very high. The headphones typically require about 500mV to provide enough drive for comfortable listening levels. This same voltage would also be present at the mic input port. This is where the problem lies - the mic input level needs to be around 5mV for 0dB level. Thus we are overloading the input by a factor of 100. Adjusting the input gain to the lowest value doesn't reduce this to a safe level.

You need an external passive mic attenuator or a passive mic mixer to be able to drop this to the correct level.

In the illustration above you can see the setup using a passive mic mixer to be able to reduce the 500mV to 5mV. The camera is set to manual record levels and adjusted to give the correct level with the audio record level set to the right level and the headphone volume set to give comfortable listening levels. Instead of using the mic mixer (which typically would only be using one channel anyway) I designed a small unit which provides the right level of attenuation for the mic input signal and allowed the full 500mV to be used by the headphones. The unit is shown in use below.



The schematic for the 50:1 passive attenuator allowing the full headphone volume and the 5mV mic level audio signal.

Another option is to use a dedicated mixer/monitor.

Saramonic manufacture the SmartRig+ unit which does not need a smartphone/app to monitor the audio.

It has its own headphone amplifier/port which you could use the mixer or attenuator to provide a feed to the camera mic input.

The smartrig+ unit provides for two input sources either via XLT, 6.6mm(1/4) jack or 3.5mm (1/8). The two inputs can be mixed to a single 3.5mm TRRS connection as a stereo signal or can be output as a monaural signal on both the L + R channels.

Again the output can be recorded directly on a smartphone or audio recorder using a TRRS/TRS adaptor. Additionally by using the attenuator box a direct feed can be taken to the camera.

A note here about in-line attenuators: There are a number of these available on Amazon which provide either -25dB or -35dB attenuation from line to mic level. Some also provide the headphone output as well.

These are ready to go units but the cost is around £25. The 35dB is probably too much attenuation for Panasonic cameras in the USA https://amzn.to/3iw9IYV in the UK https://amzn.to/3bZXdU0

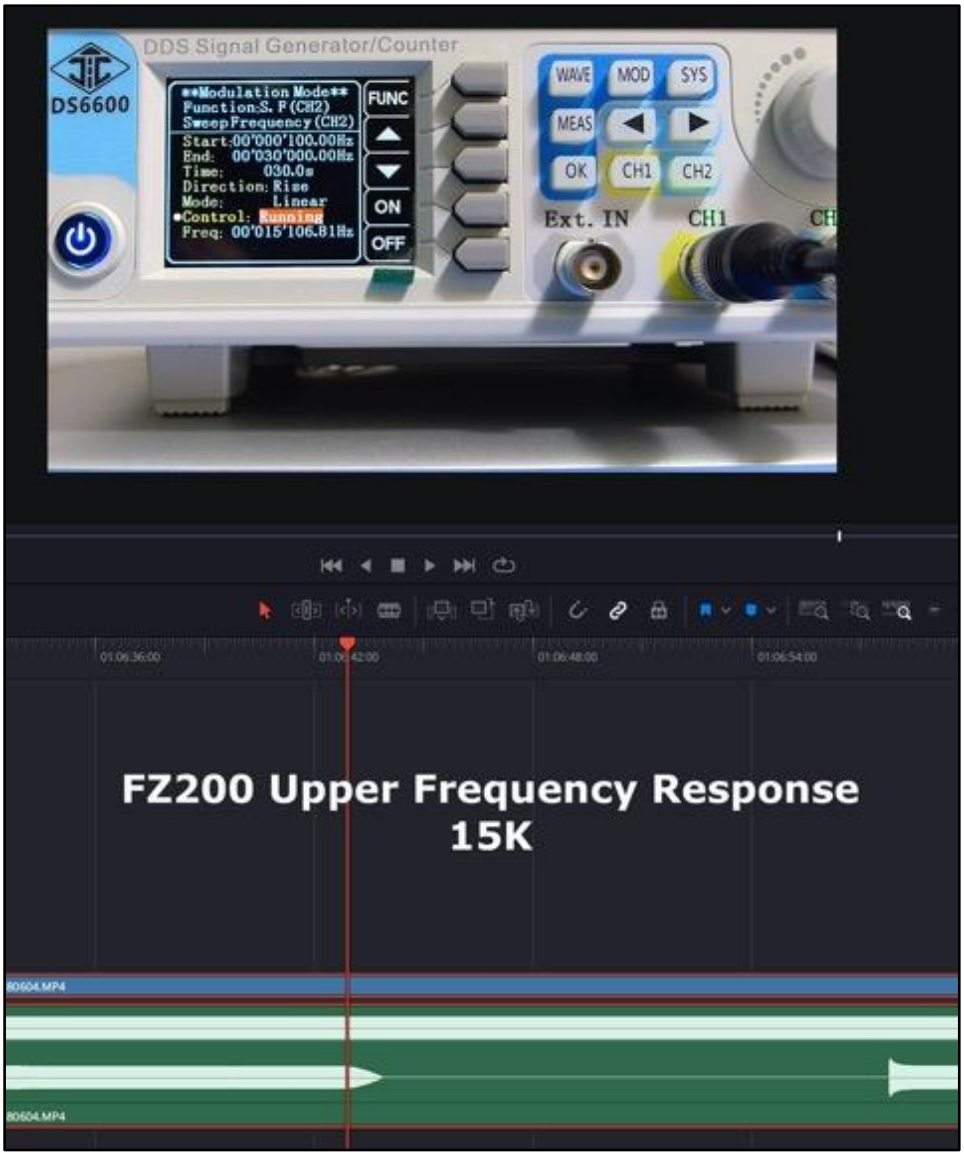
The next option is looking at wireless transmission systems that include a headphone monitoring port on the receiver. Such a device is the Pixel Vocal air system

This 2.4GHz wireless system supports a transmitter which has a built in mic or you can use non-powered/powered electret condenser mics as well. The receiver has a 3.5mm (1/8) headphone port where you can monitor the signal being passed through to the camera mic input socket.

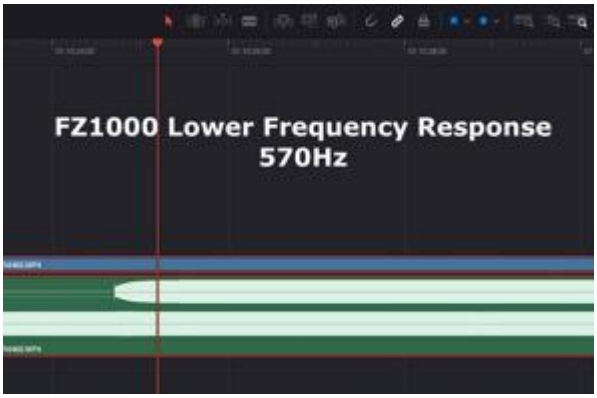
There are a few more options that are available and if this interests you there are more details and examples in my Photo Blog Photoblog article on Audio Monitoring

Panasonic Bridge Camera Audio Frequency Response

As part of my development work in producing a low noise microphone pre-amp for use with my bridge cameras I needed to know just how good the audio circuit was in these cameras. By using an audio signal generator with a sweep pattern from 100Hz to 30KHz and recording the video of the signal generator output I was able to record the response that the camera had across this range. Good audio is often cited as 20Hz to 20KHz with 3dB loss – that is when the signal drops to half of its original value.



In this illustration above from the video you can see that at 15Khz to signal drops off to nothing.



At the low frequency end the FZ1000 only begins to record audio at just below 100Hz and only reaches correct levels at 570Hz – not a particularly good result as it looses a lot of bass response.

From this result it really dictates that if you want the best fidelity in your audio recordings then you must use an external audio recorder which has a better lower frequency response!

Smartphone Photography for illustrations

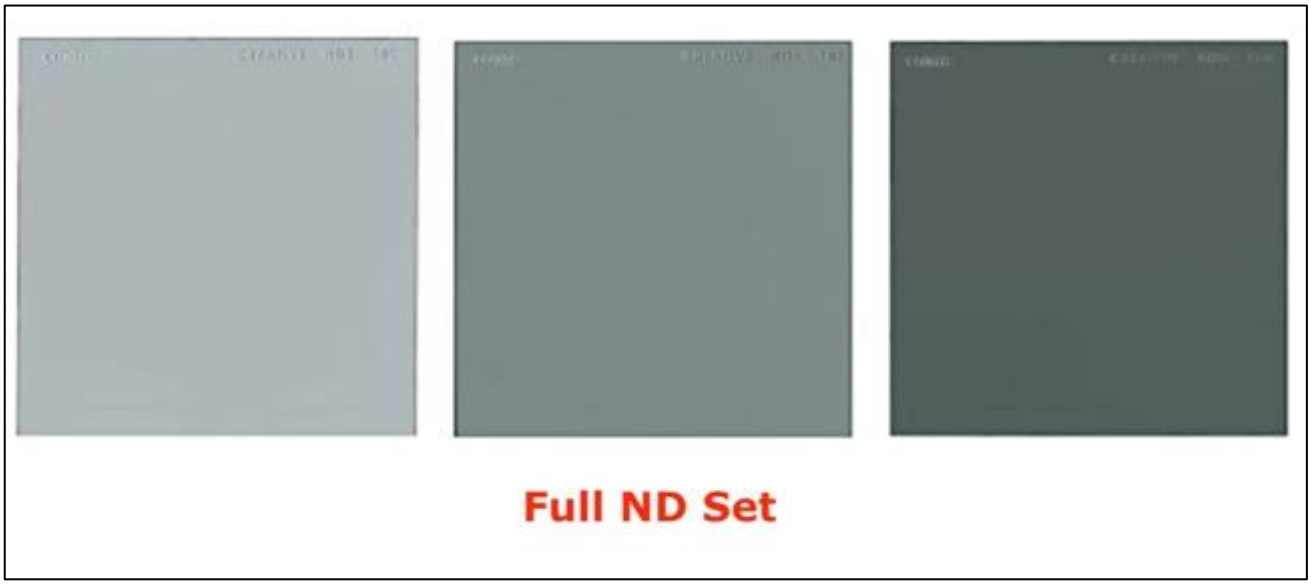
The iPhone 12 Pro Max

An example of the image quality now being able to captured with these cameras.

Just the overhead concealed lights plus a window to the right was used to illuminate the scene.

Hand held using the x2 lens.

Neutral Density Filters



So what are Graduated Neutral Density (ND) Filters?

Essentially they rectangular or square, optically perfect pieces of resin or glass with a gradient from dark to light. They are called “neutral” because the dark part of the filter should not make any colour differences, or add a colour cast to the scene being photographed.

Resin filters are normally dyed using a dipping technique. They main disadvantage is that they are relatively easy to scratch however they give you a very cost effective route into long exposure or landscape photography. Once you get a feel for the filter that you use most it may be worth purchasing a glass filter.

This is not always true of cheaper filters, but the well-established filter brands leave very little colour cast on the final image.

The reason behind using a graduated ND filter is to hold light back so that the part of the scene that is brightest (usually the sky) does not overexpose. The sky is well exposed and the foreground is correctly exposed as well.

If you were to expose the scene without using an ND grad filter, very often, the foreground would be well exposed while the sky may simply be overexposed or, if you were to expose for the sky, the foreground would be very dark.

ND graduated filters have a few variables. The first is whether the filter has a hard or soft division. There is a reason for this and both types are useful.

The hard edge filter has a very definite transition between the dark gradient part of the filter and the part that is clear. The soft edge filter gently blends the gradient across the filter, so the line is less obvious. Each one of these filters are used on different scenes.

For example, the hard edge filter is really useful if you have a very definite horizon line (i.e. a seascape or a landscape scene where the horizon is pretty flat and straight). The soft graduated filter is used for scenes where there is no clear horizon (i.e. a forest, mountain or street scene).

Learning when to use which type of filter takes some practice, but once you can visualise what the result will look like, it is pretty easy.

The filters are made in different strengths to allow for different lighting conditions. Depending on the dynamic range (the difference between highlights and shadows) in your scene you can choose an Graduated ND grad filter that will be darker or lighter.

Darker filters hold back more light and lighter filters, hold back less light.

ND Grads are made in the following strengths

0.3ND or 1 F-stop of light, often called ND2

0.45ND or 1.5 F-stops,

0.6ND or 2 F-stops, Often called ND4

0.75ND or 2.5 F-stops,

0.9ND or 3 F-stops. Often called ND8

The important calculation to remember is to try and keep your sky and your foreground within one stop of one another. Also, ND grads can be stacked if the light is really bright, so you can make the sky even darker, depending on the effect you want.

Landscape photographers use both Full and Graduated neutral density filters for creative control over shutter speed. They can be used singularly or combined to achieve the desired effect.

Think about the exposure settings landscape photographers tend to use. You normally set ISO to the lowest setting and the aperture to F/11 or F/16 on a full frame camera F8 on a mirrorless and F5.6 on a Bridge camera. This gives you maximum image quality (low ISO) and good depth-of-field (narrow aperture).

The shutter speed required to give the correct exposure will depend on the ambient light levels. In bright light, it might be around 1/125th of a second. In the fading light at the end of the day or in subdued shade, it might be around 1/2 second.

But what if you want a longer shutter speed? This is where neutral density filters come in. They attenuate the light so that you can get longer shutter speeds. Longer exposures allow moving parts of the landscape (like clouds or water) to blur, which in turn creates mood and atmosphere.

The ultimate example of this is long exposure photography, where exposures of several minutes are used to blur the motion of the sea and clouds. This often requires the strongest of Full ND filters like the 3.0ND or 10 F-stops filter to be used.

Using these filters requires modifying your shooting technique as with this level of light attenuation you will see nothing on the LCD screen.

It’s best to frame your composition with the camera on a tripod set the focus and the aperture and shutter speed to manual setting.

Once you have established the correct exposure and focus screw on, or slide in your ND filter into its mount. Now you can adjust the exposure by the F-stop rating of the filter. Do this by adjusting your shutter speed. Don't adjust aperture, ISO or focus. Typically you will be working with the ND2, ND4 or ND8 filters so changing the shutter speed can be done in your head or by simply changing the shutter speed dial by 1, 2 or 3 F-stops slower.

Finally it is worth mentioning that these glass based filters can be quite expensive and it would be advisable to consider which lenses that you are going to use these on. Go for the biggest lens diameter that you have and use step up rings for the smaller lens diameters.

Long Exposure Effect without ND Filters

We have seen the use of ND filters to allow longer shutter speeds for creating silky smooth water, streaking clouds etc. If you haven't got a ND8 or ND200 filter with you to create long exposures there is a technique that I can share with you which allows you to create this effect from a series of still images using another "stacking" operation – this time using the "mean" value.

For this example I took a small 1080p video clip and extracted 8 images about 4 frames apart and then loaded them into Photoshop (you could use Affinity Photo) as a stack and then used the mean value of the stack to create the final image. (enlarged section

By using a greater number of frames the effect will be accentuated

The full frame image of the mean stacked images showing the smoothing effect on the waves.

FZ70/72/80/82 Image quality considerations

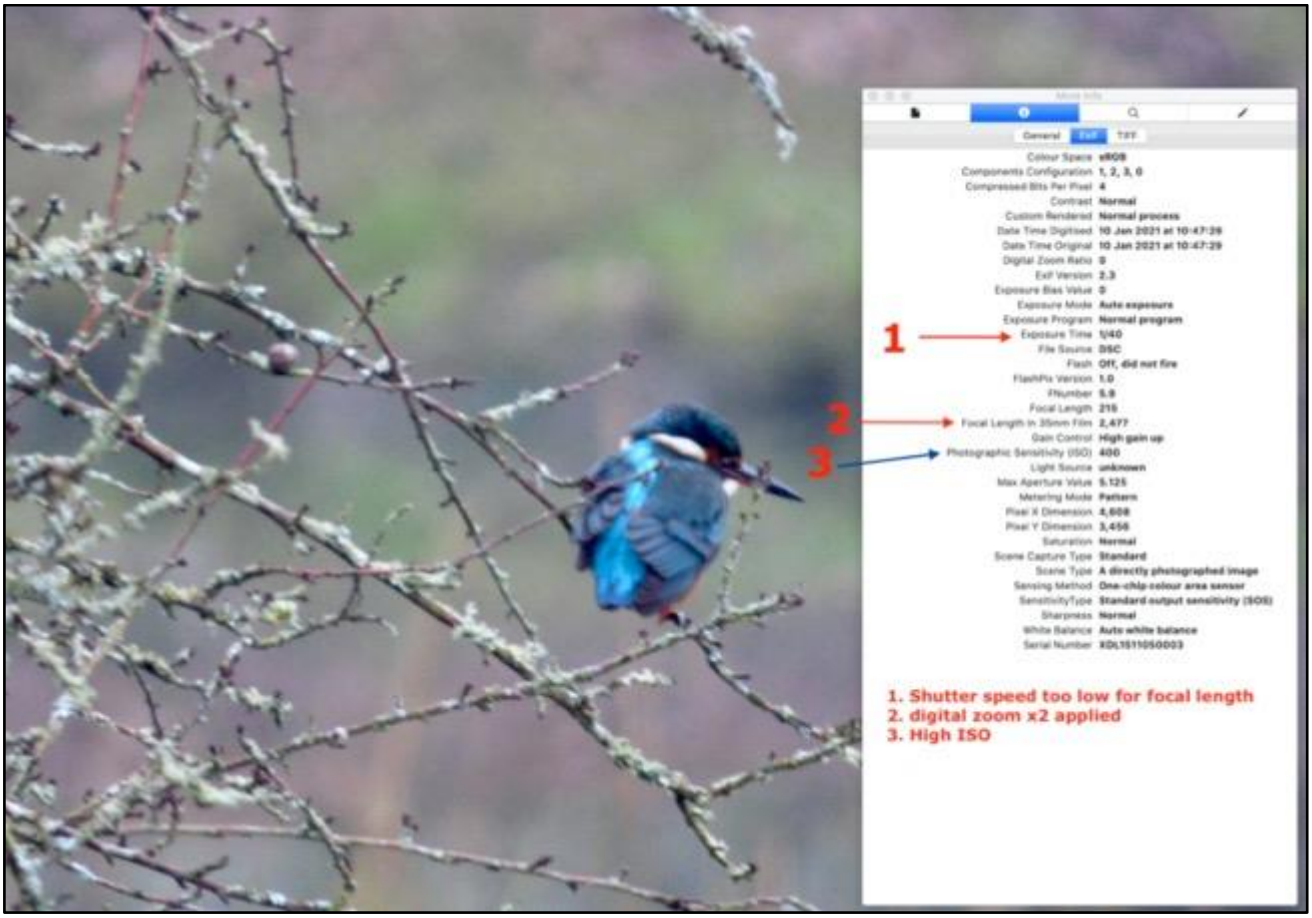
I was contacted by one of my subscribers through my Facebook page wanting some help with trying to get images that were of better quality than he was experiencing from the camera.

I asked him to send me the camera images so that I could examine the EXIF data as Facebook strips this from uploaded images.

I have his permission to show the images and my recommendations.

The images above were the two that he sent me from the original submissions.

Let's look at the kingfisher image EXIF



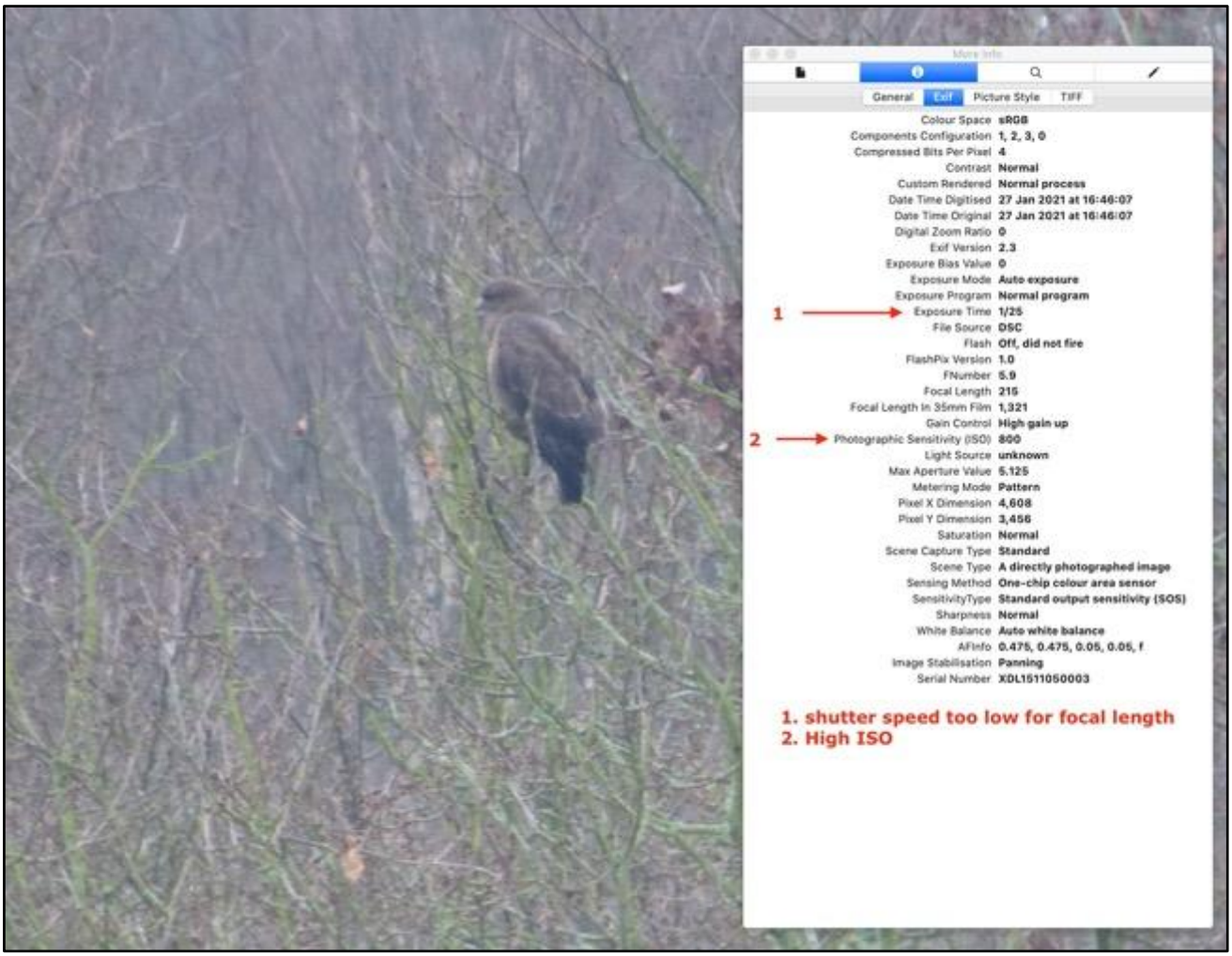
Firstly the image was captured using the iA mode. In this mode the maximum zoom is increased to a staggering 2400mm EFL. However this is achieved by using digital zoom and so this increases image noise and increases image softness by amplifying the lens poor resolving power at full optical zoom.

Apart from this the reduced aperture of F5.9 drives the camera to use a low shutter speed of 1/40sec and raises the ISO to 400.

Generally when hand holding these long focal lengths the rule is to use the reciprocal of the focal length to get the minimum shutter speed and then subtract 3 F-stops for the optical image stabilizer.

So with this image we should use at least 1/2000 sec exposure less 3 F-stops resulting in a lowest shutter speed of 1/250 sec. Of course this does not account for subject motion. If the subject is moving forget the image stabilizer adjustment.

The image looks to be in focus which is also surprising as there are many twigs between the camera and the kingfisher which usually throw the focus system.



For the hawk? The main cause of the poor image is the 1/25sec exposure combined with the very high ISO value of 800. There appears to be a little atmospheric mist as well.

Sadly this is an all too common problem with these bridge cameras that don't have the advantage of a constant F2.8 aperture lens. The maximum aperture is F5.9 at the longest focal length and this necessitates moderate bright/sunshine in order to get the ISO lower and raise the shutter speed. The use of a monopod or tripod will allow slower shutter speeds and as these birds tend to stay quite still and if the ISO is still above 200 it may be worth using the burst mode and attempting to use the median image stack that I have previously outlined in this newsletter.

I get really angry as many users of this type of extra-long zoom cameras are not aware of the limitations imposed by the design of the camera.

Panasonic do nothing to make this apparent (and why would they as they would lose sales) and new users quickly become disillusioned with the cameras as they lack the necessary knowledge to understand how to fix the issues.

These cameras ARE capable of good images if you follow my recommendations.

A comparison of direct out of camera images from the FZ82 at the 20mm wide angle to the full optical zoom of 1320mm in the 16:9 aspect ratio. The lamp is at the centre of the doorway entrance to the hall!

Creating a long time exposure look

We have seen how ND filters can be used to create longer exposures however what if you don't have one to hand? In this technique I will show you how to create a long time exposure look using a series of burst mode images and grouped as a stack object and then apply a MEAN Filter to that stack.

You can use Photoshop CC or Affinity Photo to perform this task.

Just shoot a burst mode sequence and open these as a stack image and apply the **MEAN** filter to the stack

You could shoot a video clip and extract the images from that video if you prefer.

I created a tutorial video using both Affinity Photo and Photoshop to explain how to do this.

how to tutorial.

That's it for this month's newsletter.

I'll hopefully post the next one early March.

Graham