The Camera sensor used in Mavic Pro

Mavic Pro uses a new SONY sensor, the IMX377, using the same foundation as its predecessor, IMX117, the sensor used in Phantom 4. Figure 1 shows the comparison of dynamic range, color sensitivity and 18% SNR measure by DXO Analyzer.

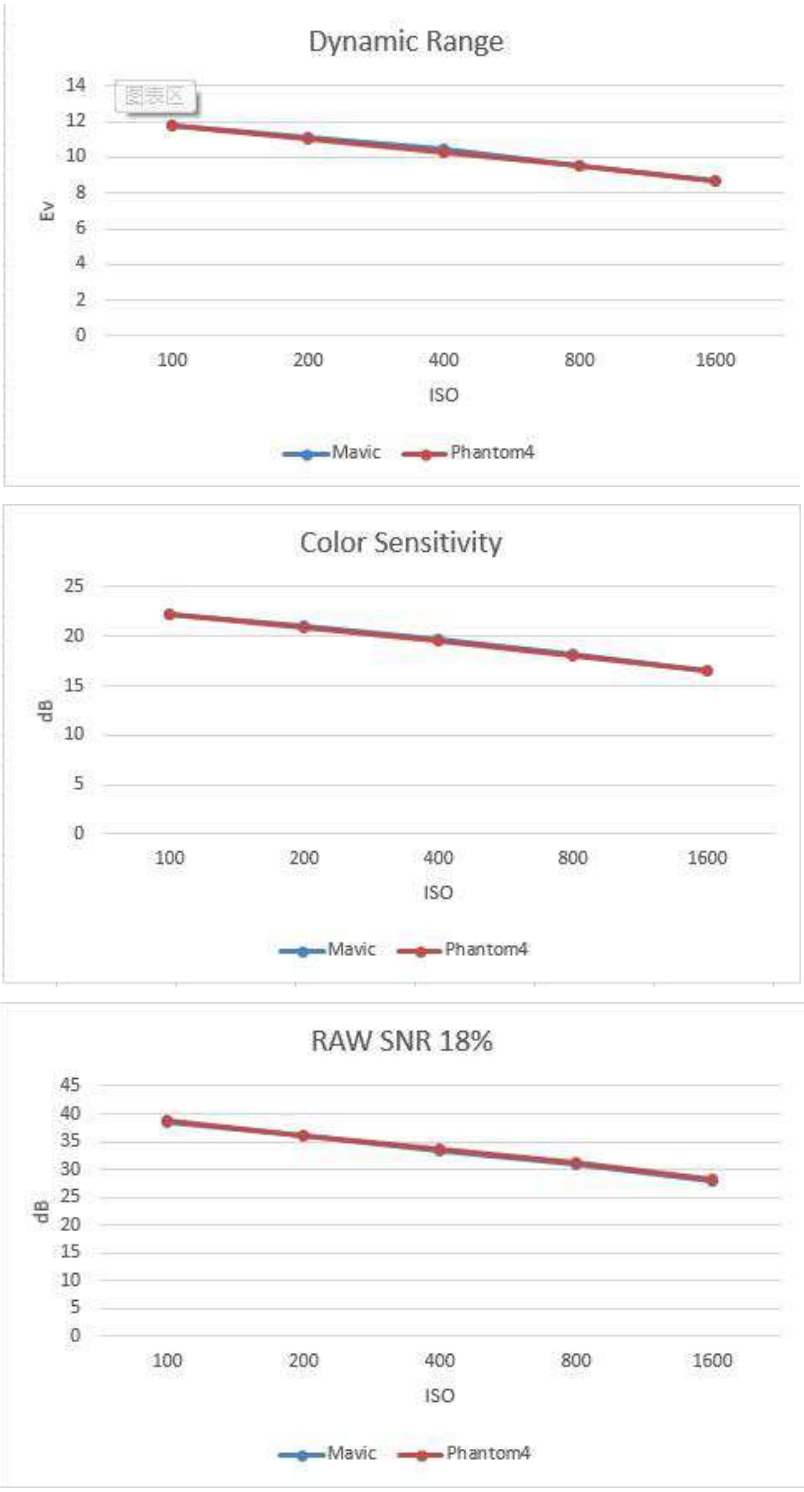

Figure 1 Comparisons of the dynamic range, color sensitivity and SNR 18% of Mavic Pro and Phantom 4

However, the 1080p60/96 modes are known to have saw tooth shaped edges and moiré pattern, which are both the effect of signal aliasing. The reason is that IMX377 cannot output full pixels and need to work under the binning mode in the high frame rate more than 60fps. Although the sensor tries its best to correct the aliasing by the equation illustrated in Figure 2, the aliasing still happens. Based on the Nyquist sampling law, the aliasing happens when the frequency of the signal passing through the lens is nearly twice higher than the maximum sampling frequency of the sensor. Unfortunately, the signal acquired by the sensor has already been corrupted and are unable to save.

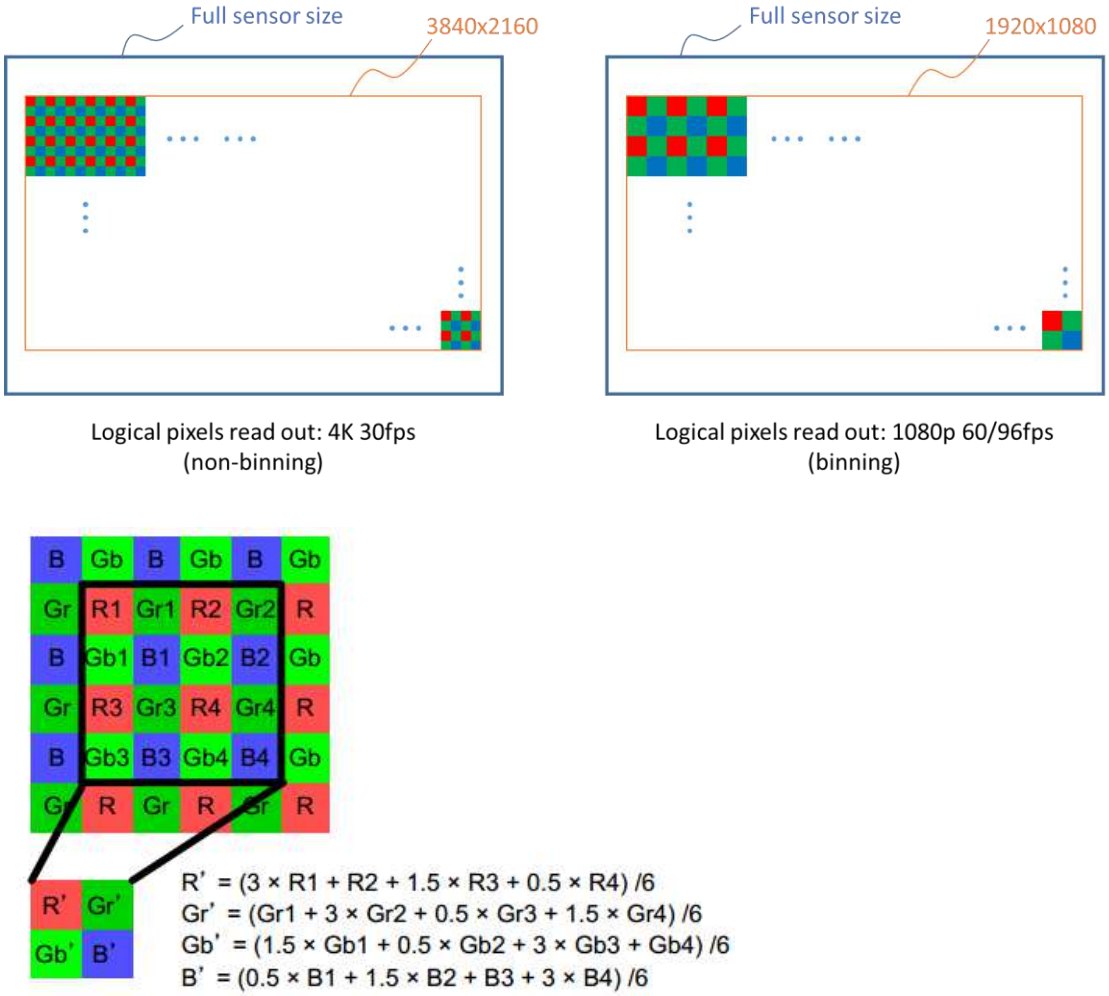

Figure 2 Sensor read out schemes for normal frame rate (4K 30fps) and high frame rate (1080p 60/96fps), showing the binning technique does not change the physical size of the area read out, thus keeping the field of view. Only the pixels at the two corners of the active region are shown.

This effect can be demonstrated using the following analogy. Although there are many details to address, the main concept is the same. Consider a sharp optical image on the sensor produced by a high-quality lens (Figure 3, left). When sampled in binning mode, the zigzag appears as a result of larger logical pixels (Figure 3, right).

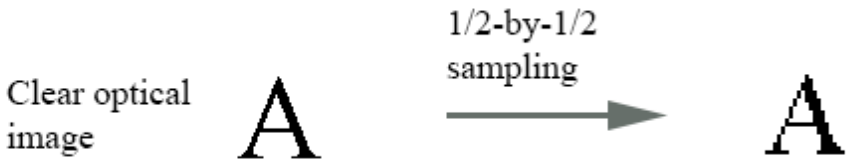

Figure 3 Simulation of binning causing aliasing. (Note: for best quality, view at 100% ratio.)

Some customers who own the Phantom 4 do not see such an artificial phenomenon because the IMX117 can output 4KP60. The processor, therefore, downscale the frame from 4K to 1080p using an anti-aliasing filter, which is superior to the internal combination of the sensor

What is the purpose of 1080P60 and 1080P96?

Basically, the main purpose to support the modes of 1080p60 and 1080p96 is for the low-latency and high-quality FPV based on DJI Goggles. The new OcuSync system supports the joint source-channel coding (JSCC) and the adaptive modulation and coding (AMC) technologies. The smart drone will sense the surroundings and select the most appropriate modulation and compression schemes accordingly, yielding to a variable data rate of downlink ranging from 6Mbps to 40Mbps. Therefore, the FPV in FHD becomes possible in Mavic Pro.

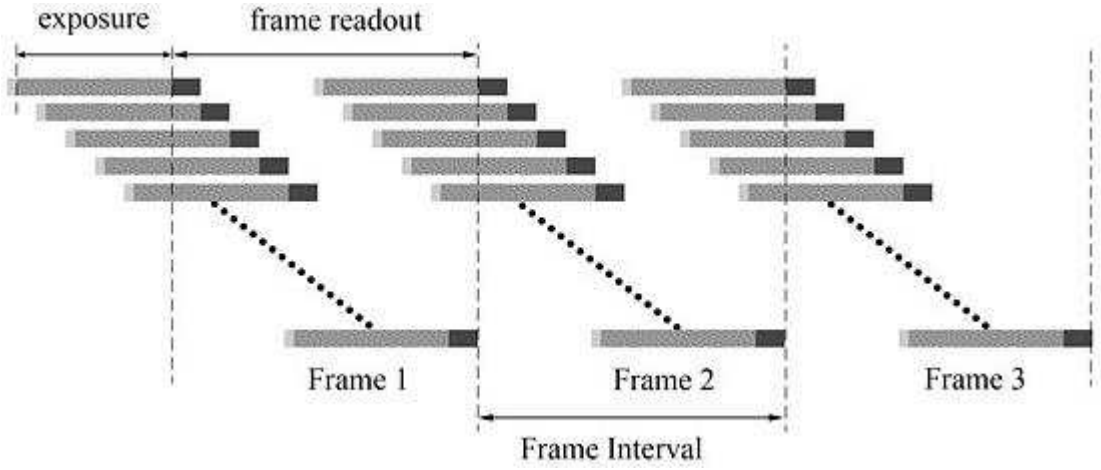

Figure 4 Timing of the sensor exposure.

To avoid of dizziness of DJI Goggles in FPV mode, the key is to ensure the latency from sensor to screen being as short as possible. Figure 4 illustrates the readout timing of a modern rolling shutter sensor. There is at least one frame delay because the sensor needs time to transfer the data line by line. So increasing the frame rate will significantly reduce the latency.