Binning in the Neo and Zyla sCMOS cameras

The Effect on Frame Rates

There are a number of techniques used to manipulate the readout of CCDs to achieve various effects. One of these techniques is 'binning'. For sCMOS based cameras, such as the Andor Neo and Zyla models, the binning process differs from that of CCD's due to the technical differences between the two sensor technologies. This technical note outlines the use of binning for sCMOS and the effect of frame rates on different Neo and Zyla sCMOS camera models at different resolutions. Binning for CCD camera models is explained in the Andor Technical Note CCD Binning- What does Binning mean?

What is Binning?

Binning is the procedure of combining the signal from a number of adjacent pixels into an output for a single pixel (super-pixel). For 2x2 binning, an array of 4 pixels becomes a single larger pixel, reducing the overall number of pixels that need to be readout and also reducing the resolution available. By combining the charge from 4 pixels into one super-pixel, the number of read events is reduced, therefore resulting in a lower read noise. Consequently, it is possible to use binning to increase the signal to noise ratio at the expense of lower resolution.

Binning and sCMOS

In general, when binning is performed for CCD's, fewer pixels are read-out so the acquisition speed can be increased. This provides benefits when a higher frame rate is desirable and the reduced resolution is not so critical.

Although the binning process is different to that of CCDs, binning in the Neo and Zyla sCMOS (Figure 1) also enables significant increases in frame rates. In the Andor Neo and Zyla sCMOS cameras, binning is performed in the FPGA after the image is read out from the sensor. Therefore, applying binning makes no difference to the number of pixels that are read-out from the sensor. Binning is performed after all other processing takes place and the binned image is then transmitted over the Camera-Link or USB 3.0 interface to the PC. The frame rates which can be achieved from the sensor are unaffected- but binning may enable higher frame rate transmission to PC.

Figure 1: Andor Zyla and Neo sCMOS Cameras

It is important to note that the bit-depth does not scale with binning, 12-bit images will saturate at 4095 counts while 16- bit images will saturate at 65,000 whether binning is applied or not.

Neo 5.5, Zyla 5.5 and Zyla 4.2 (Camera-link and USB 3.0 variants)

Binning in the Neo 5.5 and Zyla 5.5 USB 3.0 and Zyla 4.2 USB 3.0 can have a significant effect on frame rates since the sensor read-off is the limiting factor and not the FPGA processing. This is illustrated in the following figures for Neo 5.5, Zyla 4.2 and Zyla 5.5 USB 3.0. This increase in speed with binning does not apply to the Zyla 5.5 or Zyla 4.2 10-tap since the maximum speeds are already being achieved with the 10-tap Camera Link interface; however there is a slight increase in acquisition speeds when using the 16-bit mode in Zyla 5.5 10-tap.

The effect of Binning on frame rates of the Neo 5.5, Zyla 5.5 and Zyla 4.2

Neo 5.5
RS= Rolling Shutter Mode, GS= Global Shutter Mode
12-bit (left), 16-bit (right)

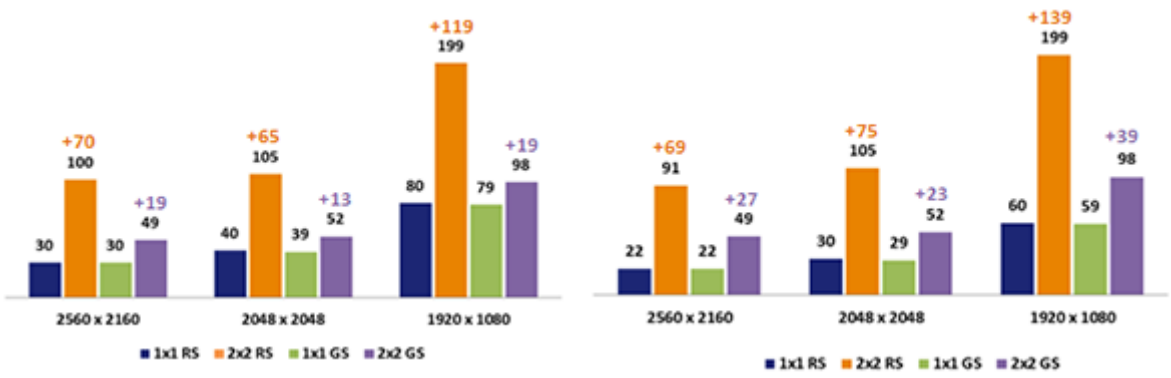

Figure 2: The effect of binning on the frame rate of Neo 5.5 at 12-bit (left) and 16-bit (right)

Zyla 4.2 USB 3.0
RS= Rolling Shutter Mode, GS= Global Shutter Mode

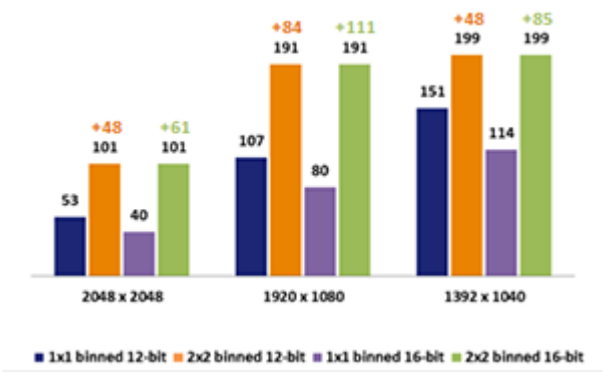

Figure 3: The effect of binning on the frame rates of the Zyla 4.2 at 12-bit (left) and 16-bit (right).

Zyla 5.5 USB 3.0
RS= Rolling Shutter Mode, GS= Global Shutter Mode
12-bit (left), 16-bit (right)

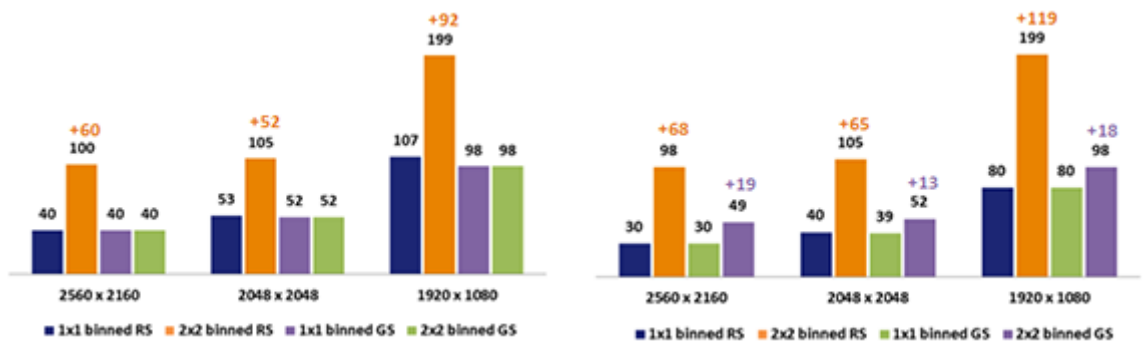

Figure 4: The effect of binning on the frame rates of the Zyla 5.5 at 12-bit (left) and 16-bit (right).

Zyla 5.5 Camera Link
RS= Rolling Shutter Mode, GS= Global Shutter Mode
12-bit (left), 16-bit (right)

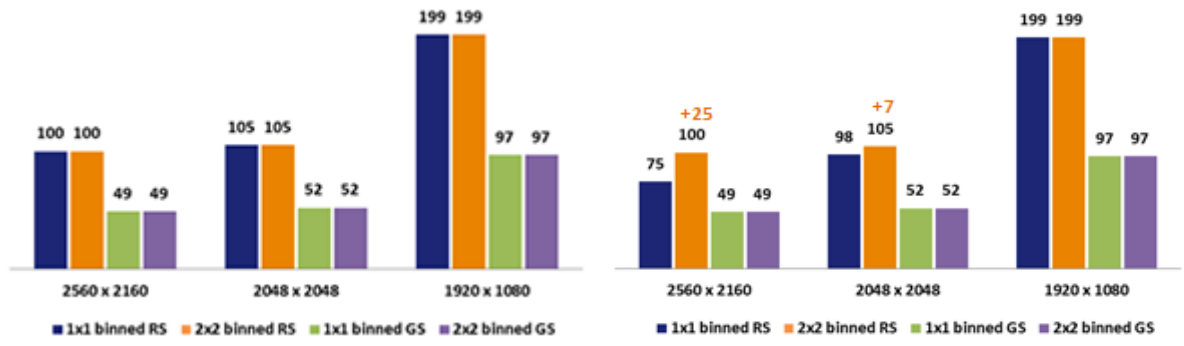

Figure 5: The effect of binning on the frame rates of the Zyla 5.5 Camera Link at 12-bit (left) and 16-bit (right).

Summary

The binning process on sCMOS sensors differs from that of CCD's, but as with CCDs binning may also be utilised to provide increased frames rates. In this technical note, the effects of binning on the frame rates achievable with the Neo, Zyla Camera Link and USB 3.0 models have been outlined- showing that in some cases the frame rates can be significantly increased. For more information on the Neo and Zyla sCMOS cameras please go to the following link: http://www.andor.com/scientific-cameras/neo-and-zyla-scmos-cameras

Data Tables for Andor sCMOS Neo and Zyla models showing the framerates (fps) attainable under different modes

Neo 5.5

	12-bit				16-bit			
	Rolling Shutter		Global Shutter		Rolling Shutter		Global Shutter	
	1 x 1	2 x 2	1 x 1	2 x 2	1 x 1	2 x 2	1 x 1	2 x 2
1920 x 1080	80	199 (+119)	79	98 (+19)	60	199 (+139)	59	98 (+39)

2048 x 2048	40	105 (+65)	39	52 (+13)	30	105 (+75)	29	52 (+23)
2560 x 2160	30	100 (+70)	30	49 (+19)	22	91 (+69)	22	49 (+27)

Zyla 4.2 USB 3.0

	12-bit		16-bit	
	Rolling Shutter		Global Shutter	
	1 x 1	2 x 2	1 x 1	2 x 2
1392 x 1040	151	199 (+48)	114	199 (+85)
1920 x 1080	107	191 (+88)	80	191 (+111)
2048 x 2048	53	101 (+48)	40	101 (+61)

Zyla 5.5 USB 3.0

	12-bit				16-bit			
	Rolling Shutter		Global Shutter		Rolling Shutter		Global Shutter	
	1 x 1	2 x 2	1 x 1	2 x 2	1 x 1	2 x 2	1 x 1	2 x 2
1920 x 1080	107	199 (+92)	98	98	80	199 (+111)	80	98 (+18)
2048 x 2048	53	105 (+52)	52	52	40	105 (+65)	39	52 (+13)
2560 x 2160	40	100 (+60)	40	40 (+19)	30	98 (+68)	30	49 (+19)

Zyla 5.5 Camera Link

	12-bit				16-bit			
	Rolling Shutter		Global Shutter		Rolling Shutter		Global Shutter	
	1 x 1	2 x 2	1 x 1	2 x 2	1 x 1	2 x 2	1 x 1	2 x 2
1920 x 1080	199	199	199	199	97	97	97	97
2048 x 2048	105	105	98	105 (+7)	52	52	52	52
2560 x 2160	100	100	75	100 (+25)	49	49	49	49