

## How to Increase Dynamic Range and Signal-to-Noise-Ratio for Fast Cameras



Super-fast cameras like the [Basler sprint line scan family](#) are optimized for speed. At a line rate of 140 kHz, the maximum exposure time is only 7  $\mu\text{s}$ . By comparison, exposure for area scan cameras is usually set for several milliseconds, a thousand times longer than the sprint cameras.

The challenge for Basler sprint cameras is to collect complete image information within this very short time. Even when the light source is very strong, and focused on the area being inspected, not many photons can be collected. The saturation capacity (maximum allowed electrons per pixel) should match the limited amount of light.

If you now compare this camera with a line scan camera that only runs at 30 kHz, the fast camera does not achieve the dynamic range and signal-to-noise-ratio (SNR) of the 30 kHz camera, because the 30 kHz camera is optimized for a maximum exposure time of about 33  $\mu\text{s}$ . Using the same light source, the 30 kHz camera can collect approximately 4.6 times more light, due to the longer exposure time. The saturation capacity is matched to this amount of light. This results (theoretically) in an increase of 13.4 dB in dynamic range and 6.7 dB in SNR.

### Multiple Exposure and Readout

With the average-exposure feature of the 2k and 4k sprint cameras, a multiple exposure (and readout) can compensate for the disadvantage described above: during an exposure time of 33  $\mu\text{s}$ , we can do a four-time exposure and readout of 7  $\mu\text{s}$  each. The saturation capacity is multiplied by four. The contents are summed up and divided by four for averaging. This results in a theoretical increase of 12 dB for dynamic range, and an improvement of 6 dB for SNR. At this speed, the fast camera becomes very comparable to the line scan camera. The average exposure setting is 1x (default), and it can be set to 2x or 4x for averaging to enhance the saturation capacity. Selectable saturation capacity through multiple (intermediate) exposures offers a major advantage.

Basler sprint cameras are designed for high-speed applications, but with these features, they can also be a very good choice for mid-speed applications.

[Origine Basler]