Basler Optimizes Automatic Channel Balancing on pilot Series Cameras for High Quality Imaging Results

The Basler pilot camera family now offers reproducible, extremely high quality imaging results that are optimized for the most stringent demands of industrial imaging. In comparison to other cameras that employ Kodak sensors, Basler's Kodak based pilot cameras offer factory calibration that delivers homogeneous images under every working condition.

A homogeneous image with consistent pixel behavior and performance is the basis for reliable, reproducible imaging results. When Kodak sensors are properly integrated into a camera, they produce images that meet these image quality demands and are the heart of a camera that exceeds customer needs.

Because they feature a "one tap" design where all pixel data is processed by a single analog-to-digital-converter (ADC), deploying Sony CCD sensors, such as the 1.45 megapixel ICX285, is relatively easy. By comparison, Kodak sensors use a "two tap" design where the pixel data from the left half of the sensor and the right half of the sensor passes through two separate channels (taps).

Figure 1 shows the Kodak sensor layout.

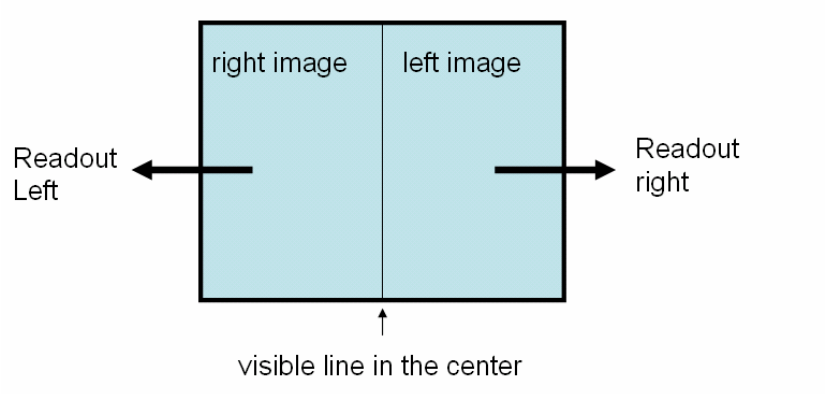


Figure 1: Kodak CCD Sensor Layout

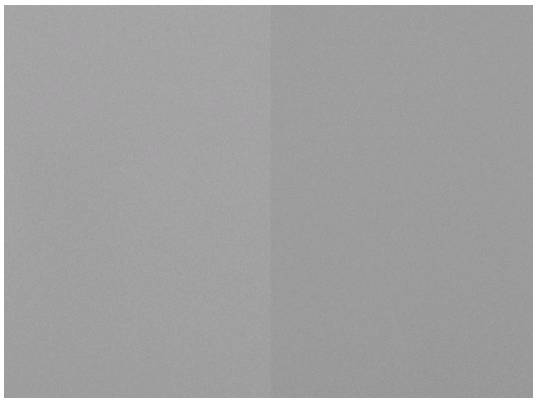
With this type of two tap sensor, a separate set of peripheral components is normally required for each tap and this influences image quality. A frequent result of this design is a mismatch between the pixel data output by the sensor halves. This is counterproductive for many of the algorithms used in machine vision, traffic systems, and medical imaging.

During the pilot development process, one way that Basler addressed the two tap situation was by selecting a new type of ADC that can process the output from both taps with a single device. This limits deviations caused by temperature and analog transmission time and eliminates the tolerance variations inherent in using two separate devices.

The most visible effects of the Kodak sensor layout are a center line and somewhat different behavior for each of the sensor halves. These effects are apparent in nearly every sensor that Kodak delivers and are non-linear, i.e., their magnitude varies with different gain settings, temperature settings, and other effects. Therefore, the major task for a camera manufacturer is to balance the output from the sensor halves and to produce a “good” image over the whole working area. This is accomplished by Basler’s unique CTT+ production tool. The tool automatically performs an

extensive series of tests and calibrations to ensure that the output from both halves of the sensor is balanced and stays balanced over the camera's entire range of operation.

Figure 2 shows the difference between a pilot camera and standard, non-balanced cameras such as the ones offered by many of Basler's competitors with less experience in deploying Kodak CCD sensors. The effect in the images is displayed at medium gray values. To achieve good balancing results, Basler has leveraged more than four years of experience in successfully producing and selling several thousand A202k and A202kc cameras equipped with Kodak sensors.



Unbalanced sensor with visible tap structure

Basler piA640-210gm

Figure 2: Unbalanced vs. Balanced Images

Tap balancing is integrated into these pilot cameras:

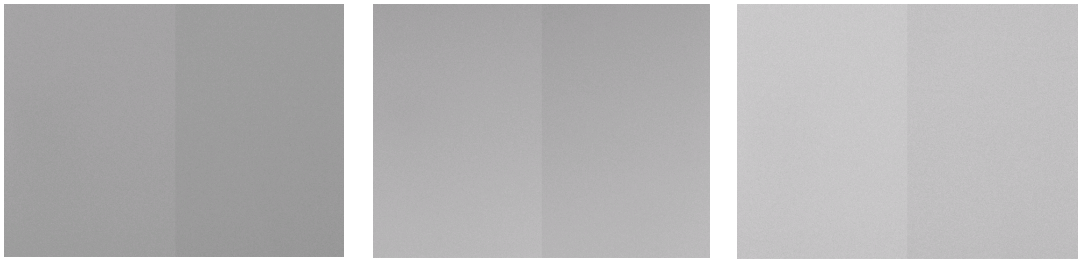
Model	Sensor	Resolution	Speed
piA640-210gm/gc	KAI-0340	VGA	210 fps
piA1000-48gm/gc	KAI-1020	1 megapixel	48 fps
piA1600-35gm/gc	KAI-2020	2 megapixels	35 fps
piA1900-32gm/gc	KAI-2093	2 megapixels	32 fps

Figure 3 shows that there is some dependency on the magnitude of the camera's gain setting and that there can be a large difference in gray values both in brightly illuminated areas of the image as well as in the darker areas. This reflects the assertion that a certain degree of calibration is required to make cameras based on Kodak CCD sensors really useable for demanding imaging applications.

These are typical images for the non-calibrated type of cameras provided by some of Basler's competitors. The camera used to acquire these images is based on a Kodak KAI-0340 running at 200 fps (mono) and is unbalanced.

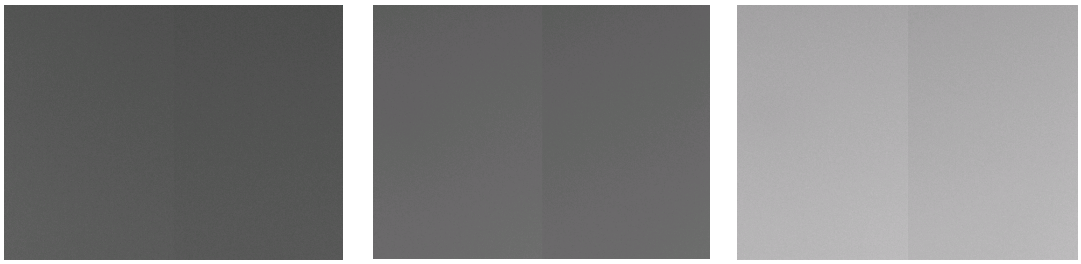
Visible differences in all images can be detected. The differences reach 15 to 20 gray values in 8 bit output modes and will influence or hinder the usability of the imaging results.

Bright



Exp. 5000 µs – Gain 0 dB | Exp. 5000 µs – Gain 6 dB | Exp. 5000 µs – Gain 9 dB

Dark



Exp. 5000 µs – Gain 0 dB | Exp. 5000 µs – Gain 6 dB | Exp. 5000 µs – Gain 9 dB

Figure 3: Unbalanced Images at Various Gain Settings

The images in Figure 4 are from a Basler piA640-210gm equipped with a KAI-0340 sensor and running at 200 fps. Channel differences have been compensated for in all images. Notice the exceptional degree of image uniformity compared to the images from a non-balanced camera.

Bright

Exp. 5000 µs – Gain 0 dB | Exp. 5000 µs – Gain 6 dB | Exp. 5000 µs – Gain 9 dB

Dark

Exp. 5000 µs – Gain 0 dB | Exp. 5000 µs – Gain 6 dB | Exp. 5000 µs – Gain 9 dB

Figure 4: Balanced Images at Various Gain Settings

Summary: Why Basler?

- Taps are factory calibrated at various knee points for optimal tap balance.
- Calibration is automatically performed by the Basler CTT+ to ensure reproducible camera quality.
- Separate gain settings are available for each tap allowing manual compensation if desired.
- Separate black level settings also available for each tap.
- Fully GigE Vision compatible.

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