

CCD versus CMOS –the application is crucial

The choice of the sensor type depends on application. There are two sensor technologies on the market: CCD and CMOS.

Normally CCD sensors have a better image quality, lower noise and no fixed pattern noise. In contrast CMOS sensors are cheaper and also have additional features, which are not integrable to CCD technology. Usually CCD sensors stand out due to an higher dynamic; an enormous advantage mainly in applications with greater differences in brightness.

Whether to use a gray scale sensor or a color sensor depends on the task. Some sensors are only available in one version. Color sensors have a color filter structure in front of the light sensitive sensor matrix, i.e. specific sensors receive only light of a specific color. This filter structures are permeable for IR light. To avoid falsification of the color during color acquisitions, a additional IR filter is needed. Due to the pixel-wise color change, however, this leads to a lesser spatial resolution. If a high color accuracy is needed like in color checkings of printouts or if a high spatial color resolution is needed, you have to use 3 chip cameras, which uses a separate chip for every color red, green and blue. A further aspect is the shutter. CCD and CMOS sensors are available with global shutter (full frame), simple CMOS sensors mostly have rolling shutter. With fast moving objects rolling shutter causes geometrical distortions due to the movement during the exposure.

Summary

Characteristic	CCD	CMOS
Signal at pixel output gate	Electron packages	Voltage
Signal at chip output gate	Voltage (analog)	Bits (digital)
Signal at camera output gate	Bits (digital)	Bits (digital)
Filling faktor / aperture	high	medium
Amplification interference	none	medium
System noise	low	medium
System complexity	high	low
Sensor complexity	low	high
Camera components	PCB + different chips + lens	Chip + lens
Research and developing costs	application dependent	application dependent
System costs	application dependent	application dependent
Performance	CCD	CMOS
Reactivity	medium	a bit better
Dynamik	high	medium
Uniformity of the pixels	high	low .. medium
Uniform exposure time	fast, combined	weak
Speed	medium .. high	higher
Windowing	limited	extended
Antiblooming	high .. none	high
Power supply and pulsing	high voltage, different	Lower coltage, easy

In a nutshell

CCD sensors have a better image quality, a higher sensitivity and dynamic and a synchronous exposure control of all pixels, for the most part CMOS cameras are more compact, allow higher frame rates and can be used a little more variably.