Glossary

ADC

ADC = **A**nalog **D**igital **C**onverter

An analog-to-digital converter (abbreviated ADC, A/D, or A to D) is a device that converts continuous signals to discrete digital numbers.

Typically, an ADC converts a voltage to a digital number. A digital-to-analog converter (DAC) performs the reverse operation.

AEC

AEC = **A**uto **E**xposure **C**ontrol

AGC

AGC = **A**uto **G**ain **C**ontrol

AWB

AWB = **A**uto **W**hite **B**alance

see **White Balance**

BAYER demosaicing

BAYER demosaicing is the process of transforming the BAYER mosaic back to RGB.

BAYER mosaic

A Bayer filter mosaic is a color filter array (CFA) for arranging RGB color filters on a square grid of photosensors. The term derives from the name of its inventor, Bryce Bayer of Eastman Kodak, and refers to a particular arrangement of color filters used in most single-chip digital cameras.

Bryce Bayer's patent called the green photosensors luminance-sensitive elements and the red and blue ones chrominance-sensitive elements. He used twice as many green elements as red or blue to mimic the human eye's greater resolving power with green light. These elements are referred to as samples and after interpolation become pixels.

The raw output of Bayer-filter cameras is referred to as a Bayer Pattern image. Since each pixel is filtered to record only one of the three colors, two-thirds of the color data is missing from each. A demosaicing algorithm is used to interpolate a set of complete red, green, and blue values for each point, to make an RGB image. Many different algorithms exist.

Binning

Binning is the process of combining neighboring pixels while being read out from the CCD chip.

CCD

Charge-**c**oupled **D**evice

Charge-coupled Device

A charge-coupled device (CCD) is a sensor for recording images, consisting of an integrated circuit containing an array of linked, or coupled, capacitors. Under the control of an external circuit, each capacitor can transfer its electric charge to one or other of its neighbours. CCDs are used in digital photography.

CMOS

CMOS (pronounced *see-moss*) stands for **C**omplementary **M**etal-**O**xide-**S**emiconductor

CMOS is a major class of integrated circuits. CMOS chips include microprocessor, microcontroller, static RAM, and other digital logic circuits. The central characteristic of the technology is that it only uses significant power when its transistors are switching between on and off states. Consequently, CMOS devices use little power and do not produce as much heat as other forms of logic. CMOS also allows a high density of logic functions

on a chip.

CSR CSR = **C**amera_**S**tatus_**R**egister

DCAM DCAM = **D**igital **C**amera **S**pecification

Digital camera A digital camera is an electronic device to transform images into electronic data. Modern digital cameras are typically multifunctional and the same device can take photographs, video, and/or sound.

Digital photography Digital photography uses an electronic sensor to record the image as a piece of electronic data.

There are two main types of sensors:

- charge-coupled device (CCD)
- CMOS semiconductor

There are also two main types of sensor mechanisms:

- Area array
- Linear array (very rare, only limited to the highest-end)

An area array sensor reads the entire image plane at once, whereas a linear array sensor works more like a flatbed scanner.

Field of View Field of View (FOV) is the area that is visible

Fixed Pattern Noise abbr. **FPN**

If the output of an image sensor under no illumination is viewed at high gain a distinct non-uniform pattern, or fixed pattern noise, can be seen. This fixed pattern can be removed from the video by subtracting the dark value of each pixel from the pixel values read out in all subsequent frames.

Dark fixed pattern noise is usually caused by variations in dark current across an imager, but can also be caused by input clocking signals abruptly starting or stopping or by having the CCD clocks not being close compliments of each other.

Mismatched CCD clocks can result in high instantaneous substrate currents, which when combined with the fact that the silicon substrate has some non zero resistance can result in the substrate potential bouncing.

The pattern noise can also be seen when the imager is under uniform illumination. An imager which exhibits a fixed pattern noise under uniform illumination and shows no pattern in the dark is said to have Light pattern noise or Photosensitivity pattern noise. In addition to the reasons mentioned above, light pattern noise can be caused by the imager entering saturation, the nonuniform clipping effect of the antiblooming circuit, and by non-uniform, photosensitive pixel areas often caused by debris covering portions of some pixels.

FOV FOV = **F**ield **O**f **V**iew

see **Field of View**217

FPN FPN = **F**ixed **P**attern **N**oise

Related with the dark current is its electrical behavior to be regionally different on the sensor. This introduces a structural spatial noise component, called fixed pattern noise, although it's not meant temporal, visible with low illumination conditions.

FPN is typically more dominant with CMOS sensors than with CCD, where it can be ignored mostly.

This noise nfpn [%] is usually quantified in % of the mean dark level.

Full binning

If horizontal and vertical binning are combined, every 4 pixels are consolidated into a single pixel. At first two horizontal pixels are put together and then combined vertically.

This increases light sensitivity by a total of a factor of 4 and at the same time signal to noise separation is improved by about 6 dB. Resolution is reduced, depending on the model.

See also: horizontal binning and vertical binning

Global Shutter

All pixels are exposed to the light at the same moment and for the same time span.

Horizontal binning

In **horizontal binning** adjacent horizontal pixels in a line are combined in pairs.

This means that in horizontal binning the light sensitivity of the camera is also increased by a factor of two (6 dB). Signal to noise separation improves by approx. 3 dB. Horizontal resolution is lowered, depending on the model.

See also: vertical binning and full binning

IEEE

The **I**nstitute of **E**lectrical and **E**lectronics **E**ngineers, Inc.

IEEE-1394 Trade Association

IEEE-1394 Trade Association is a non-profit industry association devoted to the promotion of and growth of the market for IEEE 1394-compliant products.

Participants in working groups serve voluntarily and without compensation from the Trade Association. Most participants represent member organizations of the 1394 Trade Association. The specifications developed within the working groups represent a consensus of the expertise represented by the participants.

Background of the Trade Association and IEEE 1394

The 1394 Trade Association was founded in 1994 to support the development of computer and consumer electronics systems that can be easily connected with each other via a single serial multimedia link. The IEEE 1394 multimedia connection enables simple, low cost, high bandwidth isochronous (real time) data interfacing between computers, peripherals, and consumer electronics products such as camcorders, VCRs, printers, PCs, TVs, and digital cameras. With IEEE 1394 compatible products and systems, users can transfer video or still images from a camera or camcorder to a printer, PC, or television, with no image degradation. The 1394 Trade Association includes more than 170 companies and continues to grow.

Members of the 1394 Trade Association

The 1394 Trade Association is comprised of more than 170 member companies. Membership is currently (8/00) still in a rapid growth phase, with approximately one company a week joining the 1394 TA. The membership consists of a number of companies of every size in almost every sector of the electronics industry. Some of the best known names in the 1394 TA membership are Sony, Intel, Microsoft, JVC, Matsushita, Compaq, NEC, Philips, Samsung, among other well respected electronics institutions.

Organization of the 1394 Trade Association

The 1394 TA is incorporated as a nonprofit trade organization. Its Board of Directors and Chair are volunteers elected from the membership of the

association. The 1394 TA maintains an office in Southlake, Texas, with paid staff that execute the programs organized by the 1394 TA membership.

IIDC

The 1394 Trade Association **I**nstrumentation and **I**ndustrial Control Working Group, **D**igital **C**amera Sub Working Group

IIDC V1.3

IIDC V1.3

IIDC 1394-based Digital Camera Specification Version 1.30 July 25, 2000

The purpose of this document is to act as a design guide for digital camera makers that wish to use IEEE 1394 as the camera-to-PC interconnect. Adherence to the design specifications contained herein do not guarantee, but will promote interoperability for this class of device. The camera registers, fields within those registers, video formats, modes of operation, and controls for each are specified. Area has been left for growth. To make application for additional specification, contact the 1394 Trade Association Instrumentation and Industrial Control Working Group, Digital Camera Sub Working Group (II-WG DC-SWG).

http://www.1394ta.org/Technology/Specifications/

Image processing

In the broadest sense, image processing includes any form of information processing in which the input is an image. Many image processing techniques derive from the application of signal processing techniques to the domain of images — two-dimensional signals such as photographs or video.

Typical problems are:

- Geometric transformations such as enlargement, reduction, and rotation
- Color corrections such as brightness and contrast adjustments, quantization, or conversion to a different color space
- Combination of two or more images, e.g. into an average, blend, difference, or image composite
- Interpolation, demosaicing, and recovery of a full image from a mosaic image (e.g. a Bayer pattern, etc.)
- Noise reduction and other types of filtering, and signal averaging
- Edge detection and other local operators
- Segmentation of the image into regions

PDF

Portable Document Format

Pixel

Pixels are generally thought of as the smallest complete sample of an image. The definition is highly context sensitive. For example, we can speak of pixels in a visible image (e.g. a printed page) or pixels carried by one or more electronic signal(s), or represented by one or more digital value(s), or pixels on a display device, or pixels in a digital camera (photosensor elements). This list is not exhaustive and depending on context there are several synonyms which are accurate in particular contexts, e.g. pel, sample, bytes, bits, dots, spots, superset, triad, stripe set, window, etc. We can also speak of pixels in the abstract, in particular when using pixels as a measure of resolution, e.g. 2400 pixels per inch or 640 pixels per line. Dots is often used to mean pixels, especially by computer sales and marketing people, and gives rise to the abbreviation DPI or dots per inch.

The more pixels used to represent an image, the closer the result can resemble the original. The number of pixels in an image is sometimes called the resolution, though resolution has a more specific definition. Pix-

els can be expressed as a single number, as in a *three-megapixel* digital camera, which has a nominal three million pixels, or as a pair of numbers, as in a *640 by 480 display*, which has 640 pixels from side to side and 480 from top to bottom (as in a VGA display), and therefore has a total number of 640 × 480 = 307,200 pixels.

The color samples that form a digitized image (such as a JPG file used on a web page) are also called pixels. Depending on how a computer displays an image, these may not be in one-to-one correspondence with screen pixels. In areas where the distinction is important, the dots in the image file may be called texels.

In computer programming, an image composed of pixels is known as a bitmapped image or a raster image. The word raster originates from analogue television technology. Bitmapped images are used to encode digital video and to produce computer-generated art.

RGB

The RGB color model utilizes the additive model in which red, green, and blue light are combined in various ways to create other colors. The very idea for the model itself and the abbreviation **RGB** come from the three primary colors in additive light models.

Note that the RGB color model itself does not define what exactly is meant by **red**, **green** and **blue**, so that the same RGB values can describe noticeably different colors on different devices employing this color model. While they share a common color model, their actual color spaces can vary considerably.

Signal to noise ratio

also called **SNR**

Signal to noise ratio specifies the quality of a signal with regard to its reproduction of intensities. The value signifies how high the ratio of noise is in regard to the maximum wanted signal intensity expected.

The higher this value, the better the signal quality. The unit of measurement used is generally known as the decibel (dB), a logarithmic power level. 6 dB is the signal level at approximately a factor of 2.

However, the advantages of increasing signal quality are accompanied by a reduction in resolution.

Signal to noise separation

Signal to noise separation specifies the quality of a signal with regard to its reproduction of intensities. The value signifies how high the ratio of noise is in regard to the maximum wanted signal intensity expected.

The higher this value, the better the signal quality. The unit of measurement used is generally known as the decibel (dB), a logarithmic power level. 6 dB is the signal level at approximately a factor of 2.

However, the advantages of increasing signal quality are accompanied by a reduction in resolution.

SNR

SNR = **S**ignal to **N**oise **R**atio

Sub-sampling

Sub-sampling is the process of skipping neighboring pixels (with the same color) while being read out from the CMOS or CCD chip.

All CMOS equipped Marlin models, both color and b/w have this feature (FW > 2.03).

The CCD model MF-146C is also equipped with this mode, acting as a preview mode. Because it is realized digitally there is no further speed increase.

Sub-sampling is used primarily for 2 reasons:

- A reduction in the number of pixels and thus the amount of data while retaining the original image area angle and image brightness
- CMOS: an increase in the frame rate.

Similar to binning mode the cameras support horizontal, vertical and h+v sub-sampling mode.

Trigger

Trigger is a special signal provided to a camera (or other device) to ignite some needed operation - most frequently to reset its timing, turn on a flash or a strobe etc.

The term **trigger** is sometimes used also in meaning of a trigger shutter.

Trigger shutter

A trigger shutter is a shutter mode with random timing or even with random shutter speed. Such a randomness is controlled by the trigger signal mentioned above.

Vertical binning

Vertical binning increases the light sensitivity of the camera by a factor of two by adding together the values of two adjoining vertical pixels output as a single pixel. At the same time this normally improves signal to noise separation by about 2 dB.

See also: full binning and horizontal binning

White balance

A function enabling adjustment of the image colors to make the white objects really appear as white. Thus one can avoid color shifts caused e.g. by different illuminating conditions.