



# X

## The **Xiris Glossary** of Machine Vision Terminology



# Introduction

Automated welding, camera technology, and digital image processing are all complex subjects. When you combine them in a system featuring machine vision—and factor in the rapid pace of technological change—the terminology used to discuss machine vision is necessarily somewhat complicated and diverse. To help avoid any confusion, we offer the following glossary of terms.

## **Accuracy**

The degree of conformance between a measurement of an observable quantity and a recognized standard or specification that indicates that true value of the quantity. Accuracy normally denotes absolute quality or conformance, while “precision” refers to the level of detail used in reporting the results.

## **Analog Video Signal**

A video signal that takes on a continuous range of values, usually in the range of -1 to +1 volts, which are proportional to the light level acquired at an individual point in the image.

## **Aperture**

The opening in a lens that determines the cone angle of the bundle of rays that come into focus in the image plane.

## **Artifact**

An error in the representation of an item being imaged by a camera. It could be induced in a recorded image by optical issues between light, target, and image sensor, or through the image-acquisition electronics or subsequent image-processing software.

## **Astigmatism**

In imaging, an optical aberration when horizontal and vertical features focus at different depths.

## **Auto Relearn**

A type of relearn automatically initiated after a certain number of objects have been inspected.

## **Backlighting**

When a light source is placed behind an object so that a silhouette of that object is formed. Backlighting is used when outline information of the object and its features are important rather than surface features.

## **Blob**

An arbitrary group of connected pixels in an image. The group of pixels that make up a blob must share a common or similar light intensity. A blob often represents a specific real world object for which measurements need to be obtained for inspection or analysis.

## **Blob Analysis**

The process of extracting blobs from an image and obtaining statistics and other information about those blobs. This information can then be used to determine presence or absence, location, and many other characteristics of the real-world objects these blobs represent.

**Blooming**

An artifact generated in a camera by an extremely bright light in a scene that causes the charge of one pixel to spill over to adjacent pixels. Most often found on CCD cameras, the effect produces an image with fringes (or feathers) of light extending from the borders of bright areas in an image to darker areas of the image, overwhelming the darker areas of the scene. While modern digital sensors are designed to dissipate excess charge above the full well capacity, excess charge from saturated pixels in very bright parts of the scene can still spill over—leading to saturation in pixels that would not otherwise be saturated.

**Brightness**

In imaging, the measure of the radiant power of a feature in a scene as captured on a digital camera sensor and converted to an electric charge.

**'C'-Mount**

A recognized standard mount to mount lenses to a camera body: 1" (25 mm) diameter x 32 Threads per inch, with flange-to-sensor distance of 17.53 mm.

**CCD (Charge-Coupled Device)**

A light-sensitive image sensor used in digital cameras that converts light into proportional (analog) electrical current.

**CCIR Video Format**

A video standard format used in used in many parts of the world. The picture has 582 lines and uses interlacing between two fields to get a frame. It has horizontal sync rates of 15,625 Hz and a frame rate of 50 Hz. The CCIR electrical signal is a 75 ohm system with a 1.0V (peak-to-peak, including sync) signal. The CCIR standard defines only the monochrome picture component, and there are two major color encoding techniques used with it: PAL and SECAM.

**Chromatic**

A type of optical aberration when different grey-level intensities focus at different distances or depths. Individual optical lenses may have different sensitivities to specific light wavelengths.

**CMOS (Complementary Metal Oxide Semiconductor)**

A type of sensor used in digital cameras that is based upon a semiconductor process designed for digital electronics, instead of analog electronics as in the CCD.

**CMYK**

A subtractive color model, used in color printing and to describe the printing process. CMYK refers to the four inks used in some color printing: cyan, magenta, yellow, and key (black).

**Coherent Light**

A light source whose individual light rays are in phase with each other and are usually of the same wavelength (i.e., light color).

**Coma**

In imaging, a type of optical aberration when an off-axis image appears to have asymmetric blurring that is comet-like in shape, giving the appearance of an uneven spot.

**Contrast**

The difference in visual properties that makes an object in an image distinguishable from other objects and the background in the image.

**Convexity**

The maximum perpendicular distance from the face of a convex fillet weld to a line joining the weld toes.

**Convolution**

A process whereby an image is transformed mathematically by applying a kernel, which is a set of multipliers applied to the neighborhood of each pixel. Imaging applications of convolution include edge detection, sharpening, and smoothing.

**Correlation**

A mathematical process of comparing a model to an image and determining the similarity (correlation) between the two. The result is a number between 0 and 1, where 1 is a perfect match. This number is referred to as the score.

**Defect Size**

The number of connected defect pixels within any one defect region.

**Difference Magnitude**

The degree by which a pixel in the image under test varies from the corresponding pixel in a master image.

**Difference Image**

An image that graphically represents the difference for every pixel, between the master image and the current disc, for a specific inspection.

**Difference Inspection**

An inspection process where an object is compared to its master based on the color difference between each pixel in the object's image and the same pixel in the master image.

**Depth of Field**

The range of an imaging system that is in-focus. It is measured from the distance behind an object to the distance in front of the object where all objects appear in focus. For example, if the object is a weld tip, the depth of field is defined as the distance behind the weld tip to in front of the weld tip where the image is still in focus.

**Digital Video Signal**

A method of storing, processing, and transmitting image information through the use of distinct electronic or optical pulses that represent each pixel as a combination of binary digits 0 and 1.

**Distortion**

An optical aberration in imaging when there is a difference in lateral magnification, usually appearing as a barrel or pincushion effect in the image. It can be minimized by avoiding wide-angle lenses.

**Edge**

In imaging, a rapid change in light intensity that spans several pixels between two adjacent regions of relatively uniform values. Edges correspond to changes in brightness resulting from a discontinuity in surface orientation, reflectance, or illumination.

**Edge Strength**

Imaging term for an attribute of an edge that indicates the magnitude of the change in light intensity across the edge.

**Face of Weld**

The exposed surface of a weld, made by an arc or gas welding process, on the side from which welding was done.

**False Accept**

An unacceptable object that is determined acceptable by a measurement or inspection system.

**False Reject**

An acceptable object that is determined as defective by a measurement or inspection system.

**Fiducial**

A mark or target, defining a datum point or standard of positional reference, used as a basis for calculation or measurement.

**Field of View**

The amount of area that can be seen by a camera at one time. It is a result of the size of the image sensor, the lens of the system, and the working distance between object and camera.

**Focus**

An image point or region in which light rays are made to converge. An image point or region is in focus if light from the object points is converged almost as much as possible in the image.

**Font**

A collection of models, each of which represents a printable character that originates from the same printing source.

**FPN (Fixed Pattern Noise)**

A particular noise pattern found on digital imaging sensors, often noticeable during longer exposure shots where particular pixels are susceptible to giving brighter intensities above the general background noise.

**Frame Buffer**

The memory designed to store a digitized image. Typically, it resides on a frame grabber card that plugs into an expansion slot of a computer that is capable of capturing an image and storing it. A window to the frame buffer can be identified on a video graphics array (VGA) screen by the picture that can be seen in it.

**Frame Grabber**

A hardware device that performs image acquisition, storage, and display. It is typically a plug-in adapter for a PC.

**Frame Rate**

The number of full frames of video that are transmitted per second. Typical NTSC video is 30 frames per second; CCIR is 25 frames per second.

**Full Well Capacity**

The maximum amount of charge that can be stored in each sensor element in a digital CCD or CMOS camera sensor, where incident photoelectrons are recorded as electric charge.

**Global Camera Shutter**

An image-acquisition process used in some types of digital image sensors whereby the entire image is exposed and read out at one time. This provides consistent image features across the entire image, minimizing localized artifacts that could result from variations in movement or brightness while the frame is being exposed. All portions of the image are affected equally.

**Histogram**

A function plotting the frequency of occurrence of an intensity value as a function of those intensity values. As such, a histogram illustrates the distribution of intensity values in a given region of interest in an image.

**Image Processing**

The transformation of an input image into an output image with desired properties.

**Image-Under-Test**

The digital image of the object being inspected.

**Incoherent Light**

A source of light waves that are not all of the same phase and/or wavelengths.

**LED (Light Emitting Diode)**

A special type of semiconductor diode that emits incoherent narrow-spectrum light.

**Machine Vision**

The automatic acquisition and analysis of images to obtain desired data for controlling a specific activity.

**Mask**

The set of all pixels meeting specific measurement criteria—for example, the set of all pixels which are above a specific brightness.

**Master Image**

A digital image representing the ideal, or golden part. This is typically constructed by averaging the images of several objects.

**Maximum Defect Size**

The largest Defect Size allowed. Any larger defect causes a reject.

**Model**

An image representative of a specific feature, which is used to determine the identity of an unknown feature, or to verify the correctness of a known feature.

**Noise**

Irrelevant or meaningless image information resulting from random undesirable video signals or from causes unrelated to the source of data being measured or inspected.

**NTSC**

An analog television standard for color television originally in use across most of the Americas and parts of Asia. The standard defines a color video signal that consists of 30 interlaced frames of video per second. Each frame is composed of two fields, each consisting of 262.5 scan lines, for a total of 525 scan lines. The visible raster is made up of 483 scan lines. The remaining scan lines (the vertical blanking interval) are used for synchronization and vertical retrace.

**OCR (Optical Character Recognition)**

The process by which a string of unknown characters is digitally imaged and converted into machine-encoded text by a machine vision system.

**OCV (Optical Character Verification)**

The process by which a string of known characters is digitally imaged and compared with a set of master images by a machine vision system, for the purpose of verifying the string of characters to be correct.

**OEM (Original Equipment Manufacturer)**

A company that offers a product that uses camera systems as a value-additive feature to perform a very specific task. The camera system is treated as value-added and does not represent the central functionality of the OEM's product

**Operating Dynamic Range**

The amount of light variation that can be tolerated. For a camera, it is commonly defined as the ratio between the camera's maximum signal amplitude and its noise floor.

**Optics**

A branch of physics that involves the behavior and properties of light, including the construction of instruments, such as machine vision devices, that use or detect it. Included in the discipline are various types of optical sources and components, such as lenses, apertures, and filters.

**Overlay**

A video plane that typically exists on top of a frame buffer to display graphics. For example, the rectangular frame outlining a viewport is an overlay on the frame buffer image. Generally, an overlay is the video plane that appears "on top" on a video monitor when two or more video signals are mixed.

**Path**

The route taken by a programmable motion device, such as a robot, between two points.

**Pixel**

An abbreviation for "picture element" (i.e., an individual element of a digitized image array).

**Pixelation**

An effect in imaging caused by displaying a bitmap image such that neighborhood pixels do not display a smooth transition, causing sharp "steps" visible to the human eye between groups of pixels.

**Pixel Jitter**

An error introduced into a digitized image caused by analog-to-digital converters attempting to lock sync with the video camera by picking up the horizontal sync pulse using phase-locked-loop (PLL) circuitry. It arises when the horizontal sync for each scan line drifts slightly from the expected position, causing the position of all the horizontal picture elements to be shifted by an equal amount in the scan line.

**Pointing Device**

A mouse, glide pad, or trackball.

**Polarity**

An attribute of an edge that indicates the type of transition in light intensity across the edge. A light-to-dark transition is said to have a negative polarity, whereas a dark-to-light transition is said to have a positive polarity. The polarity of an edge is viewed as occurring from the start point towards the end point of a path.

**Processing Mask**

The set of pixels that are processed for a given inspection or view.

**RGB**

An additive color model in which red, green, and blue light are added together in various ways to create a broad array of colors.

**Region of Interest**

The area of an image inside defined boundaries that enclose all the features that are to be inspected.

**Repeatability**

The degree to which repeated measurements of the same quantity vary about their mean.

**Rolling Camera Shutter**

An image-acquisition process used in some types of digital image sensors whereby portions of the image are read out at different times than other portions of the image. This is typically done one line at a time, so one line would be exposed and its current charges read out, then the next line, and so on. The image created from such a shutter can contain artifacts that result from portions of an image being exposed differently than others (e.g., movement, brightness variations).

**Rotation**

The process in which an image is remapped at 90°, 180°, and 270° from the original perspective for operator convenience.

**RS170 Video Format**

A video standard format used in used in many parts of the world (North America, Japan, and elsewhere). The picture has 525 lines and is displayed 60 times per second, with interlacing between two fields to make a frame. The RS170 electrical signal is a 75 ohm system and 1.0V (peak-to-peak, including sync) signal. The RS170 standard defines only the monochrome picture component, but is mainly used with the NTSC color encoding standard.

**Saturation**

A type of distortion in a recorded image in which individual pixels are limited to some maximum value, interfering with the measurement of bright regions of the scene. Saturated pixels contain less information about the scene than other pixels and therefore do not contribute much to the quality of an image. Saturation is caused by the physical characteristics of the sensor, particularly the full well capacity of the sensor, which limits the highest irradiance that can be measured for the given settings of the camera.

**Segmentation**

The process of separating pixels representing foreground areas of an image from pixels representing background areas of an image.

**Signal quality**

The quality (i.e., electrical cleanliness) of a video signal.

**Skelp**

Flat plates that are formed, bent, and prepared for welding.

**Spatial resolution**

The measure of how closely lines can be measured in a two-dimensional optical image.

**Spherical**

An optical aberration when rays from the center and edges of the lens focus at different distances.

**String**

A string is a series of one or more characters delineated by a larger space.

**Underlay**

The video plane that appears on a video monitor underneath another plane when two or more video signals are mixed.

**Viewport**

A two-dimensional region in an image in which special image processing or focus is made.

**Visible Light Spectrum**

Electromagnetic radiation that is visible to the human eye. Typically defined to have a wavelength between 380 - 750 nm. Some key colors include blue light (around 450 nm), green (about 520 nm), yellow (about 560 nm), orange (about 600 nm) and red (about 700 nm). Note that numbers are approximate.

**Zoom Lens**

A mechanical assembly of lenses whose focal length can be changed, as opposed to a standard lens, which has a fixed focal length.

# Would you like more information?

[sales@xiris.com](mailto:sales@xiris.com)

+1 866 GO XIRIS

+1 905 331 6660

[www.xiris.com](http://www.xiris.com)

