iX Cameras

TECH NOTE

Title: **UNDERSTANDING ISO IN A DIGITAL WORLD**
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Author: **Chris Robinson**
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Overview

Many of those responsible for specifying high-speed cameras will realize the importance of sensitivity. Those in the machine vision industry realize that the specific sensitivity of any given camera is device specific and depends on a number of factors including the quantum efficiency, pixel size, and the shot noise and temporal dark noise associated with the CCD or CMOS imager used in the camera.

Understanding ISO in a digital world

For those involved in high-speed imaging, the ISO standard is often used to describe sensitivity. ISO Sensitivity (or ISO speed) is a measure of how strongly an image sensor or camera responds to light; the higher the sensitivity the less light that is required to capture a good quality image. However, the ideas and measurements behind it are less well known. If two cameras are rated at ISO 1200, will they produce the same images for the same amount of light? Regrettably, the answer is "not necessarily."

Film sensitivity measurements began in the late 1800s and, since then, many organizations have vied to produce the dominant standard. DIN and ASA ratings were the de-facto standards for many years and, in 1974, the International Standards Organization (ISO) started collecting these together, eventually creating ISO 6, 2240 and 5800.

In 1998, as digital cameras became ubiquitous, ISO created a new standard specifically for digital still cameras. The latest version, ISO 12232-2:2006 has become the de-facto standard for digital still and video cameras. The rigorous method in the standard requires an illuminated scene, a camera to collect images and a measurement or assessment of the images. Unfortunately, there are options in each of these steps.

For example, the standard allows the use of either daylight or tungsten lighting. For a monochrome camera, especially one without an IR-cut filter, tungsten illumination is advantageous. This is supposed to be declared with a "T", such as ISO 1200T. However, the use of a "D" for daylight is optional, so the compulsory "T" could be lost without being noticed.

Also, illumination in the test can be measured at the scene as either a "scene luminance method" or at the sensor as a "focal plane method." The mathematics in the standard

should yield the same value for both techniques, but there is a temptation to try them both to see if one gives better results.

The biggest discrepancies come from the choice of image rating technique. There are two noise-based speed measurements, Snoise10 and Snoise40, which are related to film standards. There is also the saturation-based speed measurement, Ssat, but this method does not prevent manufacturers from using an undisclosed amount of gain. The concept of recommended Exposure Index (EI) correctly allows for gain in the camera, but this is closely related to another measurement, the Standard Output Sensitivity whose result does not mention gain. In truth, gain is not necessarily bad, but it will increase noise in an image, which may prove more undesirable than lower sensitivity.

The differences between Saturation-based and Standard Output Sensitivity are documented in "ISO Sensitivity and Exposure Index," Choosing a camera would be easier if all manufacturers were to use the same measurement - perhaps an update to the standard would be beneficial. In the meantime, the saturation method, with true disclosure of gain and light source technology would seem to be a good baseline.

Chris Robinson, *Director of Technology, iX Cameras*
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