Technical Details

HDR/WDR

THE IMAGINGSOURCE
TECHNOLOGY BASED ON STANDARDS

Achieving HDR/WDR Images Through the Use of Multiple Exposures

For some time now we have been witnessing an increase in the availability of cameras with high dynamic range, HDR (and respectively wide dynamic range, WDR). The abbreviations HDR and WDR are regarded as synonymous terms and can be used interchangeably. In either case, what concerns us is rendering the dynamic range of the captured image (which in HDR images can be anywhere from 10-16 bits per color channel RGB) and achieving an optimal depiction of it on 8-bit-per-channel monitors and displays. This is especially important on sunny days or when objects (or entire scenes) are brightly lit and the dynamic range exceeds 8 bits. An image captured exclusively with 8 bits per color channel will result in the displayed image being either too dark (underexposed) or with overexposed white areas on the screen.

HDR cameras avoid this problem by taking multiple exposures of an object (or scene) with varying exposure times. The consolidation of the multi-exposure images leads to the above mentioned color channels with a dynamic range from 10 to 16 bits.

HDR via Non-linear Characteristic Curve

The above mentioned techniques for creating HDR images are based on the capture and consolidation of multi-exposure images. The advantage: the digital image accurately renders the reflected ratio (incident ratio) of the light. The disadvantage: movements during the exposure time can create visible image artifacts such as ghosting and motion blur.

Image sensors which process the incident/reflected ratio in a non-linear manner can avoid these drawbacks. With a non-linear process, an incident/reflected ratio of 1:10 would then have a gray-value contrast of only 1:2 in the digital image. The advantage: No visible image artifacts are created. The disadvantage: The configuration of the sensor's characteristic curve is complicated and temperature-dependent.

A good example of this non-linear method can be found in OnSemi's Python sensors. OnSemi calls the technique "Multiple Slope Integration."

Tone Mapping

The group of techniques used to map 12-bit images onto 8-bit displays is called tone mapping and is supported by TIS camera drivers. The manner in which a CMOS sensor's raw HDR image files are made available varies from one sensor model to the next. The global shutter 2 MP Sony CMOS IMX 174, for example, delivers two variably exposed 8-bit images, which are then merged into one, 8-bit image. The Sony rolling shutter IMX 236 sensor merges the images and displays a raw 12-bit HDR image, which can then in turn be tone mapped. Some high resolution sensors even allow for differing exposure times in consecutive scan lines.

When using the HDR function, one should select the shortest possible exposure time in order to avoid creating visible image artifacts from motion. The use of tone mapping with single 10- and 12-bit images can also improve dynamic range.

Gamma Correction

A subsequent gamma correction is necessary to convert the linear image created by the camera in such a way as to take advantage of the non-linear behavior of the human eye. Typically, therefore, most computer monitors are calibrated to a display gamma of 2.2; the camera should be set to compensate for this. A gamma that is too low delivers an image that is washed out and too bright; whereas a high gamma creates a dark image with harsh contrasts.

Significant improvements to image quality can only be achieved with a robust tone mapping algorithm used in conjunction with subsequent gamma correction.

THE IMAGINGSOURCE
TECHNOLOGY BASED ON STANDARDS

Headquarters: The Imaging Source Europe GmbH
Sommerstrasse 36, D-28215 Bremen, Germany
Phone: +49 421 33591-0
North & South America: The Imaging Source, LLC
6926 Shannon Willow Rd, S 400, Charlotte, NC 28226, USA
Phone: +1 704-370-0110
Asia Pacific: The Imaging Source Asia Co. Ltd.
6F-1, No.230, Sec.3, Ba-De Road,,Song-Shan District 10555,
Taipei City, Taiwan
Phone: +886 2-2577-1228
www.theimagingsource.com

Last update: September 2015

All weights and dimensions are approximate. Unless otherwise specified the lenses shown in the context of cameras are not shipped with these cameras.