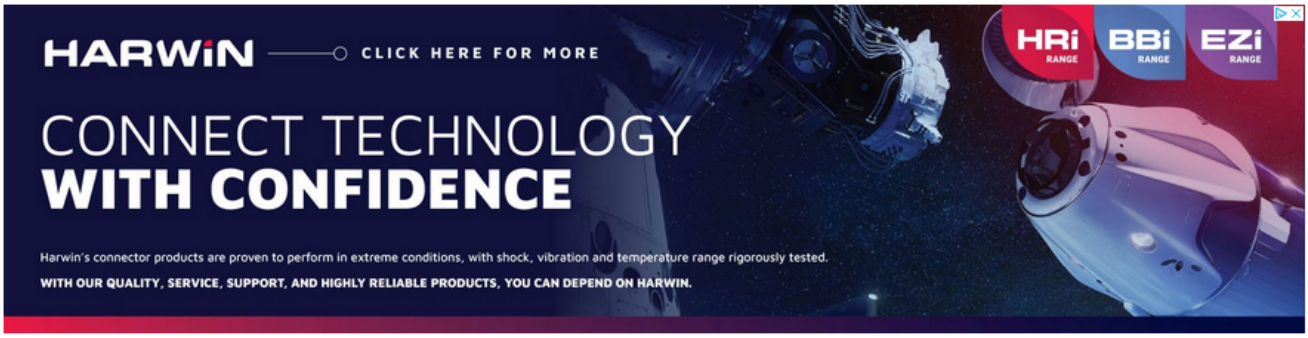

JUNE 1, 2015 | IMAGING

High Dynamic Range Imaging (HDRI) Upgrades Inspection Results

HDRI features capture details when the environment, or the objects themselves, are both bright and dark.

Designers and operators of automated inspection systems have long been challenged with completing accurate inspections when those tasks required high dynamic range, or when there was a need to capture critical details in objects or environments with high contrast between their brightest and darkest areas.

Figure 1. A composite image of the flower provides visibility in both light and dark areas of the object. (Image Credit: Teledyne DALSA)

High dynamic range is especially important if the scanned objects have some features that are highly reflective, or when inspections are performed outside where natural lighting fluctuates with changing conditions, such as from sunny to overcast.

In these situations, users have had few options. They may have chosen to focus on one particular area, accepting that their inspections would only be as accurate as the technology would allow, or they may have opted to make significant investments in complicated workarounds, such as incorporating multiple filters into the camera design to limit the level of brightness, or even deploying costly hardware and strobe lights to manage lighting intensity.

With the continued evolution in machine vision technology — due in part to increased customer demands for improved image quality and more accurate inspection capability — area and line scan cameras are now better able to address inspections that require high dynamic range. The new technology with high dynamic range imaging capability uses multiple synchronized exposures in successive images to capture the level of detail required. Successive frames or lines are combined in a composite image, producing a higher-contrast image than can be achieved with a single exposure, showing detail in both the light and dark areas of the object (see Figure 1).

INTELLIGENT TRANSPORTATION

Today's intelligent transportation systems inspect with high dynamic range capability. In particular, the technology has improved the precision of rail inspection. Advanced area cameras now offer the high resolution, speed, and dynamic range that can ensure optimized image capture in variable lighting and weather conditions, even if those changes occur in just seconds, such as when a stand of trees causes a dark shadow across a section of track.

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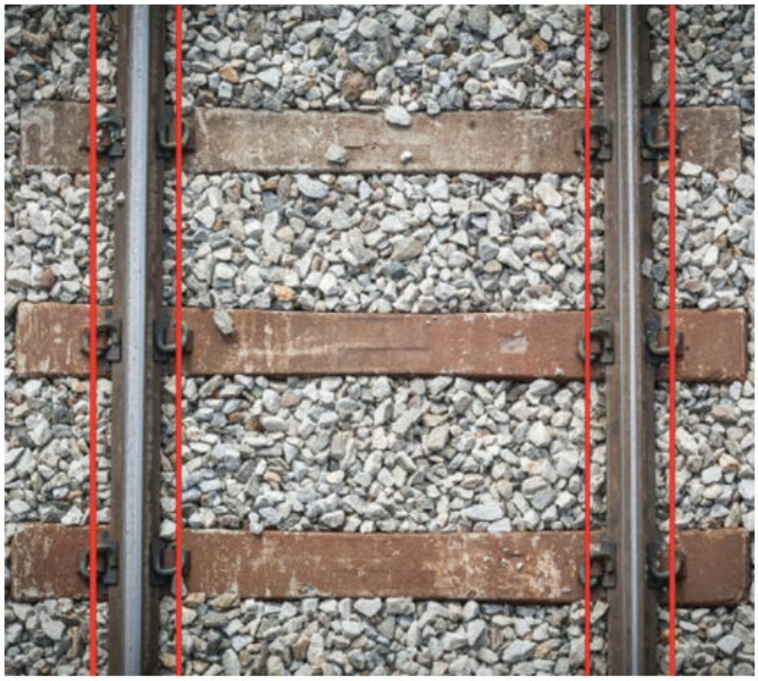

Figure 2. HDRI, a valuable technology for railroad track inspection, ensures image capture in variable lighting and weather conditions, including when a section of track is covered by shadows. (Image Credit: Teledyne DALSA)

In the case of rail inspection, high-speed sensors trigger the camera to capture frames at twice the typical frame rate. The first frame of this "double exposure" relies on a short exposure time that ensures bright areas of the railway are not over-saturated, while the second image has a longer exposure time to provide visibility of the darker area of track. In-camera image processing ensures the timely integration and analysis of the composite images, and triggers alerts or identifies the location if a problem is detected (see Figure 2).

The same principle applies to other intelligent traffic or transportation applications where the lack of sufficient lighting may otherwise yield insufficient detail. In the case of red-light cameras, for example, a high dynamic range image ensures that license plates are visible even under variable lighting.

OTHER APPLICATIONS

High dynamic range imaging also has multiple applications in manufacturing environments, where inspections of multi-colored objects have posed a challenge. One example is the inspection of assemblies that include high-contrast components, such as printed circuit boards that have highly reflective solder joints interspersed with dark integrated circuits or green solder masks.

In this case, the combination of reflective metal parts with darker materials requires that users determine which area needs the greatest focus and then design the inspection system accordingly. High-intensity lighting captures dark elements and over-saturates reflective parts, while lighting appropriate for bright areas makes the dark components impossible to view.

With high dynamic range imaging, the use of multiple synchronized exposures ensures that the optimized exposure time produces good image detail regardless of object contrast. The result can be either independent images or consolidated images that provide visibility of both light and dark elements.

High dynamic range imaging capabilities are now available in some line scan cameras as well. Multi-line scan cameras accommodate high dynamic range by capturing simultaneous images with varying exposures: the first line with a short exposure, the second with a longer exposure. The different exposures provide two images with different intensities.

Inspections using line scan cameras that offer high dynamic range imaging are becoming more and more common in the production of banknotes. New generations of banknotes from around the globe now incorporate security features designed to prevent counterfeiting, including the use of metallic threads or strips. Because the metal elements can be highly reflective, making them much brighter than the material around them, they can make the print inspection of banknotes difficult to accomplish with traditional machine vision technology.

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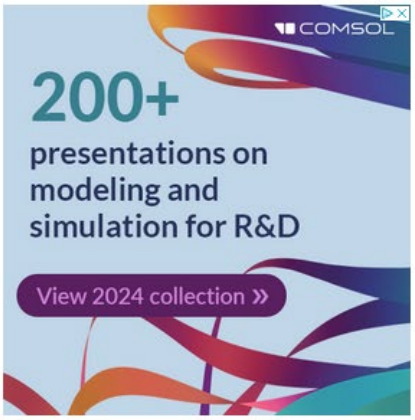

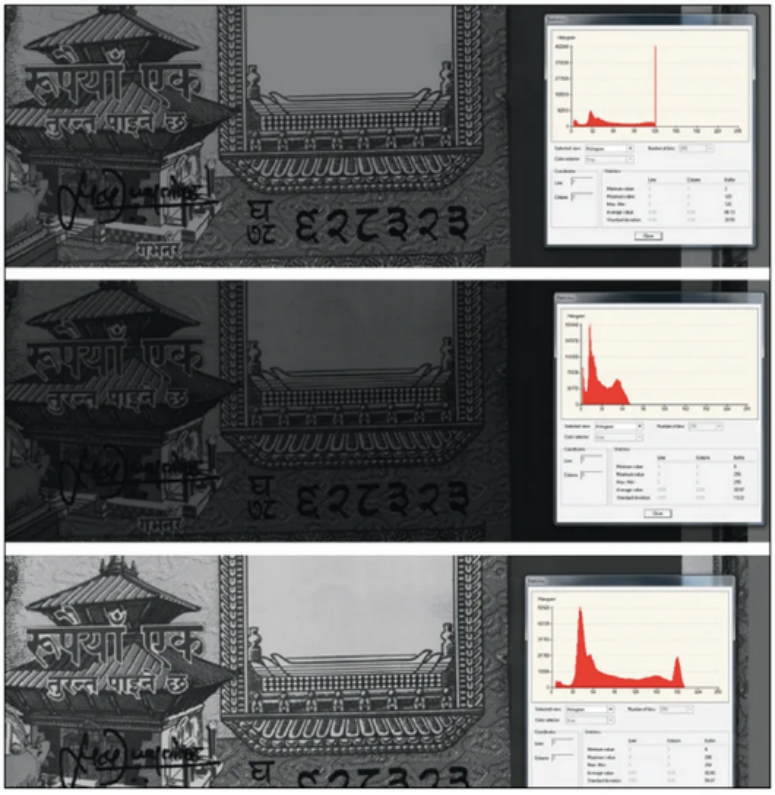

Figure 3. Teledyne DALSA's Linea™ line scan camera uses long exposures and half gain (shown in top image) and short exposures (shown in middle image) to highlight flaws with banknotes. The final HDR imaging results appear in the bottom image. (Image Credit: Teledyne DALSA).

With traditional image capture, the use of lower-intensity lighting could accommodate the metallic surface, but the non-reflective surface would become difficult to inspect because it would appear too dark. With today's line scan technology, cameras can be preprogrammed to use different exposure times per line, increasing the object-image contrast. Thus, images captured using short exposure can highlight problems with the metallic elements of the banknote, while the image taken with a longer exposure ensures visibility of the dark area (see Figure 3).

In both area and line scan cameras, high dynamic range allows for comprehensive visibility in light and dark elements, in bright and dark environments, and across a wide range of inspection applications, including intelligent transportation systems, print inspection, electronics and printed circuit board inspection, medical imaging, and food and beverage inspection — increasing a user's inspection capabilities far beyond what is possible with only a single exposure time.

This article was contributed by Manny Romero, Product Manager at Teledyne DALSA (Waterloo, Ontario, Canada). For additional information, visit http://info.hotims.com/55590-155 .

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