

HDR Photography of Products

Richard M. Adams II*, Alexandru Andrei*, Dusan Sigulinski*,
and Tanya Walters*

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Abstract

First conceived in 1850, HDR, or high-dynamic-range, photography was introduced to Photoshop in Adobe Creative Suite 2 (Photoshop 9) as the Merge to HDR function. HDR has recently been incorporated into newer digital SLR cameras including the Pentax K and Sony Alpha line. HDR attempts to overcome the limited density ranges of photography and print as compared to the human eye. The technique involves combining multiple exposures that capture the highlight and shadow detail of high-contrast scenes, such as sunsets or brightly illuminated buildings against dark backgrounds. Online image galleries showcase HDR's aesthetic affects, in which photos often have a posterized or surrealistic appearance.

This study was performed to determine the value of HDR photography in capturing low-key subjects, such as products for publication in magazines, catalogs, and newspapers—specifically, whether HDR would bring out more highlight and shadow detail without creating a posterized look. The authors compared conventional Camera Raw (DNG) captures with HDR captures made automatically by a Pentax K-r DSLR and manually in Photoshop. Captures were made on a studio copy stand with a 3M/Stouffer 12-step grayscale at the edge that was used to plot a tone reproduction curve comparing percent dot area in Photoshop with density of the original.

HDR compressed the tone reproduction curve and also brought out more shadow contrast in low-key images. By subjectively evaluating proofs of conventional and HDR photos, the authors observed that

*School of Graphic Communications Management, Ryerson University,
Toronto, ON, Canada

HDR images can be captured of low-key subjects that have more detail but avoid a posterized look. However, HDR processing added about 22 sec. to each camera HDR photo and 48 sec. to each Photoshop HDR merge. In a 100-photo catalog scenario where each subject took 2 minutes to set up, HDR could add 10–25% to production time.

Introduction

First conceived in 1850, HDR, or high-dynamic-range, photography was introduced to Photoshop in Adobe Creative Suite 2 (Photoshop 9) as the Merge to HDR function. HDR has recently been incorporated into newer digital SLR cameras including the Pentax K and Sony Alpha line. HDR attempts to overcome the limited density ranges of photography and print as compared to the human eye. The technique involves combining multiple exposures that capture the highlight and shadow detail of high-contrast scenes, such as sunsets or brightly illuminated buildings against dark backgrounds. Online image galleries showcase HDR's aesthetic affects, in which photos often have a posterized or surrealistic appearance.

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Literature Review

Little technical literature appears to exist on the practical use of HDR photography for publication. Sammons (2010) instructional book shows samples of high-contrast indoor and outdoor scenery, captured with both conventional and HDR photography. The author points out that HDR works best for high-contrast scenes where the user wants to see all visible detail. This principle is also important in product photography, where the prospective customer wants to see detail in products.

Moughamian (2010) explains Photoshop's Merge to HDR Pro automation function (File > Automate). He points out that 3–5 exposures work best for HDR photography.

Procedure

1. Using a Pentax K-r CMOS 12-megapixel digital SLR camera with a Pentax 18–55-mm zoom lens, the authors photographed various subjects containing low-key and high-key elements, including a 3D black greeting card, a feather table decoration, and some dark statues (Figure 1) using conventional and HDR photography. A 3M/Stouffer 12-step grayscale was included with each exposure for use in plotting a tone reproduction curve. Images for merge to HDR in Photoshop were captured with a ± 0.5 , 1.0, and 1.5 EV bracket.
2. HDR photography was done using Photoshop CS5's File > Automate > Merge to HDR Pro function with default settings (Figure 2) and with the built-in HDR mode on the Pentax K-r DSLR camera.
 - a. Photoshop was used to merge photos captured on the Pentax K-r as Camera Raw digital negative (DNG) files.
 - b. The K-r's HDR settings include 5 modes: HDR-Auto, HDR, HDR1, HDR2, and HDR3 (Figure 5). Each successive setting has a wider exposure range, meaning it captures a wider range of density but also produces a more posterized look. HDR captures can only be saved in JPEG format.
3. Captures were opened in Photoshop, and the Window > Info palette was used to read the percent dot area of each of the 12 grayscale steps. Dot areas, along with the original grayscale densities, were saved in Excel and used to plot a tone reproduction curve, "Density of Original vs. Percent Dot Area of Reproduction."
4. After opening in Photoshop, captures were visually evaluated on a calibrated Apple iMac display. The authors compared overall lightness and darkness, highlight and shadow detail, and tone and color match to the original, with special reference to the "posterized" look that characterizes some HDR photos.
5. The authors also captured a 140-patch Macbeth ColorChecker SG target with the K-r camera's HDR setting and used it to make a

camera ICC profile with X-Rite's i1 Match software. The profile was applied to images using Photoshop's Edit > Assign Profile command. Delta-E color difference was compared between the original target's LAB values and those of the unprofiled and profiled captures.

6. To assess the effects of HDR photography on productivity, the authors timed the exposure steps with a stopwatch. Producing HDR images with Photoshop is a two-step process where images are first opened in a preview window and then merged to make a single HDR photo. The Pentax K-r camera's HDR feature is also a two-step process in which 3 exposures are made and then merged in the camera, during which a "Processing image" message with progress bar is displayed. The time to produce one Photoshop HDR image and one Pentax K-r HDR image was compared with a baseline of exposing and opening a JPEG image in Photoshop. Results were compared using a hypothetical catalog job consisting of 100 images.

Results and Discussion

Visual evaluation. Examining captures on-screen, the authors observed that HDR photos of products could be made that bring out more detail than conventional photos while avoiding the posterized look characteristic of HDR photography.

Tone reproduction. Tone reproduction curves (Figure 3) showed that HDR compresses the tonal range of photos, producing a curve that is flatter and has less contrast than with conventional photos. The wider the exposure range of original photos, or the higher the level of camera HDR, the flatter is the tone reproduction curve and the less contrast there is in the reproduction (Figure 4).

ICC profiling. The authors observed that applying an ICC camera profile to HDR photos corrects hues and provides a closer match to the original subject (Figure 5). Comparing the average ΔE color difference between the original Macbeth ColorChecker SG target and captures thereof, the unprofiled Pentax K-r had a ΔE of 4.95 for a conventional photo and 5.30 for an in-camera HDR photo, which were not statistically significant. Assigning a profile reduced the conventional capture's ΔE to 2.67 and the HDR capture's ΔE to 3.41.

Effect on Productivity. Timed with a stopwatch, a 6-megapixel in-camera HDR on the Pentax K-r DSLR took 2.52 sec. to expose and 10.24 sec. to process, for a total of 12.76 seconds (Table 1). Merging

three 12-MP DNG files to HDR in Photoshop required 15.57 sec. to open the files and 13.35 sec. to merge them on a 2.4-GHz MacBook, for a total of 28.92 sec. The time was reduced to 20.47 sec. by using 6-MP JPEG images. In a catalog production scenario requiring 100 images, each of which takes 2 minutes to set up (including positioning, lighting, zoom, and exposure), capturing with in-camera HDR would add 21.27 min., or about 11%, to the 3.33-hr. production time. Merging HDR in Photoshop would add 34 minutes, or 17% more time, for 6-MP JPEGs and 48 min., or 24% more time, for 12-MP DNG captures. Service providers would need to weigh the cost of the additional production time against the benefits of HDR in showing more image detail that could be important for consumers.

Table 1. Time			
	<i>1 Photo</i>	<i>100 Photos¹</i>	<i>% Job Time</i>
Conventional			
Open 6-MP JPEG	1.07 sec.	1.78 min.	0.89%
Open 12-MP DNG	5.84	9.73	4.87%
In-camera HDR			
Expose	10.24 sec.	4.20 min.	
Process	2.52	17.07	
Total	12.76	21.27	10.63%
Photoshop HDR from 6-MP JPEG			
Open JPEG	7.91 sec.	13.18 min.	
Merge JPEG	12.56	20.93	
Total	20.47	34.12	17.06%
Photoshop HDR from 12-MP DNG			
Open DNG	15.57 sec.	25.95 min.	
Merge DNG	13.35	22.25	
Total	28.92	48.20	24.10%

¹ Assumes 100-photo job with 2 min./photo setup time or 3.33-hr. production time.

Conclusions

The authors concluded that HDR photography, using either in-camera settings or Photoshop's Merge to HDR Pro automation, can be used to capture product images that show more detail while avoiding the characteristic posterized look. Applying an ICC camera profile slightly increases the color match to the original. HDR does increase production time. Depending upon setup time, it could add 10% or more to the time required to complete a large job.

After preparing the poster session that led to this paper, the authors attended the 63rd Annual TAGA Conference keynote presented by Narasimhan (2011). The speaker mentioned that cameras aim for color intensity instead of color accuracy, thus the middle image used when making an HDR photo focuses on color intensity since it is the "standard" photo that a camera would take. Once this middle picture is

removed from the equation and just the high key and low-key photos are combined the middle is interpolated by Photoshop and actually goes on to create a very color-accurate image. By removing the photo that focuses on color intensity we were able to remove the cartoonish effect of the photos and introduce a much more color accurate capture.

Ideas for Further Research

While working on this project the authors recognized several additional areas where research on HDR photography could be helpful:

1. How does in-camera HDR compare on different cameras, such as Pentax and Sony?
2. How does the dynamic range of HDR photography compare with that of Camera Raw, which also captures a wide range of highlight and shadow detail?

References

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- Narasimhan, Srinivasa. 2011. Lights, Camera, Action! Keynote address at 63rd Annual TAGA Meeting, Pittsburgh, PA, March 6, 2011.

Figures



Figure 1a. Subjects used to study the effects of HDR photography for use in capturing products.



Figure 2. HDR modes on the Pentax K-r digital SLR camera.

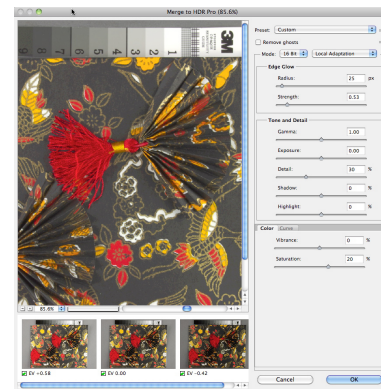


Figure 3. Merge to HDR function in Photoshop.

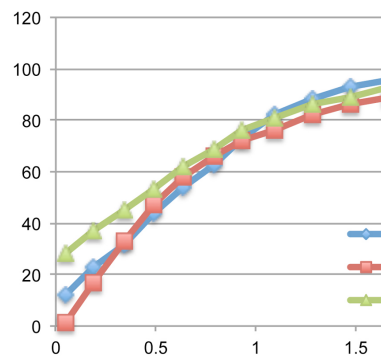


Figure 4a. Unprofiled HDR capture.

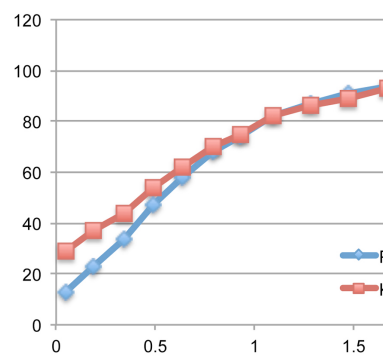


Figure 4b. Profiled HDR capture.



Figure 5a. Normal photo



Figure 5b. Pentax K-r HDR Automatic



Figure 5c. Pentax K-r HDR



Figure 5d. Pentax K-r HDR-1



Figure 5e. Pentax K-r HDR-2



Figure 5f. Pentax K-r HDR-3



Figure 6a. Unprofiled HDR capture.



Figure 6b. Profiled HDR capture.