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John J. McCann and Alessandro Rizzi, Eds., 389 pp., ISBN 978-0-470-66622-7, John Wiley & Sons, Ltd. (2011), $135 hardcover.

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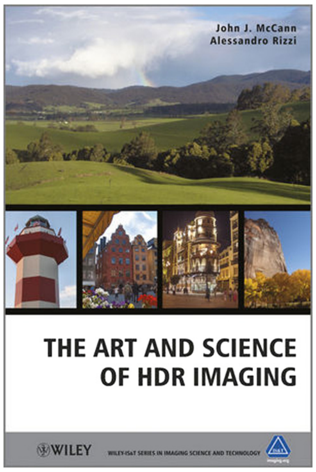

High dynamic range (HDR) imaging is a topic that invariably surfaces in any discussion of cameras or image enhancement applications. Dynamic range is the ratio of the light from the lightest areas to the darkest areas in an image. A given image output, such as a LCD display or a photographic print, typically has only a small range of colors and intensities within its gamut for producing an image. On the other hand, in actual scenes, the dynamic range can be huge; over 1000:1 ratios between sunlit portions and shadows are common. HDR imaging describes all facets of image processing on HDR scenes, including the mapping of these scenes into (possibly) lower dynamic range image outputs.

The book points out that this mapping problem (from HDR scene to output media) is one that has been tackled by humans for thousands of years, from the cave artists to the Renaissance to film systems and now digitally. The book is part history lesson, part scientific notebook, and part tutorial on a biologically inspired point of view of HDR imaging.

The book contains a total of 36 chapters, arranged in six sections. In Section A, a fascinating history of imaging commences. This part of the book also paints various mental analogies for HDR imaging, comparing the process of mapping the colors of the scene to the output media as analogous to cramming the furniture from a large house into a smaller one. More than a dozen color reproductions from artists across time and geography stunningly illustrate the result of artists' efforts to map the colors they saw to the available palette of paints. A lively history of photography follows, with examples of HDR photographs produced with dodging and burning and by combining multiple negatives and exposures. These chapters are about the personalities as much as the processes. Scientists such as C.E.K. Mees from Eastman Kodak's Research Labs and photographer Ansel Adams are highlighted. In this section, the book is at its very best.

In Section B, the narrative turns to measuring the dynamic ranges of scenes and images, and terms of the trade such as irradiance and radiance are introduced. The book remains accessible to the beginner, and it contains a glossary of terms to help all readers keep the definitions straight. This section, and Section C that follows, introduce the relationship between veiling glare and dynamic range. As glare increases, achieving a good signal in the dark portions of the image becomes impossible, thus lowering the dynamic range. Fortunately, the human visual system (HVS) contains the mechanism to counteract this effect, whereby perceived lightness depends on both the value of a patch, and local and global contrast. Sections C, D, and E largely describe specific experiments that were performed by McCann and his colleagues to investigate the relationship between the perceived lightness of patches, their actual reflectances and photometries, and various configurations of scene components. Section C investigates the effects of glare, Section D studies the scene contents and contrast patterns, and Section E studies constancy of color and 3D information with respect to HDR. These sections describe many of McCann's studies, all to emphasize that perception by humans is complicated, and our perception of a color patch depends not just on the characteristics of that patch, but also on the characteristics of both near and far surrounding patches as well. These sections contain many high-quality color figures, so the reader can experience firsthand the effects of his or her visual system to a wide variety of visual stimuli. This portion of the book reads like one optical illusion effect after the next, and the breadth of the studies is impressive.

Finally, Section F presents a summary of HDR processing algorithms, with the most emphasis on the Retinex algorithm originally proposed by Edwin Land and extended by McCann. Again, this part of the book is part history lesson, part descriptions of algorithms for processing images, and again impressive color figures show stunning before-and-after images.

Overall, the book provides an interesting history of HDR, imaging in general, and photography (more chemical than digital). The flow of the narrative is smooth, although it feels a bit unnatural when McCann is referred to in the third person. The book covers a wide range of processing algorithms, although Retinex variants and ACE are given the most in-depth coverage. Other tone-mapping algorithms (e.g., bilateral filtering for HDR), which are highly regarded in the graphics community, seem to not be given as much credit as they might deserve, perhaps because they are not seen as attempting to imitate the visual process.

This is one area where perhaps the authors could explain their philosophy bit more. It is clear that scene dynamic range must be compressed to fit within the range of output media. Further, the book convincingly explains that the HVS naturally will compress the range of HDR scenes. However, it is not clear that the best strategy for reducing scene dynamic range in an imaging path should contain the same mechanisms as the human visual system, especially since the resulting image will be viewed by a human. This is a point of philosophy, and it appears that the authors would be well equipped to enter into a discussion on the topic.

Overall, this book provides an excellent overview of the history of imaging, HDR imaging algorithms, and the abilities of the human visual system. The book is a great achievement for the authors, and it will be well appreciated by anyone who enjoys learning about a field from the key players. Most importantly, it will encourage the reader to think about how visual processing works, and how that process can serve as a model for imaging systems for HDR images.

Andrew Gallagher has been a visiting research scientist at Cornell University's School of Electrical and Computer Engineering since June 2012. He earned the PhD in electrical and computer engineering from Carnegie Mellon University in 2009, advised by Prof. Tsuhan Chen. Before that, he earned his MS from Rochester Institute of Technology in 2000, and BS degree from Geneva College in 1996. Andrew worked for the Eastman Kodak Company from 1996 to 2012, initially developing image enhancement algorithms for digital photofinishing. These efforts resulted in more than 90 issued U.S. Patents and Kodak's Eastman Innovation Award in 2005. More recently, Andrew's interests are in the arena of improving computer vision by incorporating context, human interactions, and unique image cues.