

## Retinex at 40

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Edwin Land first described the Retinex idea in the 1963 RESA William Proctor Prize Address, Cleveland, Ohio, on December 30, 1963. He said that it was fruitful to suggest that receptors exist in sets. A Retinex is all mechanisms from retina to cortex necessary to form images in terms of lightness. This was a distinct departure from the point-by-point thinking that dominated physics and colorimetry. It required that models of color appearance evaluate all the pixels in the field of view as input. It is difficult in today's world, dominated by digital images, to imagine just how novel this idea was in the 1960s. Nevertheless, many experiments in the 60s were fundamental to our understanding of human vision. Hubel and Wiesel's studies of cat and monkey cortex, Land's Mondrians, and Campbell and Robson's work on human spatial frequency responses all made a strong

case for the idea that vision is the result of image processing of spatial information found in the image. The physics of receptor quanta catches dominates the first step in vision, but cannot be used as a model for the rest of the visual appearance process. All receptor quanta catches are the input to the multiple spatial comparisons that generate appearance.

If human vision depends on spatial processes, then imaging technology will greatly improve performance when cameras make spatial comparisons. Digital imaging technology started with very primitive imaging devices in the 60s. Rapid advances were made in remote satellite imaging in the 70s, and graphic arts systems in the 80s. Common usage of amateur digital cameras happened in the 90s and amateur cameras with Retinex algorithms became available in 2003.

This special section includes many aspects of spatial vision. It has an an-

notated bibliography of papers by Land and his colleagues, experiments on spatial vision in humans, a review of early applications of human vision to imaging technology, and a wide variety of different implementations of spatial imaging applied to digital images.

I want to thank the authors and the referees who worked long and patiently to produce this special section. It was based on the joint conferences of Human Vision and Electronic Imaging VII; Color Imaging: Device-Independent Color, Color Hardcopy, and Applications VII; and Internet Imaging III at the IS&T/SPIE Electronic Imaging Symposium in January 2002. Although the conference proceedings have a different author list than this journal special section, the last time a majority of the authors were in the same room was at EI. The photograph below was taken at that session.



Left to right: Bob Sobol, Ted Cooper, Jack Cowan, Jon Frankle, John McCann, Daniele Marini, Hawley Rising, Reiner Eschach, Carlo Gatto, Ale Rizzi, Zia-ur Rahman, Irwin Sobel, Doren Saked, Shin-fya Ishihara, and Brian Funt.



**John J. McCann** received his BA degree in biology from Harvard University in 1964. He managed the Vision Research Laboratory at Polaroid from 1961 to 1996. His work concentrated on

research in human color vision, large format

instant photography, and the reproduction of fine art. He is a fellow of the IS&T. He is a past president of IS&T and the Artists Foundation, Boston, Massachusetts. In 2003, he received the IS&T/OSA Edwin Land Medal. He is currently consulting and continuing his research on color vision.