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Human Vision

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The human visual system is an exquisitely engineered system that can serve as a model and inspiration for the design of many imaging systems. Optics and optical engineering play a key role in developing new techniques and approaches for both the study of human vision and the design of novel imaging systems. For example, advances in optical sensing and imaging have led to important discoveries about retinal image processing, and optical design tools are necessary for improving vision in patients. While advances in optics are improving our understanding of the human visual system, this understanding has also led to improvements in artificial vision systems, image processing algorithms, visual displays, and even modern optical elements and systems.

Vision is a major modality by which people obtain information and interpret the world, and investigating and improving vision is undoubtedly an important endeavor. Historically, papers on human vision were well represented in *Optical Engineering*. Over the last decade, however, the number of papers on this topic has declined. This special section on human vision is intended to bring vision, visual optics, and optics for vision back into the folds of the journal. This special section includes a series of articles that describe how optics is used to investigate human vision, how new methods for correcting or enhancing human vision are developed and evaluated, and how models of human vision can be used to design and evaluate other imaging systems. Several articles describe new optical imaging techniques such as quantitative anterior segment optical coherence tomography that measure 3-D biometry of the cornea and the lens in the front of the eye. Some of the techniques discussed here, such as aberrometry or reflectometric ocular optical quality analyzers, have already made their way into clinical practice and are being continually improved. Doppler measurements of physiological function may become standard diagnostic tools in the clinic. The better resolution, accuracy, and comprehensive information provided by these techniques will allow earlier diagnosis of disease, accurate monitoring of treatment, and guidance for treatment and surgery.

Optical engineering and design plays a critical role in improving vision. Virtually all vision correction alternatives—spectacles, contact lenses, refractive surgery, intraocular lenses, and low vision aids—depend on an understanding of optics. 25% of the population are myopic in western populations (90% in some areas in Asia), and 100% of the population over 45 years are presbyopic. These statistics motivate the need for improved and more efficient methods for correcting vision. And using optics to enhance the vision of the more severely visually impaired patients greatly improves their quality of life. Advances in our understanding of human optics will lead to the development of new vision corrections, allowing a higher degree of customization for both young and old patients.

This special section on human vision emphasizes the use of optics as an enabling technology to both advance our understanding of human vision and to develop new imaging systems for the enhancement of human communication. We hope to see many more articles on human vision in future issues of the journal.

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Joyce Farrell received a BS from the University of California at San Diego and a PhD from Stanford University, both in the area of experimental psychology. She has more than 30 years of research and professional experience working at a variety of companies and institutions, including the NASA Ames Research Center, New York University, the Xerox Palo Alto Research Center, Hewlett Packard Laboratories, and Shutterfly. She is currently a senior research associate in the Stanford School of Engineering and the Executive Director of the Stanford Center for Image Systems Engineering.