INTRODUCTION

The dependence of technological progress on advances in basic science is obvious to nearly everyone. The reciprocal dependence of scientific progress on advances in technology, however, is sometimes overlooked. It is increasingly clear, for example, that further advances in television technology will depend on understanding its interactions with the human visual system. What may not be obvious to everyone, however, is that many recent discoveries in human vision have relied on the use of television technology.

The interdependence of visual science and visual technology formed the basis of a topical meeting on applied vision, held in July 1989, jointly sponsored by the Optical Society of America and the National Aeronautics and Space Administration. Early versions of many of the feature papers in this issue were initially presented at that meeting. The goal of that meeting and of this feature is to strengthen the mutual exchange between those who study the basic properties of the visual system and those who apply what is learned. The meeting and the feature were predicated on the assumption that increasing communication in both directions will serve both groups. Basic research provides the understanding on which solutions to applied problems depend. Applied research, in turn, calls attention to important unanswered basic questions about vision. Moreover, applied research often leads to results with important implications for basic science. For example, the color coding convention chosen by the National Television System Committee depends on an important property of image coding in the human visual system that is just now beginning to be understood. And as we have argued, applied research often provides improved technology for basic research.

Applying technology forces the engineer to articulate a problem concretely and to seek the relevant principles of basic science to solve it. But basic researchers can easily lose sight of some of the most important questions in vision, and they have little impetus to seek out the new technologies arising from applied research until they know that these new technologies exist. Therefore we have decided to position these papers as a feature in an issue of the Journal of the Optical Society of America A, where they are more likely to be seen by basic researchers than in another, equally appropriate journal, such as Applied Optics.

As with all features in this journal, the papers appearing here are those that were submitted in response to an announcement, passed the criteria for quality and appropriateness, and conformed to our inflexible time constraints. Therefore the papers appearing here reflect currently active topics in applied vision rather than our preconceived ideas of what should be included. Many important topics were left out simply because a suitable paper was not submitted within our time limit.

The issue begins with a paper by Watson wherein he uses a model of the spectral, spatial, and temporal sensitivities of the human visual system as an ergonomic driving force for the design of efficient digital codes for images intended for human viewing. He has outlined a scheme that removes information to which the human is insensitive, that hides signal distortions introduced by quantization, and that is error tolerant, device independent, scalable, and extensible.

The next three papers, by Silverstein et al., by Sigel et al., and by Farrell and Fitzhugh, address the problem of eliminating the artifacts that result from undersampling a high-resolution image and reconstructing it at a lower resolution. The issues raised in these papers will assume greater importance as flat panel displays become more readily available.

Two papers, by Smallman and Boynton and by Nagy et al., explore how to use color effectively to code information. A bright and distinctive color can make a car stand out in a parking lot or signal to the operator of a nuclear power plant that a problem that demands the operator's attention has occurred. Why this is so is still largely a mystery, and the designers of control interfaces have little more than rules of thumb to guide their work. These two papers provide design principles and link these phenomena to theories of vision.

The papers by Legge et al. and Arditi et al. address the problems of legibility of text that arise in the design of electronic display devices, printing systems, and lighting. The first paper separates the contribution of luminance and color to legibility and relates the results to the mechanisms of human visual coding, and the second separates the conditions in which proportional spacing of letters hinder reading from those that enhance it.

Three papers are devoted to metrics for assessing the quality of images made on any arbitrarily selected device. These papers, by van Meeteren, by Barten, and by Peli, define indices for complex scenes that predict visual performance. Such metrics are necessary to guide and evaluate display designs.

The feature ends with two papers by Brill. One discusses and extends several recent results on color constancy, and it suggests how a computational algorithm could be built into a machine to segment objects by color. In the final paper, Brill formally analyzes the influence of rods on color vision under mesopic conditions, i.e., at the luminances of most electronically generated displays.

These papers do not exhaust the interesting topics in applied vision, but they do sample an important subset.
Moreover, they illustrate the richness of the potential exchange between applied and basic researchers and the opportunities for benefit to both.

We are grateful to the Executive Committee of the Optical Society and to NASA for agreeing to sponsor the applied vision meeting and to Laura Hughes for her efforts and support in organizing the San Francisco meeting. We also thank the Executive Committee and the editors of this journal for publishing this feature. Finally, we thank Harry Barrett, the editor of *Journal of the Optical Society of America A*, and extend special thanks to Cathy Barrett and Jane Lockwood for the hard work distributed over many months that they invested in this issue.

Jim Larimer, chair
Joyce Farrell
William Glenn
Walter Makous
Feature Editors
Applied Vision
Perceptual-components architecture for digital video
Effects of spatial sampling and luminance quantization on the image quality of color matrix displays
Visual artifacts in chromatically subsampled images
Discriminability metric based on human contrast sensitivity
Segregation of basic colors in an information display
Visual search for color differences with foveal and peripheral vision
Psychophysics of reading. XI. Comparing color contrast and luminance contrast
Reading with fixed and variable character pitch
Characterization of task performance with viewing instruments
Evaluation of subjective image quality with the square-root integral method
Contrast in complex images
Image segmentation by object color: a unifying framework and connection to color constancy
Mesopic color matching: some theoretical issues

Andrew B. Watson
Louis D. Silverstein,
John H. Krantz,
Frank E. Gomer,
Ye-Yu Yeh,
Robert W. Monty
Claude Sigel, RuthAnn Abruzzi,
James Munson
Joyce E. Farrell,
Andrew E. Fitzhugh
Harvey S. Smallman,
Robert M. Boynton
Allen L. Nagy,
Robert R. Sanchez,
Thomas C. Hughes
Gordon E. Legge,
David H. Parish,
Andrew Luebker,
Lee H. Wurm
Aries Arditi, Kenneth Knoblauch,
Ilana Grunwald
A. van Meeteren
Peter G. J. Barten
Eli Peli
Michael H. Brill

1943
1955
1969
1976
1985
1995
2002
2011
2016
2024
2032
2041
2048