Guest Editor’s Introduction:
The Exotic Becomes the Credible

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For many years, the industry viewed optical processing and computing as exotic approaches to perform exotic functions with exotic materials for exotic applications. Today, optics loses some exoticism but gains credibility. Technological advances in compact solid-state laser sources, high-bandwidth detectors and modulators, micro-optic components, and new holographic materials make possible demonstrations of optoelectronic systems that combine the high parallelism of optics with the accuracy of digital electronics.

The present issue of IEEE Micro highlights some of these achievements, from component level to system integration.

First, M. Taghizadeh and coworkers review the design, microfabrication, and performance of computer-generated holograms as free-space interconnection elements for photonic switching and computing. They present fan-out array generators and their integration in optical cellular logic image processors and optically connected parallel machines.

In the area of optical data storage, P. Marchand et al. describe the concept and implementation of an original technique capable of retrieving data from optical disk systems in parallel.

Nonlinear optical processing is the subject of the next article. E. Lange et al. report on a monolithically integrated optoelectronic neural chip. Based on an integrated array of photodetectors of variable sensitivity, this chip performs high-speed neuroprocessing and offers on-chip weight storage and learning capabilities. In an artificial retina configuration, the chip performs basic image processing operations such as feature extraction and Fourier or discrete cosine transformations.

The last two articles cover the area of image processing for pattern recognition and vision systems. E. Washwell et al. look at the prospects and problems of optical correlators. In particular, they outline the performance of spatial light modulators required in optical correlators to outperform their electronic counterparts; they also propose an electronically controlled multichannel architecture to overcome current technological limitations. F. Reichel et al. illustrate the use of liquid crystal spatial light modulators for spatial frequency analysis. The authors unveil and describe a fully developed incoherent image-processing system for a variety of applications in industrial quality control, identification, and classification.

This theme of IEEE Micro will be completed next issue with additional articles. For example, A. Louri et al. will explore the use of optics to implement a sorting algorithm on n data at a constant time, thus improving state-of-the-art sorting requiring O (log n) steps and O (n^2) processors. R. Chamberlain will discuss inverted graph topologies such as a hypercube and an inverted mesh. These topologies exploit the advantages of optical interconnections in tightly coupled multicomputer systems.
I hope that this December issue and the next one will illustrate the growing appeal of optical technologies in processing and computing and show that, for selected applications, photons are really good friends of electrons.

Acknowledgments
I sincerely thank all the authors, reviewers, and the editorial team of *IEEE MICRO* for their hard work, responsiveness, and patience.

Henri Rajbenbach is a research scientist at the Thomson-CSF Corporate Research Laboratories. His research activity includes nonlinear optics, photorefractive materials, optical pattern recognition, and optoelectronic correlators. He published numerous papers in these areas and contributed to two textbooks on photonic computing. Earlier, he worked at the University of California at San Diego on optical parallel data processing.

Rajbenbach graduated from the Ecole Superieure de Physique et Chimie Industrielles, Paris. He engaged in research on photorefractive materials and received his PhD from the University of Paris VI working on nonlinear optical media. He is a member of Optical Society of America, Society of Photo-Optical Instrumentation Engineers, the European Optical Society, and the Societe Francaise d’Optique.

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