

Photonic Switching and Interconnects

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It would be tempting to dig out our crystal ball, especially at the start of the last decade of a century, to see what the future might bring to the field of photonic switching and interconnects. I shall not succumb to such a temptation but will merely introduce this special issue. As the title suggests, it is devoted to both photonic switching and interconnects. It is evident from the literature that there is significant research in switching and that work on interconnects is growing substantially. The boundary between the two fields is somewhat fuzzy, so it seems only logical to combine them into a single special issue, which in this case consists of seven papers.

The first paper is "Self-routing photonic switching with optically processed control," by Paul R. Prucnal and Philippe A. Perrier. This paper describes architectures based on code-division and time-division multiple access (or CDMA and TDMA for the experts). Self-routing is performed by detecting autocorrelation peaks of the header codes. Experimental results are presented that show self-routing of packets with 12.5 Gb/s pulse-interval time-division address sequences.

The second paper is "Demonstration of a photonic space switch utilizing acousto-optic elements," by W. E. Stephens, P. C. Huang, T. C. Banwell, L. A. Reith, and S. S. Cheng. This paper describes a switching system built around acousto-optic deflectors and power combiners. Point-to-point, multicasting, and "or-wiring" are experimentally demonstrated. The performance analysis of the 4×4 switch shows a 15 dB fiber-to-fiber insertion loss, a crosstalk of -20 dB, an extinction ratio of more than 30 dB, and a 0.8 dB polarization sensitivity, all at a 1.3 μm wavelength.

The third paper is by H. Inoue, T. Kato, Y. Takahashi, E. Amada, and K. Ishida and is titled "InP-based optical switch operating through carrier-induced refractive index change." It describes a thorough study of an integrated optic switch array made of crossing waveguides whose state (bar or cross) is controlled by current injection. In addition to the fabrication process of the 4×4 module, including fiber attachments, the authors report on high-speed operation and temperature measurements. Application of this switch in ATM (asynchronous transfer mode) networks is also suggested.

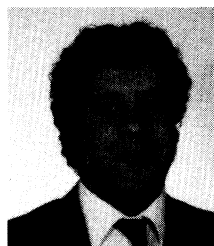
The fourth paper is "All-optical ultrafast nonlinear switching utilizing the optical Kerr effect in optical fibers," by Toshio Morioka and Masatoshi Saruwatari. It gives a detailed physical picture of the effects used for switching and reports on a 2 Gb/s all-optical complete demultiplexing of a 30 ps probe pulse train.

The fifth paper is "Surface-emitting microlasers for photonic switching and interchip connections," by J. L. Jewell, Y. H. Lee, A. Scherer, S. L. McCall, N. A. Olsson, J. P. Harbison, and L. T. Florez. This paper reports on the fabrication and characterization of two-dimensional arrays of lasers. These devices are essential for switching systems and interconnect architectures that take advantage of the parallelism of optics. Densities of up to 2 million lasers per square centimeter can be fabricated.

The sixth paper, by A. Marrakchi, W. M. Hubbard, S. F. Habiby, and J. S. Patel, is on "Dynamic holographic interconnects with analog weights in photorefractive crystals." It describes a photorefractive interconnect system with coherently erasable synapses, or PISCES. This system utilizes phase modulation to implement programmable analog weights. In addition to the storage capacity issues of an 8×8 network, it analyzes the state-of-the-art components that make up the system.

The final paper is "Dynamic holographic interconnects using static holograms," by Eric S. Maniloff and Kristina M. Johnson. The authors describe holographic alternatives to perform interconnections between spatially distributed processors. The interconnect system is based on the programmability and storage capabilities afforded by photorefractive crystals.

In conclusion, this issue is well balanced and represents the ongoing efforts on photonic switching and interconnects at different laboratories. The first paper addresses some architectural issues, the following three describe switching systems and devices, the fifth paper emphasizes the need for some critical components, and the last two deal with the problem of interconnects. I would like to thank all of the authors for their excellent contributions, and all of the reviewers for their helpful comments that enhanced the quality of each paper and of the issue as a whole. In particular, I would like to thank my colleague S. Habiby for his help in the early stages of editing this issue.



Abdellatif Marrakchi was born in Tangier, Morocco. He received MS and engineer's degrees and a "Doctorat 3eme Cycle" in electrical engineering, with majors in optics and instrumentation, all from the University Pierre and Marie Curie, Paris, in 1978, 1979, and 1981, respectively. His thesis work at Thomson-CSF Research Laboratories in Orsay, France, and the Swiss Federal Institute of Technology in Zurich involved holographic optical elements and real-time holography, phase conjugation, and two-beam coupling in photorefractive materials. He also received MS and Ph.D. degrees in electrical engineering, with a major in electrophysics and optics from the University of Southern California, Los Angeles, in 1983 and 1986, respectively. His dissertation work involved the physics and application of the photorefractive effect. In March 1986, he joined Bellcore, where his primary interests are the analysis of current technologies with potential application in the field of photonic switching and the optical implementation of neural networks. He has published numerous papers in these fields and holds two patents. Dr. Marrakchi is a member of the OSA, IEEE, and SPIE.