Guest Editorial

Spatial Light Modulators

David Casasent
Department of Electrical Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213

The real-time and parallel processing advantages of coherent optical processors are well known. The ease with which the Fourier transform and correlation operations (that are the hallmark of data processing and pattern recognition) can be performed optically has intrigued researchers for years. This once virgin discipline of optical computing is now maturing and emerging from the laboratory and research arena into deliverable and fielded systems. As this occurs, one of the key technology items that continues to plague program managers and contractors is the real-time and reusable spatial light modulator (SLM) used as the input (and often filter plane) transducer. Without such devices, the full speed advantages of optical processors cannot be realized.

In this special issue, eight invited papers summarize the current state of the art of these real-time and reusable replacements for photographic film. The applications discussed for these devices extend beyond coherent optical processing into the display and mass data storage markets which fostered much of their initial non-coherent imaging applications. Only devices that are currently being actively researched are included.

In the first paper, W. J. Burke et al at RCA summarize the status of volume phase holographic storage materials. These elements are intended for write/read and archival mass data storage applications. Major attention is given to Fe-doped $LiNbO_3$, the most promising and understood material of this class. The multitude of research on PLZT ceramics for displays, block data (page) composers, and optical memories and processors is then reviewed by C. E. Land of Sandia Laboratories. Photodichroic materials are often considered to be only volume storage media; however, as described in the review by Frank Caimi, Carnegie-Mellon University, these crystals are the subject of considerable present research as coherent optical processing elements.

Thermoplastic materials have long been of interest in optical processing. The present status of photoconductor-thermoplastic transducers, including many new developments by ERIM & Honeywell, is included in the paper by W. S. Colburn and B. J. Chang of ERIM. The pattern recognition and data processing applications of this candidate class of SLM are presently being emphasized.

The SLMs described in the last four papers (the Electron-Beam DKDP and the Photo-DKDP, by David Casasent, Carnegie-Mellon University; the PROM, by Bruce A. Horwitz, Itek; and the Liquid Crystal, by W. P. Bleha et al, Hughes Aircraft Company) have received the most use in diverse applications of any SLMs. The many optical data processing and image processing operations described in these four papers serve as an excellent review of the wealth of applications possible for optical processors.

From this state-of-the-art review of SLMs, considerable active research is seen to be in progress on these key technology items. No one SLM is a panacea and each of the devices discussed is in a different stage of research and development, although many are commercially available. Color displays using SLMs exist and CCD-addressed SLMs will soon materialize. Of utmost importance are the many reported instances in which these SLMs have been integrated into coherent optical processing *systems*. Optical computing is truly emerging as a viable technology due to many recent SLM advances such as those reported in these eight papers.

Other candidate 2-D SLMs exist on which papers could not be prepared for this issue. These are described in: Casasent, *Proc. IEEE, 65,* 143 (1977) and in SPIE Proceedings Vol. 83, *Optical Information Processing* (1976). Acousto-optic 1-D SLMs were reviewed in a recent special issue of *Optical Engineering* (September/October 1977, 16:5).