SLMs key to optical information processing, displays

The importance of spatial light modulators (SLMs), devices that impose spatial information patterns on optical beams, lies in their being the critical elements of optical information processing, communication, and display systems. Thus, SLMs, or light valves, are the key elements in most display applications—from wristwatches and miniature liquid crystal TV monitors, through flat panel displays to high brightness, large screen projectors for theaters, teleconferencing, and flight simulation applications.

SLMs also constitute a critical element in optical data processing (ODP) systems. Since the overall function of such systems is to use optical methods in processing information, SLMs are needed both as the input image generator and as the programmable reference or filter “mask.” In optical processors, SLMs also perform a variety of fundamental operations on parallel information patterns including: nonlinear thresholding and contrast modification, amplification and signal regeneration, parallel analog arithmetic, binary logic, and storage or memory latching functions.

Artificial neural networks may revolutionize the computation of complex problems in multiple constraint optimization, pattern recognition, associative memory, adaptive and learning systems, and in a host of additional challenging artificial intelligence domains such as symbolic processing, vision, speech, robotics, and expert systems. Optical implementation has significant advantages due to the inherent parallelism and interconnectivity of optics. Here again, SLMs are needed to present the optical data that is to be processed, as well as to encode stored information. Variable cross-coupling between multiple optical channels carrying high-bandwidth data—an operation called “cross-bar switching”—is expected to be a critical function required by communication systems and can be implemented with the aid of an SLM.

Progress in the development of SLMs, in particular for optical processing applications, has accelerated dramatically in the last few years. We are presently witnessing the implementation of novel optical materials such as quantum wells and ferroelectric liquid crystals in SLM devices. We are also observing the penetration of SLM technologies into new applications, namely those of phase conjugation, adaptive optics, and neural net systems. The actual implementation of real-time correlation using SLMs, perceived as a speculation only 10 to 15 years ago, is now a reality. Another evolving trend in this technology is the hybridization of the “classical” SLM with on-chip electronic processing elements.

The Topical Meeting on Spatial Light Modulators and Applications, to be held Sept. 10-12 in Incline Village (Lake Tahoe), Nev., is co-sponsored by the Optical Society of America and the Lasers and Electro-Optics Society of IEEE. The program will cover three main topics: (1) materials for SLMs, (2) novel device structures including hybrid devices, and (3) system applications where the emphasis will be on optical processing, neural network, optical interconnection, and active optics. A panel session addressing the future directions in SLM technical is scheduled for the first evening.

The meeting is of particular importance for scientists involved in designing next-generation ultra-high-throughput computer architectures involving optical interconnects and optical co-processor systems.

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