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Preface

This volume contains a collection of invited presentations intended to provide an authoritative overview of diffractive and miniaturized optics technology. Topics include analysis/design, fabrication, and application. The current status and projections for future directions of the technology are also described.

In the analysis of diffractive and miniaturized optics, Glytsis, Gaylord, and Bundrett reviewed rigorous coupled-wave theory and its applications specific to subwavelength structures where conventional scalar theory has been found inadequate. Raguin, Norton, and Morris analyzed subwavelength structures using effective medium theory and compared it against rigorous coupled-wave analysis. Studying both analysis and synthesis problems, Dobson and Cox developed mathematical models for diffractive optics. To design complex diffractive optics, Johnson et al. applied genetic algorithms and showed results of fast convergence, in addition to simulated annealing and gradient-based algorithms. Chen and Anderson provided many important system-designed examples, where diffractive optics simplified the optical design, improved the image quality, and lowered the cost and weight by reducing the number of lens elements and desensitizing the alignment tolerances.

The technology of fabricating diffractive and miniaturized optics has advanced. Akkapeddi et al. introduced the process of laser-assisted chemical etch. Zaleta et al. investigated electron-beam direct write on analog resists to reduce fabrication time and cost. Larsson et al. studied compensation techniques for electron-beam lithography to improve the quality of diffractive optics. Shvartsman offered a promising replication technology using photopolymer to reduce the cost of manufacturing diffractive optics. To characterize the fabricated diffractive optics, Ricks examined their scattering properties due to systematic and random sources of errors in fabrication and design. Behrmann, Bowen, and Mait analyzed their thermal behaviors and searched for ways to minimize the thermal effects.

Applications of diffractive optics also continue to expand. Beyond optical testing, wavefront transformation, scanning for diode laser printers, optical pick-up heads for CD players, and bifocal lenses, Raguin, Norton, and Morris showed that diffractive optics with subwavelength structured surfaces can perform the functions of antireflection coating, narrowband filters, and phase plates. Morrison et al. applied diffractive optics in free-space photonic switching networks; Lee applied them for optically interconnecting multichip electronic modules. Motamedi discussed the potential for merging micro-optics with micromechanics to create a new class of micro-opto-electro-mechanical devices, a couple of examples of which are laser scanners and dynamic micromirrors. Gal demonstrated application of diffractive optics in advanced sensors, an example being an array of dispersive microlenses for multicolor focal plane sensors.

In summary, advancement in all fronts of the technology are evident. For the field to prosper, more advancement in replication technology will help to reduce the cost of diffractive optics, leading to even more applications of this technology, which will in turn lead to new designs and further advancement in fabrication.

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