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Optical fabrication, testing, and metrology is at the heart of optical sciences. Over the past few years impressive developments related to the design, manufacture, and characterization of optical components and systems have opened the field to new and great possibilities.

Increasingly challenging requirements on optical components have led to the development of highly sophisticated optical fabrication techniques such as magnetorheological finishing, polishing using deformable tools, and computer-controlled polishing. These techniques allow optical components to be manufactured with arbitrary shape (i.e., freeform optics) and highest surface quality (e.g., figure, mid-, and high-spatial frequency roughness). With fabrication advancements come stringent demands on optical metrology. The latest highly stable and precise interferometers employ new mathematical techniques to assess surface shape, and advanced methods characterize surface roughness, including scanning probes and light-scattering techniques.

This special section of *Optical Engineering* provides a sampling of current state-of-the-art techniques in both optical fabrication and optical testing. Papers submitted include topics on magnetorheological finishing, ion beam figuring, aspheres fabrication and testing, astronomical telescope fabrication, new and improved optical testing techniques and instruments, surface characterization techniques, interferogram evaluation techniques, and specification of surface properties (such as shape, roughness, and defects).

Many of the manuscripts for this special section were solicited from individuals and groups from around the world who have been doing incredibly exciting work in the field. Several papers focus on the characterization of optical surfaces, in particular with respect to roughness and shape. Two papers discuss light-scattering techniques as an interesting way to analyze surface features such as roughness and defects. Shape measurement of freeform surfaces is

particularly challenging, and a variety of approaches are presented that tackle this issue. Finally, innovative manufacturing approaches particularly useful for the generation of freeform optics are included in this special section. Enjoy.

Daniel Malacara-Hernández obtained his PhD in optics in 1965 from the University of Rochester. He has published more than 130 refereed papers in optical engineering/optics journals. He is a Fellow, both of OSA and SPIE. In 1987 he was elected vice-president of SPIE. He served OSA as a topical editor for *Applied Optics* from 1989 to 1992. He also served SPIE as a member of the Board of Governors from 1990 to 1991. In 1989 he was granted the Rudolf and Hilda Kingslake Chair in Optical Engineering at the Institute of Optics of the University of Rochester. He was also awarded the A. E. Conrady Award for Scientific Achievement by SPIE in 1994, the Galileo Galilei Award by the International Commission for Optics in 1996, and the Joseph Fraunhofer Award/Robert M. Burley Prize from OSA in 2002. In 2012 he also received the Gold Medal Award from SPIE. His specific areas of research include optical testing and interferometry, optical design, and optical metrology.

Joanna Schmit, PhD, is a senior staff optical engineer at Bruker Nano Surfaces Division in Tucson, Arizona, USA. She specializes in 3-D optical microscopy with a focus on white light and phase shifting interferometry, as well as confocal microscopy. She received her MS degree in applied optics at Warsaw University of Technology, Poland, and earned her PhD at the Optical Sciences Center at the University of Arizona. She is the author of over 80 papers, 9 book chapters, and 11 patents; she is an editor of *The Optics Encyclopedia*. She is also an SPIE Fellow.

Sven Schröder graduated in physics and received his PhD from the Friedrich Schiller University in Jena, Germany. Since 2004, he has been with the surface and thin-film characterization group at the Fraunhofer Institute for Applied Optics and Precision Engineering in Jena. In 2007, he was a co-winner of the Thuringian Research Prize, awarded for the support of extreme ultraviolet lithography development. In 2010, he spent one year with the Imaging Group at CREOL/UCF in Orlando, Florida, USA. His interests are directed to the study of roughness and light scattering properties, the development of new measurement and analysis techniques, and the standardization of these procedures.