Polarization in Remote Sensing—introduction

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This Polarization in Remote Sensing special issue of *Applied Optics* presents 11 papers that describe research in polarization measurements and applications. The subject matter covered ranges from a review of passive imaging polarimetry, the first paper, to a presentation of twilight atmospheric polarization measurements, the last.

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Many of the great names familiar to us from the development of optical science, e.g., Huygens, Arago, Fresnel, and Stokes, made significant contributions to the specialty of optical polarization. However, quantitative measurements were difficult before the existence of modern electronic detectors not to mention detector arrays. In the latter half of the twentieth century, significant advances resulted from a resurgent interest in potential applications as imaging sensors improved in resolution and sensitivity. Early studies and measurements showed strong promise for the detection of unique image features through polarization, and more recent results have confirmed the utility for a variety of passive imaging purposes. The breadth of applicability for polarization continues to grow as researchers pursue areas of system development, phenomenology studies, devices, and remote sensing. Commercial development and application of polarization components has benefited from this growth, whereas significant imaging system development has resulted from scientific and military stimuli. The significant growth in computing power has allowed substantial improvements in the sometimes iterative development of calibration and data reduction techniques for imaging polarimetry. All these themes have come together to produce the latest generation of highly sophisticated instrumentation, models, and results in passive imaging polarimetry.

This special issue contains 11 papers describing research in polarization measurements and applications. The opening paper by Tyo, Goldstein, Chenault, and Shaw is a review of passive imaging polarimetry. In the next paper, Pust and Shaw describe an imaging spectropolarimeter based on liquid-crystal variable retarders and discuss fish-eye atmospheric polarization measurements in clear and cloudy conditions. Jellison, Hunn, and Rouleau describe a polarimetric microscope for characterizing materials. Drobczynski, Bueno, Artah, and Kasprzak discuss a transmission-mode imaging polarimeter based on a carrier frequency method and apply it with Fourier analysis to measure retardation of birefringent media. The last instrument or methodology paper in this issue is by Tyo and Wei, who consider the effect of imperfect polarization optical elements used in imaging polarimeters. The following papers turn our attention more toward applications of polarimeters and polarimetric data. Yemelyanov, Lin, Pugh, and Engheta present a method of adaptively determining two optimum information channels for deriving information from polarization images in a medium with nonuniformly distributed polarization states. Hassebo, Gross, Oo, Moshary, and Ahmed show that the polarization state of a lidar transmitter and receiver can be rotated throughout the day to minimize the negative effect of skylight on atmospheric lidar data. Nothdurft and Yao explore the use of active polarimetry for enhancing the visibility of objects embedded in highly scattering media. Chowdhary, Cairns, and Travis present models for use in underwater light-scattering calculations that are part of an overall scheme to use multiangle, multiwavelength, polarimetric measurements for studying ocean color and aerosols in the atmosphere over the water. Another

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use of polarization in studying radiative transfer in a water–air system is described by Gilerson, Zhou, Oo, Chowdhary, Gross, Moshary, and Ahmed, who discuss the use of a polarization discrimination technique to separate elastic scattering from chlorophyll fluorescence in the total water-leaving radiance signal. Finally, Cronin, Warrant, and Greiner take us back into the atmosphere and show measurements of twilight atmospheric polarization.

Whether your interest is in the polarization optical elements, the systems, or the applications, we hope you enjoy this special issue. We extend our appreciation to all the authors, reviewers, and editorial staff who worked hard to produce a high-quality issue covering a wide range of topics that represent some of the interesting work being conducted currently in the field of polarization imaging and applications in remote sensing.