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Infrared Spectropolarimetry

by

David Blair Chenault

A Dissertation

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of
The School of Graduate Studies

of

The University of Alabama in Huntsville

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To the memory of my mother,

Frances Gwaltney Chenault

ABSTRACT

A new instrument, a Fourier transform infrared (FTIR) spectropolarimeter, has been developed to characterize the elements of polarization critical optical systems. The rotating sample spectropolarimeter measures linear diattenuation (polarization) and linear retardance spectra of samples over a spectral range from 2.5 to 20 μm. The dual rotating retarder spectropolarimeter measures Mueller matrix spectra from 3 to 14 μm. This information provides essential data on the wavelength response of polarization elements and the modulation characteristics of spatial light modulators as a function of wavelength.

This dissertation describes data reduction algorithms for the rotating sample and dual rotating retarder polarimeters. The discussion includes description of common sources of systematic errors in polarimetric systems and how many of these errors are reduced or removed through the choice of appropriate measurement parameters and Fourier analysis of the polarimetric signal. The data reduction algorithms for spectropolarimetric measurements incorporate the wavelength dependence of the polarization elements. Self-calibration data reduction methods are also described.

Linear diattenuation, linear retardance, and linear birefringence spectra of cadmium sulfide and cadmium selenide multiple order waveplates and three liquid crystal materials are presented. Linear diattenuation and linear retardance calibration spectra of the polarization elements used in the spectropolarimeter, an infrared wire grid polarizer on a zinc selenide substrate and an infrared achromatic quarter

wave retarder, are also given. Mueller matrix spectra of a cadmium telluride modulator are given as a function of voltage. The electro-optic coefficient spectrum of cadmium telluride calculated from the Mueller matrix spectra is presented.

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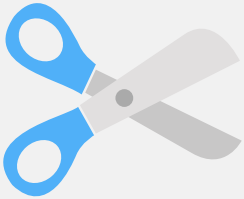

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11/17/92

Dr. Warren Peele
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Dr. Dr. Peele:

I have completed my dissertation and my doctoral program. I will receive my doctorate on December 13th from the University of Alabama in Huntsville. I am pleased to enclose my dissertation and a copy of a paper that has been accepted for publication in Applied Optics. I would like to thank you and express my appreciation to the Air Force for their support of my doctoral research program.

I have accepted a postdoctoral fellowship through the Office of Naval Technology and will begin by postdoc at the Naval Research Laboratory on December 1st. My new address is given below. If you have any questions or comments, don't hesitate to get in touch with me there. Thank you.

Sincerely,

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