Measurement of linear birefringence and diattenuation properties of optical samples using polarimeter and Stokes parameters

Po-Chun Chen,1 Yu-Lung Lo,1 Tsung-Chih Yu,1 Jing-Fung Lin,2 and Tsung-Tse Yang1
1 Department of Mechanical Engineering, National Cheng Kung University
2 Department of Computer Application Engineering, Far East University
(loyl@mail.ncku.edu.tw, NSC-94-2120-M009-007)

Abstract --- A technique is proposed for measuring the linear birefringence and linear diattenuation of an optical sample using a polarimeter. In the proposed approach, the principal axis angle (α), phase retardance (β), diattenuation axis angle (θd), and diattenuation (D) are derived using an analytical model based on the Mueller matrix formulation and the Stokes parameters. The dynamic measurement ranges of the four parameters are shown to be α = 0–180°, β = 0–180°, θd = 0–180°, and D = 0–1, respectively. Thus, full-range measurements are possible for all parameters other than β. In this study, the proposed methodology does not require the principal birefringence axes and diattenuation axes to be aligned. In addition, the linear birefringence and linear diattenuation properties are decoupled within the analytical model, and thus the birefringence properties of the sample can be solved directly without any prior knowledge of the diattenuation parameters. Also, the characteristic parameters in the baked polarizer with linear birefringence are successfully extracted from an optically equivalent model and proved by the respective simulation and experiment introduced in this study.

Keywords: Mueller Matrix, Stokes Parameters, Polarimeter, Linear Birefringence, Linear Diattenuation, Principal Axis, Retardance, Diattenuation Axis.