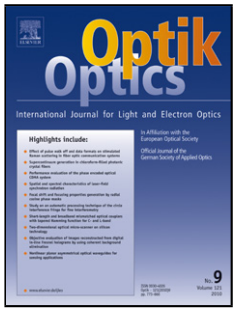

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Stokes polarimeter for the measurement of full linearly Stokes parameters with immunity to Gaussian and Poisson noise

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Abstract

The optimization of Stokes polarimeter to determine the full linearly Stokes parameters in the presence of additive Gaussian noise and signal-dependent Poisson shot noise is addressed. The measurement matrix to minimize the total measurement variance on the full linearly Stokes parameters is optimized. Compared with the previous measurement matrix, the optimal measurement matrix proposed in this paper can effectively improve the measurement precision of the full linearly Stokes parameters statistically. In addition, a practical configuration of Stokes polarimeter is optimized by a cost function to generate the optimal measurement matrix. For the Stokes polarimeter composed by a variable retarder and fixed polarizer, the optimal measurement matrix can be easily generated by a 179.28° retardation with a pair of azimuths ±78.84° and a 179.64° retardation with a pair of azimuths ±33.84°.

Keywords: Polarimetry; Stokes parameters; Polarization state

1. INTRODUCTION

It is well known that the state of polarization (SOP) of light is a powerful information indicator that can provide us the targets' surface features, shape, shading, and roughness with higher contrast [1-3]. Stokes polarimeters are optoelectronic instruments that determine the SOP of light across a scene by measuring its Stokes vector, which include four Stokes parameters, S0, S1, S2 and S3 (S0 is the total intensity of the light, while S1 denotes the part of 0° linear polarized light over 90°, S2 for + 45° over −45°, and S3