Light Science & Applications

Liquid Crystal based Polarization Measurement: Calibration and Optimization

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Polarization measurement represents a fundamental high-dimensional diagnostic technique with broad applicability across diverse scientific and engineering domains nowadays. Over the decades, the field has evolved from time-sequential approaches to one-shot methods leveraging innovations in metasurface, polarization cameras, and integrated photonic systems. Despite these technological advances, polarization measurement remains a vibrant and challenging research area. This work delves into the rigorous error analysis associated with the retrieval of polarization information, specifically focusing on the reconstruction of Stokes vectors and Mueller matrices. It critically examines the limitations of the widely adopted optimization criterion, the condition number, which is traditionally used to design polarization state generators and analyzers. This work proposes a refined perspective on the trade-offs between system robustness, accuracy, and noise resilience. Furthermore, the work introduces novel strategies for intrinsic noise suppression, offering a potentially transformative framework for the design of polarization measurement systems with improved reliability and accuracy in practical applications.

Short Bio:

Yuxi Cai completed his MEng degree in Engineering at the University of Oxford, and is currently pursuing a DPhil in the Vectorial Optics & Photonics (VOP) group at Oxford, under the supervision of Prof. Chao He and Prof. Stephen Morris. His primary research focuses on the optimization of polarization measurement methodologies and the exploration of high-dimensional optical topological invariants.