Marine Skylight Polarization Patterns Measurement and Polarization Navigation in the South China Sea

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Polarized light navigation offers the advantage of no cumulative errors over time and strong resistance to interference, making it a valuable technology for marine navigation. This study focuses on the measurement and analysis of skylight polarization patterns in the South China Sea, utilizing an innovative camera based on confocal plane Division of Focal Plane (DOFP) polarization imaging technology, equipped with a 185° fisheye lens. This advanced system integrates pixel units and micro-polarization devices on the same focal plane, enabling each superpixel to simultaneously capture light information in four polarization directions (0°, 45°, 90°, and 135°). The instrument can detect the full-sky polarization pattern in a single shot, eliminating asynchronous errors caused by rotating polarizers, ensuring spatial and temporal consistency, and offering a more compact structure. This design facilitates the comprehensive analysis of incident light's Stokes vector[1], degree of polarization, and polarization angle, providing a robust method for interpreting atmospheric polarization information.

In this talk, we summarize these recent advancements and compare the simulation results obtained using the backward Markov chain Monte Carlo method[2] with the measurements from the DOFP polarization instrument. The findings indicate that while the skylight polarization patterns observed in marine environments are similar to those observed on land, the unique properties of marine aerosols often cause higher degrees of scattering and absorption, which can alter the polarization patterns, especially under varying humidity and salt particle concentrations. These differences impact the skylight polarization patterns and, consequently, the polarization navigation[3].

These results provide critical insights and theoretical support for the application of polarization navigation in marine environments, demonstrating the potential for using skylight polarization patterns for reliable navigation in the South China Sea, while highlighting the need to account for marine aerosol[4, 5] effects in polarization-based navigation systems.

References

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