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Development and applications of small airborne polarization imaging system

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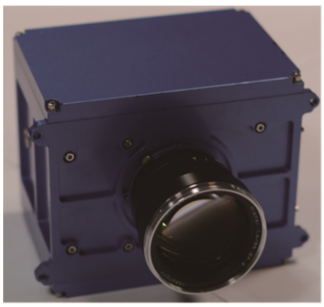

Size	150 mm×100 mm×80 mm (no imaging lens)	Weight	2.5 kg
Polarized parameter	Full stokes	Working band /nm	480, 532, 632, 780, 850, 980 (customizable)
Measuring error	<2%	Pixel number	2048×2048
Detecting range	1~5 km	Store time	≤3 h
TCP	GieE and PAL	Working method	Storing online /real-time processing
Shock resistance	20 g(Vertical), 15 g(horizontal)	Vibration resistance	5 g(vertical), 2 g(horizontal)(20 Hz-500 Hz)
Working temerature	–20 ℃~50 ℃	Average Power	≤20 W

The practicality structure and technical index of small airborne imaging polarimeter.

Abstract: Polarization is the important feature of reflected light from object (including wavelength, amplitude, phase, and polarization). According to the Fresnel reflection law, polarized characteristic will occur within the reflecting effect or radiating effect, which is the foundation for polarization remote sensing. Especially, man-made objects typically produce relatively strong polarization reflection signatures compared to natural materials. Theses signatures can be exploited for target or image contrast enhancement. Airborne imaging polarimeter is one of the important research techniques in the remote sensing fields which could be used to further describe the surface roughness, texture direction and surface orientation of the interesting object, especially for the recognition of object contour and surface roughness.

The high-precision polarization controller based on the birefringence effect of liquid crystal with the customizable working band between 420 nm~1000 nm and the measuring error less than 2% was developed and calibrated. Then a miniaturized airborne polarization imaging system (integrating liquid crystal polarization controller, optical detector, imaging memorizer, and electrical system) has been built and calibrated. Finally, the polarization imaging system was fixed on small unmanned aerial vehicles to check out its technical index and enhanced detectivity of low contrast target, man-made target and so on.

Three results could be found from our experiment. 1) The polarized modulator based on liquid crystal variable retarder could be used to control polarized status and realize the full Stokes parameters inversion calculation of reflected light, which has many technical features such as small size, light weight, big transmission aperture and high detection accuracy. 2) The airborne polarization imaging system based on the liquid-crystal polarized modulator has been achieved with the boundary size less than 150 mm×100 mm×100 mm (not including the imaging lens) and the weight as 2.5 kg. The airborne polarization imaging system was proved to be suitable to environmental requirements of most small unmanned aerial vehicle, and could be used to obtain the polarized information with the two working methods such as storing online and real-time processing. 3) The small airborne polarization imaging system could be used to effectively suppress the background interference and improve the contour extraction ability and target recognition ability of the low contrast targets. Our finding provides an effective technical approach for expanding the polarized imaging applications in target surveillance, environmental monitoring and crop investigating.

Keywords: airborne; polarization imaging; remote sensing; liquid crystal; unmanned aerial vehicle; enhanced detect; target surveillance

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