Compensation of gray value drift for ground-based MWIR measurement system

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Original and corrected gray level of infrared detector. (a) Integration time of 2 ms; (b) Integration time of 4 ms

Overview: With the development of infrared detectors and atmosphere measurement technology, infrared radiation characteristics measurement is applied to more and more important field of measurement. As infrared radiation characteristics measurement is the main method for the precaution and discrimination of missiles, relevant research is worthy in military application. Nowadays, infrared device is applied in the tracking and measurement of infrared target. To realize the quantitative measurement of space moving target infrared radiation, infrared radiation measurement system must be calibrated in advance. The infrared radiation calibration is the precision reference of infrared radiation characteristics. To ensure the accuracy of radiation measurement, it is necessary to calibrate the infrared radiation measurement system. The related researches in the past show that the results of infrared radiation characteristics measurement is affected by the change of environment temperature. However, even at the same environment and blackbody temperature, when we use extended area blackbody to radiation calibration, the output gray of infrared radiation characteristics measurement is drifting. We consider that the reason of gray value drift must be the stray radiation. After this, we conduct an experiment at different environment and same blackbody temperature, the results show that the gray value will be drifted when the blackbody temperature is higher than environment temperature, and the gray value drift of infrared radiation measurement system is time-varying. Meanwhile, because extended area blackbody must be heated to a high temperature, and the distance between extended area blackbody and lens cone of infrared radiation measurement system is so close, the primary cause of gray value drift is the heat of extended area blackbody. In this paper, the environment temperature of infrared detector is defined as ambient temperature and the gray value drift of infrared radiation measurement system is caused by the change of ambient temperature. Because we think the output gray value of infrared radiation measurement system is constant at an one certain blackbody temperature in advance, the gray value drift caused by the change of ambient temperature is one of the significant errors in radiation calibration and measurement. In order to reduce the output gray value of infrared radiation characteristics measurement caused by ambient temperature, we conduct an experiment to find the relationship between ambient temperature and gray value drift. At last, the reason of gray value drift of infrared system is found, a gray value drift compensation method based on ambient temperature is proposed by analyzing the data of experiment, and the relationship between ambient temperature and gray value drift was derived. A calibration experiment is designed for verification, and the results indicated that before and after gray drift compensation the max gray drift error is 23.87% and 1.54% at integration time of 2 ms, the max gray drift error is 15.33% and 0.96% at integration time of 4 ms. The method in this paper can compensate gray value drift effectively at any ambient temperature and integration time of infrared radiation characteristics measurement system that can reduce the gray value drift caused by ambient temperature which is measured in real time.

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