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Radiometric Calibration of Compact Infrared Camera (CIRC) for Earth Observation

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We have developed a compact infrared camera (CIRC) with an uncooled infrared array detector (microbolometer) for space application. CIRC is the first microbolometer sensor without a calibration function in orbit, like a shutter system or an onboard blackbody. The main objective of the CIRC is the technology demonstration of wildfire detection. Microbolometers are suitable for application in resource-limited sensor systems or small satellites because no cooling systems are required. Another main characteristic of the CIRC is its use of athermal optics. The athermal optics system compensates for defocus occurring owing to temperature changes. The CIRC achieves a small size (approximately 200 mm), light mass (approximately 3 kg), and low electrical power consumption (<20 W) by employing athermal optics and a shutterless system. The shutterless system suggests the need to devise a method of achieving stray-light correction and temperature calibration without the use of a mechanical shutter for calibration. We completed the ground calibration test of the CIRC Proto Flight Model (PFM) in a vacuum environment and at ambient temperature ranging from −15 to 50 °C using blackbody images at various temperatures (−30 to 50 °C), and accomplished the method of temperature correction to achieve temperature accuracy of 4 K without a calibration function. In this paper, we report on the constructed radiometric algorithm and results relevant to imaging and radiometric quality.

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