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THE DESIGN OF INFRARED IMAGING SYSTEM WITH HIGH SENSITIVITY CHARACTERISTIC BASED ON DIGITAL TDI

Abstract

Now infrared imaging technology has been widely used in the field of the weather prediction, detection of nature disaster and earth environment, navigation, agriculture and astronomy etc. Whether in the civil field or astronomy research, developing the infrared imaging technology of high sensitivity plays an active role. While signal to noise ratio with time delay integration (TDI) is of great significance to the satellite remote sensing system. Usually the routine infrared TDI FPA has the characteristic of low charge capacity compared with high background radiation which leads to be easily saturated. So the long time integration is not able to be realized compared to the relatively long resident time. Consequently, a new working mode adapted to infrared FPA with low charge capacity should be researched to extend the integration time in order to satisfy the high requirements of sensitivity in the infrared remote sensing system. Thus an innovative method of digital TDI technology with serial scanning and push-broom mode based on the technology of time delay and integration has been presented. Firstly, the noise sources of the whole infrared system during the transmission are analyzed, which include the photon noise, the interior noise of the detector, such as thermal noise, shot noise, 1/f noise, produce-composite noise and the noise of information processing electronics, such as the amplifier noise and A/D noise. Furthermore, the paper deduces the expressions of signal to noise ratio and the characteristics of resolution of the system influenced by digital TDI technology, which have been tested and proved by experiments. At the same time, an array FPA detector is utilized to set up the prototype imaging system. Windowing mode of the detector is employed to validate the performance of digital TDI. The experiment results validate the contribution of digital TDI technology to the sensitivity of the system and the influence to the space resolution of the system. The testing result shows that the system has achieved the sensitivity of superior to 50mK and proved that the sensitivity of the imaging system is in the proportion of square root to the stage of digital TDI. The researches have demonstrated that the digital TDI technology is suitable for the infrared imaging system with high-resolution and sensitivity.