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NEW APPLICATION OF SHAPE MEMORY ALLOY SPRING ACTUATOR TO CALIBRATION MECHANISM WITH DUAL-FUNCTION OF LAUNCH LOCKING AND FAIL-SAFE

Abstract

Tilting calibration mechanism has been widely used for on-board calibration of a spaceborne imaging sensor. The main objective of the mechanism is to reflect a radiance temperature from the reference black body to the image sensor to correct a non-uniformity output characteristics of the sensor. For this, the calibration mechanism is periodically deployed to view the black-body during calibration, and stowed after calibration to avoid field of view interference with the main optical path. However, when the calibration mechanism is unintentionally stopped at a certain position on the main optical path due to motor failure or other problems, it is not possible to perform the main mission of imaging acquisition any more. Therefore, it is required to implement fail-safe function on the mechanism under the emergency state such that the stopped mechanism is intentionally removed from the main optical path by actuating the separation device such as pinpuller or frangibolt-type actuators. In addition, structural safety of mechanical driving part of the mechanism under harsh launch environment can be guaranteed by applying launch lock device. The usage of multi-separation devices for implementing fail-safe function and mechanical constraint on the driving part of the mechanism might increase the system complexity and development costs of the calibration mechanism. To overcome aforementioned drawbacks, we newly proposed a new application of shape memory alloy (SMA) spring actuator to calibration mechanism that provides dual-function of implementing mechanical constraints on driving part of the mechanism and fail-safe function under launch and emergency states, respectively, instead of using conventional separation devices. This is great feature of the mechanism design proposed in this study. In this paper, the operation concept of mechanism, design, and functional test results of the mechanism have been introduced. The functional test results demonstrate that the design approach proposed in this study is feasible for realizing the design goal of the on-board calibration mechanism.