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Author: Prof. Ke Liu
China Academy of Launch Vehicle Technology(CALT), China, liuke_102@163.com

Prof. Yinxiao Miao
China Academy of Launch Vehicle Technology(CALT), China, miaoyx102@163.com

RESEARCH ON CALIBRATION METHOD OF SPACE-BORNE HIGH TEMPERATURE STRAIN SENSOR

Abstract

To achieve better structure stability and safety, the high temperature strain sensors are extensively used in astronautic vehicles to monitor the distribution and variation of the structure strain. But the vibration, high temperature in the process of launching and complex environmental conditions of the outer space always generate nonlinear creep, and thermal output drifts, which greatly reduce the measurement accuracy of strain sensor. Therefore, to ensure the structure stability of astronautic vehicles, it is necessary to calibrate the high temperature strain sensor in various experiment conditions. In this paper, a high-precision calibration method for space-borne high temperature strain sensor is proposed. The calibration device consists of three parts, a bidirectional strain field generation mechanism, a high temperature furnace and an optical speckle interference measurement system. Firstly, a bidirectional strain field generating and loading mechanism is designed. The strain girder is implemented by bidirectional pulling and pressure loading, using a torque motor, a force screw and a lever structure, so that the positive and negative strain fields are generated on the same side of equal-strain regions on the equal-strength strained beam. Equal-strength strained beams are placed in a high temperature furnace to achieve temperature loading and controlling from 25 to 1200. Through the optical window on the high temperature furnace, the calibration for positive and negative ranges is achieved only requiring a single installation of the strain sensor. In the process, the surface deformations of the linear working zone and the strain sensor surface of the strain beam are measured. By the speckle interference map, the all-field strain is derived as the standard strain value. Then the output parameters of the high temperature strain sensor, such as nonlinear creep, thermal output drift, sensitivity coefficients are calibrated under different temperature regions. This method was applied to high temperature strain sensor calibration for astronautic vehicles of different models, and the experiment data for these astronautic vehicles validated the proposed method.