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REAL-TIME MEASUREMENT OF LINE OF SIGHT DRIFT IN SPACE CAMERAS BY A BUILT-IN ELECTRO-OPTICAL SYSTEM

Abstract

In many remote sensing electo-optical space systems, it is essential to measure the drift of the line of sight of the camera, with respect to a reference system of coordinates. Star trackers can be an example for such a system of coordinates. This measurement is essential when, for example, it is required to co-align two or more optical channels, or when there is a need to register the image to a reference system of coordinates. The knowledge of the drift vector allows real-time correction of the line of sight or correction of the image registration in post-imaging processing. In this paper, we present an electro-optical measurement system, which allows the real-time measurement of the line of sight drift in space cameras. The system is based on a collimated light source mounted at the edge of the entrance aperture of the camera. The collimated light source is aligned in such a way that the collimated beam passes through the optical system and creates a definitive spot image on the detector. By analysis of the spot image, an estimation of its location on the detector in each measurement is possible. Computation of the two-dimensional difference between these locations in different times, allows an estimation of the temporal drift of the line of sight of the camera with respect to the system of coordinates that the collimator is mounted to. The measurement system is designed to be highly stable in thermal changes, in order to avoid errors resulting from the collimator's drifts. When the camera is based on a two-dimensional sensor (e.g. matrix CCD), an accurate estimation of the line of sight drift can be achieved by estimating the two-dimensional center of gravity (COG) of the imaged spot. However, many space systems are based on a one-dimensional detector. For example, line scanning space cameras, based on one row of pixels or a number of TDI (Time-Delay Integration) lines. In this case, the field of view of the camera, in the scanning direction, may be much smaller than the required range of measurement, which imposes the use a spot size much larger than the detector active size in the scanning direction. For these cases, special algorithms are required in order to be able to estimate the line of sight drift in the scanning direction, where only a part of the measurement spot is imaged on the detector.