

Digital Optical Correlator X-ray Telescope Alignment Tracking System

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Overview

The High Energy Replicated Optics to Explore the Sun (HEROES) program is a collaborative balloon-borne X-ray telescope mission to observe hard X-rays from the sun and various astrophysical targets. The payload consists of eight mirror modules, which are mounted on an optical bench six meters from a matching array of matching detectors. During astronomical observations, a star camera is used to determine the pointing direction. Slight misalignments between the star camera, the optical bench, X-ray optics, and detectors may occur during flight. These misalignments, though slight, have a large impact on the observations of the sources and require monitoring. To this end, a system, referred to as the Bench Alignment Monitoring System (BAMS) was added to the HEROES payload. This system utilizes an optical/digital correlator to track a predefined, asymmetric ring pattern of LEDs. The BAMS software is a digital adaptation of an optical correlating technique known as a joint transform correlator.

Key Findings

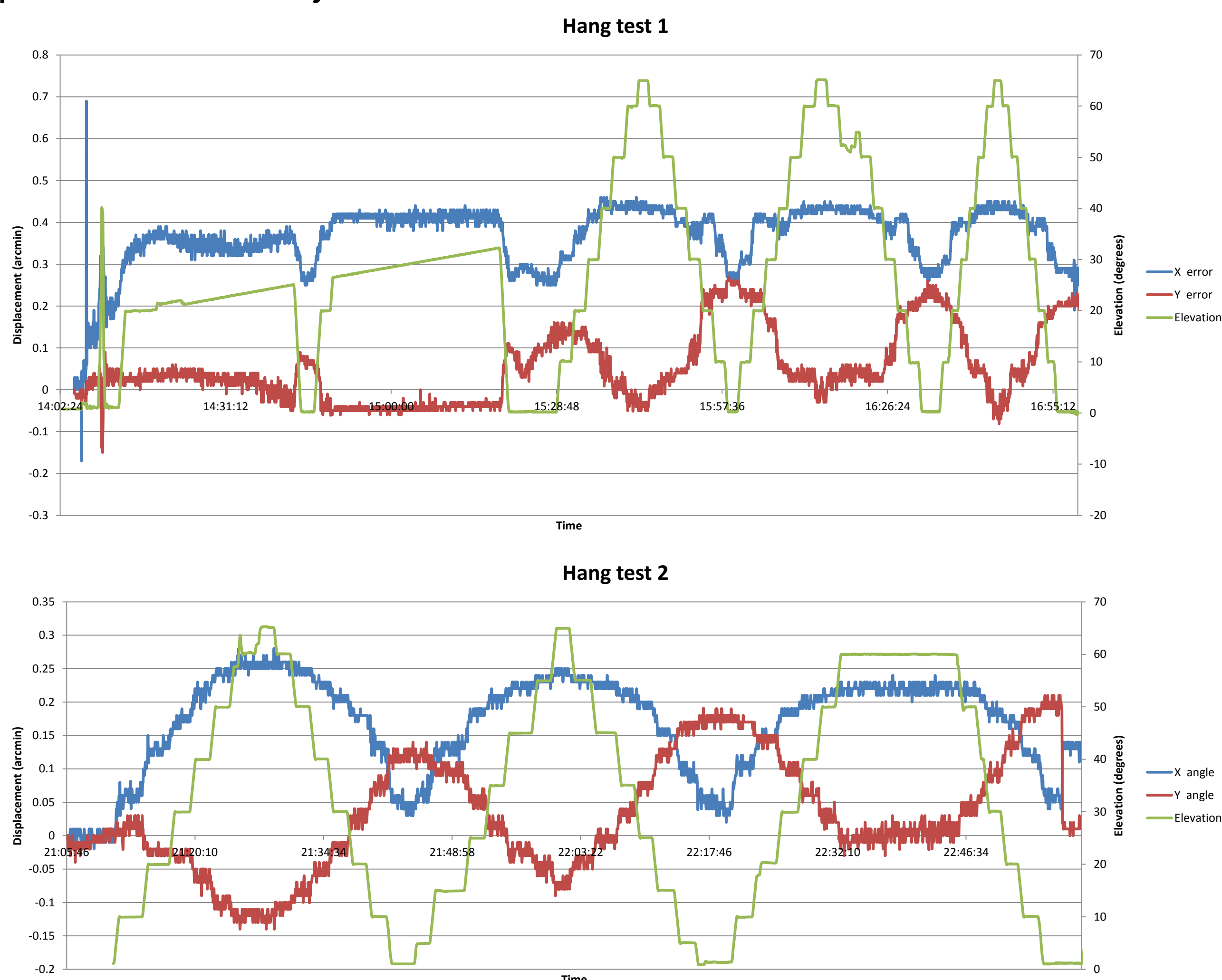
The BAMS system was shown to be able to track the movement of the payload through multiple hang tests and was flown in September 2013 from Ft. Sumner, NM. The system is capable of subpixel resolution to track movement to arcsecond accuracy. After testing the system with “static” hang tests, it has been shown that it is capable of tracking movement to +/- 15 arcseconds. This tracking knowledge will contribute to post-flight astronomical data analysis.

Impact

BAMS can be used for other missions that require high accuracy in their pointing systems. One such balloon-borne mission is GHAPS, which will provide data that will address 44 questions of the recent NASA Planetary Decadal Survey. The BAMS system is applicable for a wide variety of application including asteroid tracking, missile guidance, etc.

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Explanation

The AAS's goal is to expand humanity's understanding of how the universe and the things in it operate. The BAM system aligns with the goals of the AAS by providing pointing alignment knowledge of the NASA HEROES X-ray telescope to better than 30 arcseconds so that improved observations of the sun and astrophysical sources can be realized.

