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Landsat 5 World Reference System Error Investigation

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Abstract

In early 2007, a discrepancy was discovered between the ground track location calculated by Landsat 5 software for the spacecraft's orbit with respect to the World Reference System (WRS) when compared with Landsat 7 software computations. From a mission planning point of view, the discrepancy between the WRS navigation packages had implications for maneuver planning, the fuel budget, mission risk, cost, and mission life. The Landsat 5 software computation of the WRS error showed Landsat 5 was violating its orbit control box with no natural turnaround, which indicated a need to execute a retro-maneuver in April of 2007. Since Landsat 5 had never performed a retro-maneuver on-orbit and an anomaly was encountered just prior to a previously planned retro-maneuver, there was risk inherent in this option. The Landsat 7 software calculation of the WRS error showed the Landsat 5 orbit turning around naturally with no hazardous retro-maneuver required. It was critical to know which software package was correct to enable appropriate mission planning and risk management. The study found an apparent error in one of the commercial navigation packages.

I. Introduction

Landsat 5 (L5) was launched in March 1984 and is owned and managed by the U.S. Geological Survey (USGS). The current USGS contract for Flight Operations is with Honeywell Technology Solutions, Inc. L5 (Figure 1) is an Earth resources satellite and obtains images of the Earth in several visible and infrared bands. L5 images the earth daily and is a cornerstone of earth observation.

L5 is in a polar orbit with a ground track that repeats every 16 days. The ground track is controlled to the World Reference System (WRS), which is discussed below. The objective is to keep the ground track normally within ±3 km of the WRS, with a maximum excursion of ±10 km. The ground track is maintained by performing station-

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