THE OPERATIONAL ENVIRONMENT OF THE HIPPARCOS MISSION

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Abstract. We investigate links between the observational environment as experienced by the Hipparcos satellite and the performance of the spacecraft and payload instrumentation, with particular emphasis on finding out whether some of these effects may have been inadequately represented in instrument calibrations and could thus have affected the scientific results of the mission. Scan-coverage and radiation effects are primarily random effects with only some long-term systematics. However, long- (days to weeks) and short-term (hours) temperature variations reflected in the performance of some of the spacecraft instrumentation. It is shown that only a small sign of some long-term thermal variations could be detected in the payload instrumentation. These findings further limit the scope left for the occurrence of large-scale correlated errors in the Hipparcos astrometric data. On the other hand, a number of great circles were identified which showed a highly significant drift of the basic angle, which had not been detected in the preparation of the published data. The data from these circles may have, in some cases, led to, very localised, slightly anomalous results, in particular where stars are accidentally affected by two or more of such circles.

Key words: Hipparcos, Satellite dynamics, Space Astrometry


1. Introduction

An investigation of the calibration data for long lasting experiments like ESA’s Hipparcos astrometric satellite mission (ESA, 1997, van Leeuwen, 1997) can lead to a better understanding of the conditions that affected the accumulation and analysis of the science data. Such investigations were routinely carried out for the Hipparcos data reductions in Utrecht for the so-called ‘First-look’ analysis by Schrijver (1985), Schrijver and van der Marel (1992), where it led on a few occasions to early detection and repair of instrument faults, and at the Royal Greenwich Observatory (RGO), where for example calibrations were obtained for the gyro
Figure 1. Reflection of the cooling-down of the satellite during a period of very long eclipses. The top graph shows the phase difference for the first and second harmonic in the modulated signal for the main grid. The middle graph shows over the same interval the changes in the basic angle. The bottom graph shows the exposure factor (see text), representing the fraction of an orbit the satellite was lit by the Sun, and the relative distance to the Sun.

orientation, which affected the real-time attitude determination. Extensive studies were also presented in Volume 2 of ESA (1997).

In this paper we will review the various conditions that may or may not have affected the science data of the Hipparcos mission: the orbit, the radiation and the temperature variations, and their interaction. Most of our attention will, however, focus on the thermal conditions experienced by the mission. The reason for this is that the thermal variations contain a component which is, like the parallax factors of the stars, directly related to the rotation of the satellite, and could as such be a