THE USE OF THE HIPPARCOS CATALOG AS GEMINI'S POINTING BASIS

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Overview

During the March 1995 meeting of the A&G/AOSWG Dave Monet suggested that Gemini adopt as the fundamental basis of its astrometric pointing the HIPPARCOS catalog. This recommendation was elucidated in a subsequent report he submitted to the IGPO soon after the A&G/AOSWG. The purpose of this short technical note is to explain why the A&G/AOSWG proposes Gemini adopt the HIPPARCOS catalog as its standard. At the time of this note this recommendation has not been presented to the GSC but I will seek passage of this proposal at the September 1995 GSC meeting.

HIPPARCOS Background

The HIPPARCOS (High Precision Parallax Collecting Satellite) mission was flown by ESA in August 1989 in an effort to measure with unprecedented accuracy the astrometric positions of over 100,000 stars. The satellite produced high quality data until communications were lost in August 1993. The mission was successful in terms of its fundamental science goals despite the fact that an error in the final orbital insertion phase of the launch left the satellite in an asynchronous orbit, requiring a substantial change in the details of its data acquisition plan. HIPPARCOS scanned the entire celestial sphere several times during its mission lifetime, hence the final catalog created will be uniform and homogenous over the entire sky, unlike the HST GSC-I which is in common use at ground based observatories today but is known to have significant errors along narrow regions of the sky where overlap between adjacent Schmidt fields complicated astrometric measurements. The creation of precise astrometric catalogs has of course been attempted in the past (e.g., FK4) but all previous efforts were significantly hampered by the perturbing effects of the atmosphere on stellar positional measurements, along with gravity flexures of telescopes and sensors, and changing ambient temperatures. All of these important factors are of course eliminated from a space-

HIPPARCOS Experiment	
Number of Stars	120000
Limiting Magnitude	V = 12.4 mag
Completion Limits[a]	V = 7.3 - 9.0 mag
Positional Accuracy[b]	0.002"
Parallax Accuracy[b]	0.002"
Proper Motion Accuracy[b]	0.002"
TYCHO Experiment	
Number of Stars	>400000
Limiting Magnitude	B ~ 10-11 mag
Positional Accuracy	0.03" (B=10 mag)
Photometric Accuracy[c]	0.05 mag
Observations/Star	100

[a] varies depending on Galactic latitude and spectral type
[b] B = 9 mag
[c] per observation in B and V

Table 1 - Lists of the top-level scientific goals for the HIPPARCOS and TYCHO experiments are shown to summarize the design objectives of the overall mission.

based observing platform and lead to HIPPARCOS having more than an order of magnitude greater accuracy than the FK4 catalog. A parallel experiment named TYCHO was used to measure the two-color brightness and positions of ~10^6 additional stars, with somewhat relaxed astrometric accuracies.

One of the ultimate science goals of the mission is to define a *fixed* reference frame in our rotating galaxy that can be used to map the distance and velocity vectors of relatively nearby stars. The HIPPARCOS data set will also support detailed studies of stellar mass, luminosity, and dynamical properties for nearby stars as well. Through observations of QSO's, the HIPPARCOS data set will tie a derived optical astrometric reference frame to the radio extragalactic frame. This will potentially be important for ground based telescopes trying to find, for example, radio sources at infrared wavelengths were accurate blind telescope pointing is crucial for target acquisition.

Release of Product

At the end of 1993 HIPPARCOS data had been reduced for ~118000 stars based upon 3.2×10^6 separate measurements with median standard errors of 1.3 mas for positions, 1.5 mas for parallaxes, and 1.8 mas/yr for proper motions. Given the quality of the astrometric and photometric measurements of the $>10^6$ stars included in the HIPPARCOS/TYCHO data set it seems likely that this will become the defining catalog for ground based astronomy for many years in the future. Assuming the processing continues on schedule, the HIPPARCOS and TYCHO catalogs will be completed near the beginning of 1996 and released to the general astronomical community in early 1997. This production time scale places the catalog in the public domain early enough to support both Gemini commissioning and operations and the A&G/AOSWG recommends incorporating these catalogs into future telescope control plans.