EARTH ROTATION
IN THE HIPPARCOS REFERENCE FRAME

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Abstract. New determination of the Earth orientation parameters (EOP), based
on optical astrometry observations since the beginning of the century, is now under
preparation by the Working group established by Commission 19 of the IAU. The
Hipparcos catalog is to define the celestial reference frame in which the new series
of EOP are to be described. The novelties of the prepared solution are the higher
resolution (5 days) and more parameters estimated from the solution (celestial
pole offsets, rheological parameters of the Earth, certain instrumental constants).
The mathematical model of the solution is described, and the results based on
the observations made with 46 instruments at 29 observatories and a preliminary
Hipparcos catalog are presented.

1. Introduction

Preparation of the new solution of EOP from optical astrometry in the
Hipparcos reference frame began in 1988 when IAU Commission 19 set
up a working group to this end; the project had been initiated earlier by
Feissel (1986). The first proposal of the procedures to be used was described
by Vondrak (1991), and the expected accuracy estimated by Vondrak et
al.(1992). Several solutions based on the star catalogs originally used at
the observatories were then worked out (Vondrak et al., 1993; Vondrak and
Ron, 1994; Vondrak et al., 1994; Vondrak et al., 1995).

Since 1995, when a cooperation with the Hipparcos Science Team has
been established on the linking of the Hipparcos system to extragalactic
objects, we have been able to use the preliminary versions (H30, H37, H37C)

of the Hipparcos catalog. They were employed to work out several solutions, the last of which was used (in combination with VLBI-based EOP) to determine the linking of the preliminary Hipparcos system with respect to extragalactic objects (Vondrak et al., 1996). Here we use the last two of these catalogs to calculate the new EOP.

2. The Preliminary Hipparcos Catalog H37P

The subsets of preliminary H37 and H37C catalogs were made available to us by the Hipparcos Science Team (Turon and Morin, 1995; Turon and Morin, 1996) for linking purposes, containing 9,071 and 8,841 stars, respectively. Most of the stars (8,575) are common in both sub-catalogs that are given in the same system; we merged them, retaining the positions and proper motions of H37C and taking over the additional H37 stars. Then we used the preliminary orientation of H37C with respect to extragalactic system, obtained by combining several methods (Lindegren and Kovalevsky, 1995) and provided by Kovalevsky (1996), to bring the merged catalog into the International Celestial Reference System. Internally, we call this catalog (containing 9,337 stars) H37P, and use it in all subsequent calculations.

3. The Observations and Their Corrections

The observations of individual stars made since 1900 at 29 observatories with 46 instruments are used in the new solution. The list of the participating observatories and instruments is given in Table 1, in which the different types of instruments are abbreviated as ZT (visual zenith-telescope), PZT (Photographic zenith tube), PTI (photoelectric transit instrument), AST (Danjon astrolabe), PAST (photoelectric astrolabe), CZ (circumzenithal), VZT (visual zenith tube) and FZT (floating zenith tube).

Three different observed quantities reported by the observatories (latitude, universal time, zenith distance) are corrected, before being used in the solution, to remove certain systematic effects:

1. The submitted observations were converted into the newest astronomical standards, following (McCarthy, 1992).
2. Differences in apparent places as calculated with H37P and original catalogs were applied to correct the observed quantities.
3. Plate tectonic motions as given by the geophysical model NUVEL-1 NNR (Argus and Gordon, 1991). For the sites located near the plate boundaries (Carloforte, Mizusawa, Santiago and Ukiah) the values based on space geodetic data (Ma, 1995) were used.
4. Corrections to certain instrumental constants were determined, and the observations corrected:
   - Micrometer values for ZT, VZT, FZT, together with their time- and temperature-dependent terms for each year.