THE PROBLEM OF DYNAMICAL REFERENCE SYSTEM CONSTRUCTION AT THE MODERN STAGE

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The ICRF now is the fundamental celestial reference frame with the Hipparcos Catalog as the realization of the ICRF at optical wavelengths. Unlike past stellar realizations, which were oriented to the equinox and equator of various reference epochs, the orientation of the ICRF is independent of epoch and will not be changed in the future. The orientation and positions of the ICRF are consistent with the J2000 (FK5) System. The JPL ephemerides (dynamical system) have been oriented onto the ICRF since 1995. According to (Standish, 2003) the notion of dynamical system is no longer " relevant" "since the ICRF is assumed to be inertially founded". The necessity of keeping the dynamical system was discussed a long time ago. As a notion it is conserved and it is necessary to keep in mind another problems like conservation and usage of old observations, historical aspect of non- precessional equinox motion, the problems of mutual orientation of different astronomical systems etc. Especially the problem of mutual orientation of the ICRF and other systems is important even at our times: the link of dynamical and ICRF systems is not reliably known and it is necessary to continue improving of the orientation between different systems. The problem of non-precessional motion of equinox has not only historical aspect: it was suggested in (Vityazev, Yagudina, 2000) that the fictitious motion of the equinox is well correlated with curve $\Delta T = ET - UT$ and can be considered as the first evidence of the irregular rotation of the Earth.

About 18000 optical and radar observations of 35 NEAs and main belt planets have been used to obtain precise asteroids orbits, catalogue orientation parameters and the motion of the dynamical equinox from 1750 till 2002 in Hipparcos system. For obtaining the orientation parameters and equinox motion we collected the observations of 35 minor planets with available radar data. Most of them, 31 planets are NEAs The interval covered by optical observations for this list of objects is more than 90 years, radar measurements are available after 1968. All optical observations were taken from MPC catalogue, radar observations (Doppler and delay) from JPL database 'Small-body astrometric radar observations'. The accuracy of optical observations are of the order of $1''$ for old observations and better than $0.5''$ for observations made after 1960. The precision of Doppler observations varies from 30.0 Hz till 0.1 Hz for the frequency, and from 140 till 0.1 μs for delay. We have discussed similar problems previously, having used 24 NEAs for obtaining the FK5 orientation parameters (Yagudina, 2001). Now, in addition to that we have used the observations of the asteroids with long optical history (such as Iris, Zelinda and others) and for some NEAs (Toutatis, Golevka, etc) the radar observations in the second apparition have been used. Besides, the accuracy of optical observations during the last 4–5 years have increased significantly, the accuracy of CCD observations being about $0.3''$. All this gave us new possibilities for obtaining a more precise solution. All calculations have been performed

Table 1: The dynamical motion for different intervals of time

epoch	Time interval	$d\dot{A}$ $''/cy$	number of observations	Accuracy of optical obs.
2001.8	11 asteroids	-1.034	10252 opt	$1''$
	1900–2000	±0.079	107 rad	
	23 asteroids	-0.004	6398 opt	$< 1''$
	1950-2000	±0.001	238 rad	$> 0.5''$
	17 asteroids	-0.003	3150 opt	$< 0.5''$
	1965–2000	±0.000	181 rad	
	35 asteroids	-0.009	17650 opt	$0.5''$- $1''$
	1900-2002	±0.001	351 rad	

within the framework of ERA system (Krasinsky and Vasiliev, 1996). The orbits of asteroids have been computed by numerical integration of the relativistic equations of motion taking into account the perturbations from all major planets and the Moon, as well as the Schwarzschild's terms due to the Sun. For calculations of the coordinates of perturbing planets and the Moon the DE200/LE200 ephemerides were used. The way it was fulfilled in previous works the parameters under consideration were the following: among the total parameters of the global solution there are six parameters of the coordinates and velocities corrections for each planet for the standard epoch (they were included in the conditional equations for optical and radar observations), correction to the mean longitude of the Earth, dL, the FK5 equinox correction, dA, the FK5 equator correction, dD, the secular variation of the equinox correction, $d\dot{A}$ (they were included in the conditional equations for only optical data). Several versions of the global solution have been considered. The most interesting results concerning the values of $d\dot{A}$ for different intervals of time on the basis of different number of optical and radar observations are shown at the Table.

We consider that radar observations with refined sets of positional ground-based observations of NEARs and main belt minor planets covering long interval of time can be quite useful for improving the link between Hipparcos and dynamical systems (given by DE ephemerides) and for clarifying the historical problem of motion of dynamical equinox.

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