LONG-TERM NUTATION AND THE LENGTH DAY VARIATION FROM VLBI OBSERVATIONS

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ABSTRACT. The shift of the celestial pole with respect to its 1980 position in longitude ($\Delta\psi$) and obliquity ($\Delta\varepsilon$) from the available VLBI measurement of 1984 year within IRIS project is estimated. Formal uncertainties of the angles $\Delta\psi$ and $\Delta\varepsilon$ are 5.9 mas and 2.7 mas respectively. The day length variation was obtained from the same data. Then attempt was made to obtain annual and semiannual nutation amplitudes. The values are in reasonable agreement with the determinations of other workers.

The aim of the work is to test a software developed in the IAA (Krasinsky et al.,1989) by processing the VLBI observations which were available for us within IRIS project during 1984. In IRIS project 19 sources were observed by 3-5 stations every 5-days (24-hour session).The analysis of about 28000 delay and delay rate pairs provides of different parameters.The reduced observations of every session were processed and 64 parameters were estimated.

They included source coordinates, site locations. time behavior parameters, tropospheric correctoons, day length variation. The root-mean-square residuals are 0.2 ns for delay and 0.1 ps/s for delay rate. The main purpose of the present paper is to analyze these results and to determine shift of the celestial pole with respect to its 1980 IAU nutation in longitude and obliquity and the day length variation. It's known that VLBI measurements provide good determinations of some amplitudes in the current model the Earth nutation (see, for instance, William E.Carter, 1987). We had the total of 1798 residuals of α and δ of the below source coordinates for the determination of celestial pole shift in longitude and obliquty during 1984 year. The residuals for every 5-days intervals numbered 64 points. Formal uncertainties range from 0.001" for regularly observed sources up to 0.01" for sources which were observed only 1-2 times.

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Table 1. The list of source names in 1984 IRIS project and their errors of our determination.

Source name	σ_α (0.001")	σ_δ (0.001")
2134+00		±2.9
1637+574	±4.0	2.1
OQ208	16.2	1.8
3C345	1.7	1.4
3C454.3	1.2	2.4
VR422201	1.8	2.0
0106+013	1.0	3.2
0212+735	5.8	2.1
0234+285	2.2	2.6
NRAO150	4.2	2.4
0552+398	1.7	2.1
OJ287	1.1	2.2
4C39.25	1.6	1.7
3C273B		2.8
1803+784	7.6	1.5
0528+134	1.9	3.0
2216-038	3.8	11.9
0229+131	1.3	3.2
3C279		

For obtaining $\Delta\psi$ and $\Delta\varepsilon$ we used the standard formulae

$$\alpha-\alpha_0=\Delta\psi(\cos\varepsilon+\sin\varepsilon\sin\alpha_0 \,\mathrm{tg}\,\delta_0)-\Delta\varepsilon\cos\alpha_0 \,\mathrm{tg}\,\delta_0$$

$$\delta-\delta_0=\Delta\psi\sin\varepsilon\cos\delta_0+\Delta\varepsilon\sin\alpha_0$$

By weighted least square method 167 parameters such as $\Delta\psi$ and $\Delta\varepsilon$ for every 24-hour session, corrections to 18 coordinates of sources (18 for $\Delta\alpha$ and 18 for $\Delta\delta$) were determinated. The estimated values display a marked systematic variation and are shown in Figure 1 and 2 for $\Delta\psi$ and $\Delta\varepsilon$ respectivly. The RMS value of correction to $\Delta\psi$ is 5.9 mas and to $\Delta\varepsilon$ is 2.7 mas as mentioned before.

The attempt was made to determine annual and semi-annual values of nutation amplutudes. In Table 2 the annual values are shown as compared to other workers' determinations. It may be notices that the agreement is reasonably good (O.J.Sovers et C.D.Edvards). Figure 3 shows the day length variations which is also of good agreement with other determinations (G.O.Dicky, 1988). The accuracy of determinations at every points is no worse then 0.1 msec.

We plan to continue our work in the same direction using a great number of observations and we hope to improve our technique.

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Table 2. Corrections to 1980 IAU annual nutation amplitude. (0.001 arcsec)

Term	IRIS 1980-87	CDP 1979-87	CDN 1978-86	IRIS (IAA) 1984,IAA	Herring Observ.	Adopt.
$\Delta\psi$	4.30 ±0.07	4.26 ±0.07	5.16 ±1.08	4.01 ±0.72	5.22 ±0.25	5.23
$\Delta\varepsilon$	2.01 ±0.02	1.84 ±0.02	1.93 ±0.43	2.18 ±0.90	2.08 ±0.10	2.08

References.

Krasinsky G.A.et al.:1989, Celes.Mech. 45,219-229
Carter William E.:1988,Annual report for 1987,D-105
Sovers O.Jand Edwards C.D.: 1988,Annual Report for 1987,D-109
Dicky J.O.:1989, Lecture Notes in Earth Sciences, 22.

Length of Day

(MSec)

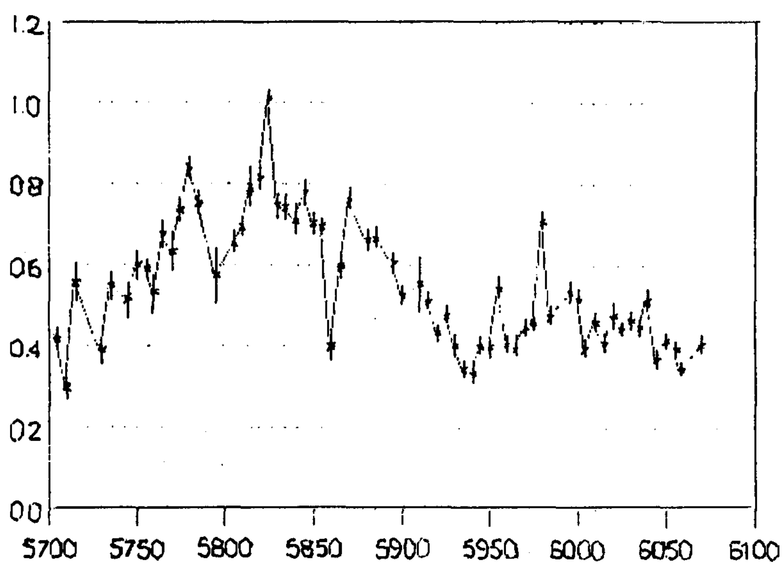

Fig. 3

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Figure 1. Nutation in longitude

(in 0.001 arcsec)

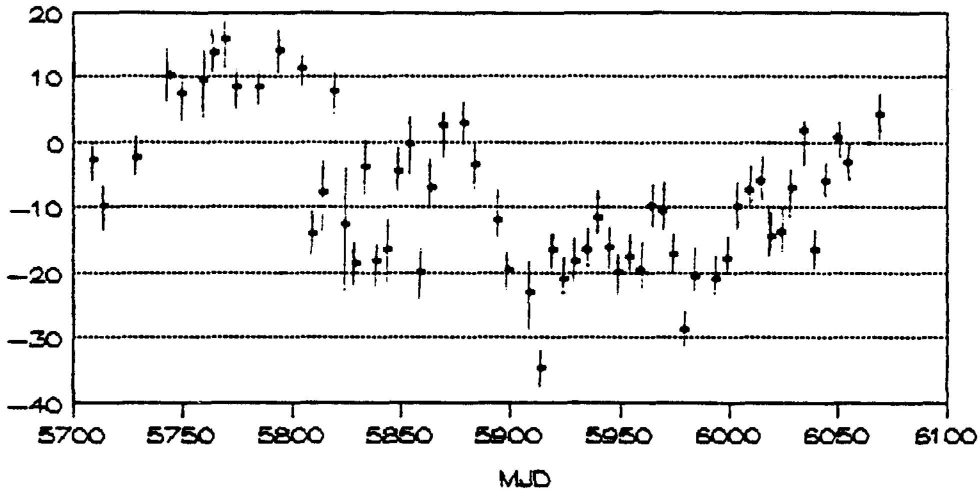
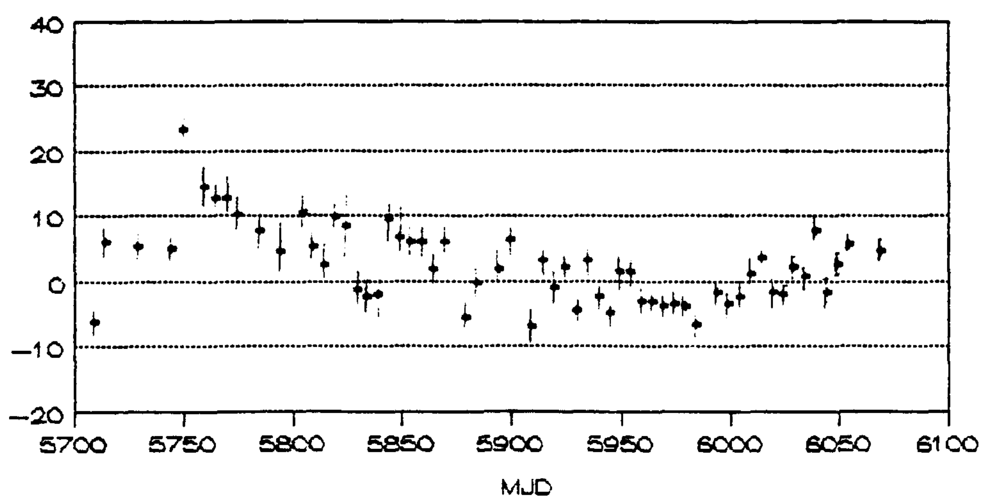


Figure 2. Nutation in inclination

(in 0.001 arcsec)



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