The Tables of Differences Between the Nutation Series IAU2000, IERS1996 and IAU1980

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1 Introduction

The work has been initiated by the EOP Product Center of IERS in Paris since they need a table of differences between the IAU2000 and IAU1980 nutation models (term by term) to incorporate it into the program IERS EOPC04 combinations.

Moreover, the usefulness of such tables has been proved in practice during the transition to the new astronomical constants in 1984, before the MERIT Campaign, and also in the recalculation of the observations of optical astrometry into the Hipparcos Reference Frame (Vondrák et al., 1998). We used effectively for these purposes the tables of differences between IAU1980 and Woolard's nutations (Seidelman, 1982).

The similar table of the differences between IERS1996 and IAU1980 nutations has been made by Gambis (1996). This table has been truncated to assure the precision of 1mas and it contains 25 terms only.

2 The series and method used

The differences between two nutation models can be obtained in two ways. Either, in time domain, one calculates the nutation angle for a given date for both models by such routines as `MHB2000A.f` of Herring (2001) and `iau_NUT80.f` of SOFA (2000) and than subtracts the nutation angles, or, in frequency domain, one can prepare table of the term by term differences and then compute the difference of the nutation angles directly. Here we will show the latter approach. The series of the differences that have been computed are following IAU2000 – IAU1980, IAU2000 – IERS1996, IERS1996 – IAU1980. We reached after the same results from both approaches, but due to the truncation we have got to the agreement to $\pm 0.5\mu$as in case IAU2000A – IAU1980 and IAU2000A – IERS1996 and to $\pm 2\mu$as in case IERS1996 – IAU1980, respectively.

3 IAU1980 theory of nutation

This set of nutation coefficients was published in the final report of the IAU working group on nutation (Seidelmann, 1982) and came into the regular use in 1984. The series consists of 106 lunisolar terms without any planetary terms and they are of the precision level of 100μas. The set of Delaunay's fundamental arguments is referred to the FK5 reference system.

4 IERS1996 model of nutation

In 1996, Tom Herring has analyzed the recent VLBI and LLR data for geophysical parameters required for non-rigid Earth theory. The coefficients were

meant to be used for prediction purposes. They were not meant to replace IAU1980 theory. This series was presented in the McCarthy (1996). It consists of 273 lunisolar terms and 122 planetary terms that reach 5μas precision. The fundamental arguments (Simon et al., 1994) are the same as that recently adopted for nutation IAU2000A.

5 IAU2000A model of nutation

The IAU2000A Precession-Nutation model (Mathews et al. 2002) has been adopted by the IAU (Resolution B1.6) to replace the IAU 1976 Precession and IAU 1980 Theory of Nutation. The original tables of the new nutation theory and the routines for calculation of the nutation angles for a given date from the Tom Herring's web site Herring (2001). The series IAU2000A consists of 678 lunisolar terms and 687 planetary terms that reach the precision level of 0.3μas .

l	l'	F	D	Ω	$\Delta\psi\cos$		$\Delta\varepsilon\sin$	
					A''	A'''	B''	B'''
0	0	0	0	1	-98	32	-53	4
0	0	0	0	2	2	0	1	0
0	0	2	-2	2	-175	34	-76	7
0	1	0	0	0	34	-16	-1	5
0	1	2	-2	2	-19	3	-8	1
0	-1	2	-2	2	-2	0	-1	-1
0	0	2	-2	1	2	0	1	0
2	0	0	-2	0	1	0	0	0
0	2	0	0	0	1	0	0	0
0	2	2	-2	2	-1	0	0	0
0	0	2	0	2	-17	8	-7	2
1	0	0	0	0	5	2	0	0
0	0	2	0	1	-3	2	-1	1
1	0	2	0	2	-4	0	-2	0
1	0	0	-2	0	-2	-1	0	0
-1	0	2	0	2	0	-1	0	0
1	0	2	0	1	-1	0	0	0
1	0	2	-2	2	1	0	0	0
2	0	2	0	2	-1	0	0	0

The table on the left side shows the out-phase-terms that are evoked by the different values of fundamental arguments that input into the IAU2000A and IAU1980 nutation theories. The maximum value of 17.5μas is reached in case of the semiannual term in $\Delta\psi$. The amplitudes of the terms A'', B'' and its time changes A''', B''' are shown in the units 0.1μas and 0.1μas/cy, respectively. The tables of differences has been provided for the nutation series IAU2000A, IERS1996 and IAU1980 and they are displayed at the following ftp servers:

- IAU2000A - IAU1980 at the pages of EOP Product Centre IERS
  http://hpiers.obspm.fr/eop-pc/models/
- IAU2000A - IERS1996 and IERS1996 - IAU1980
  ftp://ftp.ig.cas.cz/incoming/nutdiff

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