

The SLP96 Ephemeris

The SLP96 ephemeris consists of tables of Chebyshev polynomial coefficients which represent the mean coordinates of the Sun, Moon and the planets Mercury, Venus, the Earth-Moon barycenter, Mars, Jupiter, Saturn, Uranus and Neptune for the time span 1550-2350. They have been computed with the theories of the Bureau des Longitudes (Paris) using VSOP87 for the Sun and planets, and ELP2000-82B for the Moon.

This ephemeris provides rectangular or spherical coordinates in either the equinox and equator J2000 (FK5) or the equinox and ecliptic J2000 (dynamical). The fundamental time argument of this ephemeris is Dynamical Barycentric Time (TDB).

Additional information about this ephemeris can be found in the following references:

P. Bretagnon and G. Francou, "Planetary Theories in Rectangular and Spherical Variables. VSOP87 Solutions." *Astronomy and Astrophysics*, **202**, 309, 1988.

M. Chapront-Touze and J. Chapront, "ELP 2000-85 : a Semi-analytical Lunar Ephemeris Adequate for Historical Time", *Astronomy and Astrophysics*, **190**, 342, 1988.

M. Chapront-Touze and J. Chapront, "The Lunar ephemeris ELP 2000", *Astronomy and Astrophysics*, **124**, 50, 1983.

This ephemeris is distributed in eight sequential ASCII files. Each file has the same structure and contains Chebyshev ephemerides covering a century within the interval 1550-2350. The first record contains the ephemeris time span and description of the Chebyshev polynomials. The following records contain the tables of Chebyshev coefficients which represent the coordinates of the Sun, Moon and eight planets.

These ASCII data files can be found on the Internet at <ftp.bdl.fr/pub/ephem/sun/slp96>. Simply download one or more files into the *Numerit* subdirectory on your hard drive. This Internet location also contains Fortran source code utility files and documentation.

The ASCII file names and corresponding time intervals are as follows:

SLP96.S16	1549 Dec 21	(JD2287184.5)	to	1650 Jan 19	(JD2323728.5)
SLP96.S17	1649 Dec 18	(JD2323696.5)	to	1750 Jan 07	(JD2360240.5)
SLP96.S18	1749 Dec 06	(JD2360208.5)	to	1850 Jan 27	(JD2396784.5)
SLP96.S19	1849 Dec 26	(JD2396752.5)	to	1950 Jan 15	(JD2433296.5)
SLP96.S20	1949 Dec 14	(JD2433264.5)	to	2050 Jan 02	(JD2469808.5)
SLP96.S21	2049 Dec 01	(JD2469776.5)	to	2150 Jan 22	(JD2506352.5)
SLP96.S22	2149 Dec 21	(JD2506320.5)	to	2250 Jan 10	(JD2542864.5)
SLP96.S23	2249 Dec 09	(JD2542832.5)	to	2350 Jan 30	(JD2579408.5)

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Precision

The precision of the SLP96 ephemerides can be estimated by the largest discrepancies obtained with a comparison to the DE200 numerical integration which has been used for the determination of the integration constants in the theories of the Bureau des Longitudes (BDL). Information about the DE200 ephemeris can be found in "The Observational Basis for JPL's DE200", E.M. Standish, *Astronomy and Astrophysics*, **233**, 252.

Body	1650-1750	1750-1850	1850-1950	1950-2050	2050-2150
Mercury	0.03"	0.02"	0.01"	0.01"	0.02"
Venus	0.02"	0.02"	0.02"	0.01"	0.01"
Earth-Moon	0.04"	0.02"	0.02"	0.01"	0.02"
Mars	0.38"	0.21"	0.05"	0.04"	0.22"
Jupiter	0.38"	0.20"	0.09"	0.07"	0.11"
Saturn	0.46"	0.36"	0.22"	0.23"	0.51"
Uranus	0.14"	0.07"	0.06"	0.10"	0.19"
Neptune	1.10"	0.83"	0.23"	0.30"	0.51"
Moon	15.00"	9.20"	0.04"	0.03"	0.04"

program rwslp96

This *Numerit* program will read a single SLP96 ASCII data file and create the corresponding binary data file. The software will interactively prompt you for the name of ASCII input file and the binary output file. Be sure to include the file name extensions in both responses.

function slp96

This function opens and processes the SLP96 binary file. It was ported to *Numerit* using the Fortran source code subroutine provided by the BDL. The syntax and arguments of this function are as follows:

```
function slp96(tjd, ibody, icent, ipv, iframe, icoord, result, ierr)
  ` solar, lunar and planetary coordinates j2000
  ` input
  ` tjd      julian date tdb
  ` ibody    body index
  `
  `         ibody=01 : mercury          ibody=07 : uranus
  `         ibody=02 : venus            ibody=08 : neptune
  `         ibody=03 : e-m baryc.       ibody=09 : void
  `         ibody=04 : mars              ibody=10 : moon
  `         ibody=05 : jupiter          ibody=11 : sun
  `         ibody=06 : saturn           ibody=12 : earth
```

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```
` icent      frame center index
`
`           icent=00 : barycenter of solar system
`           icent=01 : mercury           icent=07 : uranus
`           icent=02 : venus             icent=08 : neptune
`           icent=03 : e-m baryc.       icent=09 : void
`           icent=04 : mars              icent=10 : moon
`           icent=05 : jupiter          icent=11 : sun
`           icent=06 : saturn           icent=12 : earth
`
` ipv        position-velocity index
`
`           ipv=1 : position.
`           ipv=2 : position and velocity.
`
` iframe     frame index
`
`           iframe=1 : equinox and equator j2000 (fk5)
`           iframe=2 : equinox and ecliptic j2000 (dynamical)
`
` icoord     coordinates index
`
`           icoord=1 : rectangular coordinates
`           icoord=2 : spherical coordinates
`
` fname      name of the slp96 data file
`
` output
`
` result     results table
`
`           rectangular coordinates (icoord = 1)
`
`           position
`
`           result[1] : equatorial or ecliptic component x (au)
`           result[2] : equatorial or ecliptic component y (au)
`           result[3] : equatorial or ecliptic component z (au)
`
`           velocity
`
`           result[4] : equatorial or ecliptic component x (au/day)
`           result[5] : equatorial or ecliptic component y (au/day)
`           result[6] : equatorial or ecliptic component z (au/day)
`
`           spherical coordinates (icoord = 2)
`
`           position
`
`           result[1] : right ascension or longitude (radians)
`           result[2] : declination or latitude (radians)
`           result[3] : geometric distance (au)
`
`           velocity
`
`           result[4] : right ascension or longitude (rad/day)
`           result[5] : declination or latitude (rad/day)
`           result[6] : geometric distance (au/day)
`
` ierr       error index
```

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```
`      ierr=0  : no error
`      ierr=10 : file error
`      ierr=11 : date error (tjd)
`      ierr=12 : body error (ibody)
`      ierr=13 : frame center error (icent)
`      ierr=14 : position-velocity error (ipv)
`      ierr=15 : frame error (iframe)
`      ierr=16 : coordinates error (icoord)
```

Please note that the unit of the position vector is Astronomical Units and for the velocity vector Astronomical Units per day.

Initialization

The `slp96` function requires initialization the first time it is called. The following statement in the main program will accomplish this:

```
islp96 = 1
```

The `slp96` function will set this "flag" to 0 after initialization. The value of `islp96` is passed to the `slp96` function using a common `islp96` statement in the main program.

Default File Name

The `slp96` function will open a binary ephemeris file named `slp96.bin` by default. You can change this by editing the statement `binfile g = "slp96.bin"` in the `slp96` function source code.