

===== SYRTE - PARIS OBSERVATORY - FRANCE =====

LUNAR SOLUTION ELP/MPP02

December 2002

===== SYRTE - PARIS OBSERVATORY - FRANCE =====

Jean Chapront jean.chapront@obspm.fr
Michelle Chapront michelle.chapront@obspm.fr
Gerard Francou gerard.francou@obspm.fr

Observatoire de Paris - SYRTE (UMR 8630/CNRS)
61, avenue de l'Observatoire
75014 Paris - France

ELP/MPP02 (Chapront, Francou, 2003) is a semi-analytical solution for the orbital motion of the Moon.

It is built on the basis of the lunar theories:

- ELP 2000-82 (Chapront-Touze, Chapront, 1983),
- ELP 2000-85 (Chapront-Touze, Chapront, 1988),
- ELP 2000-96, version used for analysing Lunar Laser Ranging (LLR).

The main differences from the previous solution 'ELP 2000-82B' is the use of the new planetary perturbations MPP01 (Bidart, 2000) and the contribution of the LLR observations provided since 1970.

Like the previous versions, ELP/MPP02 includes:

- the solution of the Main Problem 'Earth, Moon, Sun' with a keplerian orbit for the Earth-Moon barycenter (EMB) including partials with respect to various constants and parameters;
- the direct and indirect planetary perturbations that contain in particular the effects of the secular motions in eccentricity and perihelion of the Earth-Moon barycenter EMB and the secular motion of the ecliptic;
- the Earth's figure perturbations, and the Moon's figure perturbations coupling with libration;
- the relativistic effects and the tidal perturbations;

Some parameters or constants used in ELP/MPP02 have 'nominal values' which are corrected with adjustments resulting from the fit of the solution to observations. The partial derivatives given together with the series of the Main Problem allow to do these corrections.

ELP/MPP02, proposes two ways for computing the lunar coordinates:

- to use corrections obtained by the fit to Laser Lunar Ranging data (LLR);

- to use corrections obtained by the fit to the numerical integration DE405 of the Jet Propulsion Laboratory (Standish, 1998)) used as an observing model; in that case some additive corrections are also applied to secular values of the lunar angles for approaching closer the JPL Ephemeris over 6000 years.

The construction of ELP/MPP02 is explained in the note 'elpmpp02.pdf'. Explanatory comments about the original ELP2000-82 series are also given in the technical note concerning the Lunar solution ELP 2000-82B.

The series of the lunar solution ELP/MPP02 are separated in 2 parts, the Main Problem and the perturbations listed above and brought together, for the each geocentric coordinate: Longitude, Latitude and Distance. At all, there are 6 data files containing the ELP/MPP02 Series.

The FORTRAN subroutine 'ELPMPP02' (in file 'elpmpp02.for') allows to compute rectangular geocentric lunar coordinates (X,Y,Z) referred to the inertial mean ecliptic and equinox of J2000.

Files list:

README.TXT	: This file
elpmpp02.pdf	: Explanatory Note about ELP/MPP02 solution
elpmpp02.for	: Fortran subroutine for using ELP/MPP02 Series
ELP-MAIN.S1	: Series 'Main problem - Longitude'
ELP-MAIN.S2	: Series 'Main problem - Latitude'
ELP-MAIN.S3	: Series 'Main problem - Distance'
ELP-PERT.S1	: Series 'Perturbations - Longitude'
ELP-PERT.S2	: Series 'Perturbations - Latitude'
ELP-PERT.S3	: Series 'Perturbations - Distance'

References:

Chapront-Touze M., Chapront J., 1983:

The lunar Ephemeris ELP 2000,
Astronomy and Astrophysics, 124, 50.

Chapront-Touze M., Chapront J., 1988:

ELP 2000-85: a semi-analytical lunar ephemeris adequate for historical times,
Astronomy and Astrophysics, 190, 342.

Standish E.M., 1998:

JPL Planetary and Lunar ephemerides, DE405/LE405,
Jet Propulsion Laboratory, InterOffice Memorandum, IOM, 321.F-98-048.

Bidart P., 2001:

MPP01, a new solution for planetary perturbations in the orbital motion of the Moon,

Astronomy and Astrophysics, 366, 351.

Chapront J., Francou G., 2003:

The lunar theory ELP revisited. Introduction of new planetary perturbations, Astronomy and Astrophysics, 404, 735.

(end of document)