

INTEGRATED SOFTWARE PACKAGE "STAMP" FOR MINOR PLANETS

Kochetova O.M., Shor V.A., Institute of Theoretical Astronomy of the USSR Academy of Sciences, Naberezhnaya Kutuzova 10, St. Petersburg, 191187 USSR.

Abstract. The integrated software package STAMP elaborated for rapid and exact reproducing the tables of the year-book "Ephemerides of Minor Planets" and solving the typical problems connected with the use of the year-book is described.

The year-book "Ephemerides of Minor Planets" (EMP) is a publication widely used in many astronomical institutions of the world. It contains all necessary information on the orbits of all numbered minor planets and the astronomical coordinates of each planet during certain period suitable for its observations.

In accordance with the resolution of IAU the year-book is prepared and published by the Institute of Theoretical Astronomy of the USSR Academy of Sciences (ITA). The research workers of a number of astronomical institutions of different countries contribute to preparation of the data for some tables of EMP.

The use of data from EMP in astronomical practice is rather varied, but it is possible to indicate the main points of it :

- a) planning the astronomical and astrophysical observations of minor planets and making preparation for them.
- b) comparing results of observations with predicted values of coordinates, brightness and other data.
- c) investigation of structure of the asteroid belt.

The problems connected with above points are solved with the aid of ten following tables of the year-book :

1. Information on new elements
2. Elements
3. Lost minor planets
4. Osculating elements of perturbing planets
5. Minor planet lightcurve parameters
6. Opposition dates
7. Ephemerides
8. Ephemerides of some unusual planets
9. Status of minor planet observations
10. Antisun and Moon

The principal tables are those of 'Elements', 'Opposition dates' and 'Ephemerides'. The table of elements contains the osculating elements of 4646 numbered planets (EMP for 1992, see Batrakov, 1991) and their photometric parameters. The data of the table are used as the initial ones for calculation of ephemerides and for statistical study of minor planets, their distribution in space and/or the frequency distributions of their orbital elements and some functions of them.

The table "Opposition dates" determines the time most suitable for observations of each planet.

The table "Ephemerides" contains ephemeris data with ten day step for several thousand minor planets having the opposition within current year. Every ephemeris embraces 70 days interval

in the vicinity of opposition and gives calculated positions and other data taking into account the perturbations from all perturbing planets.

The usual practice of using EMP data is based on solving the elementary logical problems and carrying out such actions as interpolating, selecting, sorting and other more or less time-taking operations.

Personal computers make it possible to facilitate the use of EMP for solving majority of the problems widely met in practice (Shor, 1990). The software package "STAMP" seems to be decided step in this direction.

STAMP incorporates the elements of data base as well as program and graphics packages.

When elaborating STAMP, the principle of the "electronic book" was applied.

All the data from ten tables of EMP are inputted in the internal data base of the system as they are published in the year-book. In this way speedy and exact reproduction of the tables is ensured.

Apart from straightforward reproduction of the tables, the following potentialities are inherent in STAMP.

1. Movement along table forward and backward; outputting the table at printer or its recording in file (it is equally valid for any selection from table).
2. Selecting from table in conformity with some condition or combination of conditions imposed on elements of the Table or on certain functions of the elements.
3. Calculating some additional widely used functions of the orbital elements such as the perihelion and aphelion distances, the period of revolution, the mean daily motion in arcsec, the mean opposition magnitude and so on.
4. Sorting tabular data or results of calculations.
5. Drawing frequency distribution graphs (histograms) and computations of some statistical characteristics of the distributions.

The above possibilities are realized for the table of elements.

6. Interpolating the data using the tabular differences of various orders that retain the formal precision of EMP data. In case of close approach with the Earth, ten day step of ephemeris is too large for accurate interpolation of coordinates. The precise coordinates can be found in such case through the use of ephemerides of unusual planets. It must be also noted that interpolation does not provide desired precision for the phase angle in the vicinity of opposition, especially for very small values.

7. Computation of $O - C$ (observed minus computed) for the numbered minor planets. Observed positions can be inputted directly by typing the data according to conventional format or the input file can be formed in some way in advance.

8. Comparison of observed position of unnumbered object(s) with ephemeris of certain minor planet.

9. Identification of the planets, that is to say, ascribing the

observed positions of some object(s) to the numbered minor planet(s). User has a possibility to change the limits of allowable deviations from computed positions.

10. Preparation of the list of minor planets which can be seen at the moment within certain sky region and visualization of their mutual positions.

The most time-consuming operation is the identification. It takes about three minutes when using 286 processor. In the next version of STAMP which is under development the more economical algorithm will be used.

STAMP is written in programming language 'Clipper'. The system can work on an arbitrary IBM PC XT/AT or a compatible computer under the MS DOS. The system needs not less than 2.5 Mbytes free space on the hard disk for placing the STAMP itself and not less than 640 Kbytes of main memory.

This version of the STAMP system is supplied on a single 1.2 Mbytes distribution diskette.

Dealing with the system is organized in the form of dialogue. Description of job is specified through choice of corresponding points of menu. In some cases, that is followed by specifying dialogue to input the values of job parameters. In a number of cases the user has to edit the file typed at screen or create new file.

If required, user can appeal to 'helper' for advice. Besides, the package incorporates "introduction" and description of each table. All that enables us to hope that the package is a useful tool not only for professional astronomers, but for amateurs as well.

At present the package is ready for use for 1991 and 1992. STAMP-92 is prepared taking into account the two last resolutions of the IAU Commission 20 concerning the usage of the new fundamental epoch 2000.0 and the new list of photometric parameters of minor planets.

The present version of STAMP (v.1.1) has prospects for future development. As it was noted, more effective algorithms of some processes can be introduced. A possibility exists for incorporating unnumbered planets with sufficiently reliable orbits into the package.

Constructive suggestions on improvement of the package are welcome.

References

- Batrakov Yu.V., ed. (1991) Ephemerides of Minor Planets for 1992, 'Nauka', Leningrad. 492 pp.
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