Software Complex "Asteroids and Comets" at the Site of the Institute of Applied Astronomy RAS

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The software complex "Asteroids and Comets" offers an opportunity to solve a set of research problems connected with asteroids and comets in web-access mode. The complex not only provides the user with a certain amount of information on the issues, but also gives him the opportunity to perform some calculations and research in remote access. The list of these problems is rather wide. One of the key part of the complex is the computing-analytical package intended to predict approaches of minor bodies to the Earth and the Moon, and to estimate the collision probability. To improve object orbital elements the optical and radar observations from the catalogue of the Minor Planet Centre (USA, Cambridge) as well as radar observations of Quasar VLBI network are used.

Keywords: Asteroids, comets, orbits, observations.

The software complex "Asteroids and Comets" of the Small bodies of the Solar system Laboratory of IAA RAS is developed to create a Russian source of information, especially about the dynamics of asteroids and comets, based primarily on original domestic research and developments; to assist professional researchers and amateurs in the study of small bodies of the Solar system. It offers the opportunity to address a number of research tasks related to asteroids and comets: determination of the minimum distance between the two orbits, calculation of encounters with other objects, visualization orbits, ephemeris calculation of search, etc. An user is able to enter their own orbital object data. Each section contains a detailed description of the scope of the issues which is sufficient for the correct use of the tools provided by the site. The website contains also publications of the staff, protection seminars, links to interesting work, etc.

The list of the problems solved by the complex is the following.

Structure of the software complex "Asteroids and Comets"

Information about minor bodies

Asteroids

General information

Search by fragment name

List of named asteroids

Types of asteroid orbits

Groups and families of asteroids

Proper elements of some asteroids

Masses and density of some asteroids

Information about each asteroid

History of discovery and naming

Observations

Physical and orbital parameters

Comets

General information

Search by fragment name

List of comets

Types of comet orbits

Proper elements of some comets

Masses and density of some comets

Information about each comet

History of discovery and naming

Observations

Physical and orbital parameters

Asteroid and cometary hazard

Real bodies

Examples of calculations of circumstances of collision with Earth of real bodies

Model bodies

Calculation of circumstances of approaching or falling asteroids, which orbital and physical parameters set by the user randomly

Work in real time

Operation of the bench in real time.

Encounters of bodies with the Earth and Moon

The table of the past and forthcoming approaches of bodies which is automatically updated by calendar date in of the package

Tasks

General information

Additional orbit parameters

Proper orbit parameters

Commensurability of the motion with other objects and Tisserand criterion

Transfer of orbit parameters to new date

Minimal distance between two orbits

Encounters with big planets and other bodies

Orbit visualization

Construct of initial orbit

Searching ephemerides

Additional tasks

Text editor

Translation of calendar date in Julian days and back
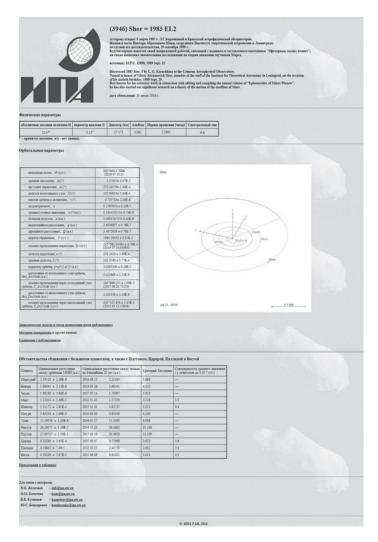
Observatories

Fig. 1. Example of a tab with information about physical and orbital parameters of an asteroid

Updating the orbital and physical characteristics of asteroids and comets is fulfilled once a month on IAA RAS web-site. To improve object orbital elements the optical and radar observations from the catalogue of the Minor Planet Centre (USA, Cambridge) as well as radar observations of Quasar VLBI network are used.

The complex not only provides an user with a certain amount of information on the issues, but also gives him the opportunity to perform some calculations and research in remote access.

The website "Asteroids and Comets" contains the following main sections.

Fig. 2. Lists of numbered asteroids with information about their discoveries
and history of assignment of a name

The section "Information on small bodies" — a user has possibility to obtain information on physical and orbital parameters of asteroids and comets at the website, to compile their own list of object's observations and to calculate object's orbit, to get history of object's discovery and naming (Fig. 1, 2). Besides, an user can choose asteroids and comets according to orbital types, families of asteroids, and other information.

The section "Tasks" lists the tasks for which users have web access. The list of such tasks is very wide. The example of the user inquiries at a formulation them tasks is shown in Fig. 3, 4.

The section occupies a special place, "Asteroid and cometary hazard", which is a tool that handles real time received information about the discovery and observations of potentially hazardous bodies, predicts their motion and in case a body enters the earth's atmosphere, recreates the whole scenario of impending disaster. A software package was developed for handling existing in database information about the potentially hazardous bodies and received via communication channels information about the discovering of a new hazardous bodies and their observations. On the basis of available data of a prediction of possible rapprochements or collisions with the Earth and the Moon on the next several revolutions of the body around the Sun and their probabilities. In addition, the complex may serves as an instrument for calculation of circumstances of approaching or falling of bodies, which orbital and physical parameters set by the user randomly (Fig. 5).

Fig. 3. Example of a typical tab for introduction of the input data necessary for the solution of tasks of the user
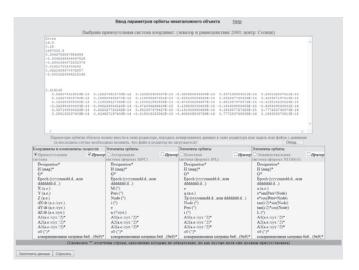

Fig. 4. Tab for input of parameters of the orbit of an object not switched on databases of the complex

The chronological table of the past and forthcoming encounters of bodies is provided in the section "Rapprochements of Bodies with Earth and Moon". Content of the table is updated in real time correspondingly by the results of operation of the package.

Fig. 5. Calculation of circumstances of approaching or falling of bodies, which orbital and physical parameters set by the user randomly
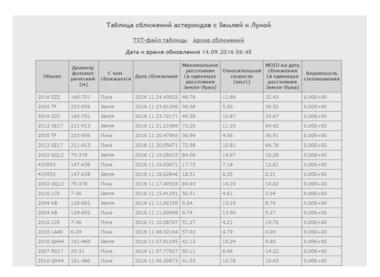

Fig. 6. Fragment of the table of past and forthcoming approaches of asteroids with the Earth and Moon