CREATION OF AN IMITATION MODEL OF NEAR-SUN ASTEROIDS WITH SMALL PERIHELION DISTANCES

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Introduction: The work is focused on creating a simulation model of near-Sun asteroids (NSAs) with perihelion distances up to $q < 0.1$ AU. The model includes astrophysical parameters of these objects, size distribution and their dynamic behavior in space. It is possible to change the parameters to simulate various states of NSAs and build tracks of their predicted values.

Methods and supports: The digital model of NSA designed for study of its dynamics and prediction. The observations from ground and space systems and dynamic regression adaptive modeling (DRAM) were used for this purpose [1]. It considered that while modeling the dynamics of discrete time series one often encounters such violations of the regression analysis schemes as high degree of autocorrelation dependence between the next and previous elements of time series, non-linearity in distribution of residuals, etc. In this regard, there arises a problem of a complex processing of time series with an obligatory checking for the observance of the normal Gauss-Markov scheme conditions and the following adaptation if there are violations [2]. Therefor for the accurate processing and analyzing time series, one uses DRAM. This approach allows increasing adequacy by assessing the quality of the constructed models on the internal and external quality measures [3].

In the recent years, there has been an intensive spread of a new computer software for performing mathematical calculations – the MatLAB and LabVIEW systems. There are main advantages of these systems, which distinguish them favorably from other currently existing mathematical systems. For exaple, they are ahead of many other similar systems in the speed of completing tasks. For these reasons, the MatLAB system was chosen for developing the DynamicSimulationModelNSA software package for science reserch for meteoroids and in order to be able to integrate it into the LabVIEW system. The DynamicSimulationNSA program is built in the form of several modules.

Results: DynamicSimulationModelNSA was created, which includes astrophysical and celestial mechanical parameters of near-Earth objects, and, if available, contains time series of changes in these parameters. For example, changes in orbital elements, brightness characteristics and associated temperature gradients. As it is known [4], near-Earth objects, according to observational selection, are divided into categories with high and low albedo. The latter can be attributed to NSAs, having small sizes and perihelion distances close to the Sun. For this reason, their intense destruction occurs even when moving away from the Sun. This effect became a criterion for identifying NSAs as objects that are either located or have recently moved in orbits with perihelion distances $q < 0.1$ AU. Using a joint analysis of albedo and orbital parameters, it becomes possible to study near-Earth asteroids as NSAs. If there is a long-period observational series for the variability of the parameters, then the DynamicSimulationModelNSA, including DRAM, makes it possible to build predictive trends in the evolution of these objects.

Conclusons: The results obtained in the work can find their application for assessing the reliability of genetic relationships between meteoroids [5], the influence of solar radiation on the evolution of NSAs [6], the study of inflationary processes on the surface of asteroids [7], the development of the evolutionary theory of the solar system [8], and for planning new space missions and observing technologies [9].

Acknowledgements: This work was partially supported by Russian Science Foundation, grants no. 20-12-00105 (according to the grant, the method for data analysis was created) and 21-72-10024 (the numerical calculations were carried out). This work is performed according to the Kazan Federal University Strategic Academic Leadership Program. This work was partially supported by the Russian Foundation for Basic Research grant no. 19-32-90024 and the Foundation for the Advancement of Theoretical Physics and Mathematics "BASIS".

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