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

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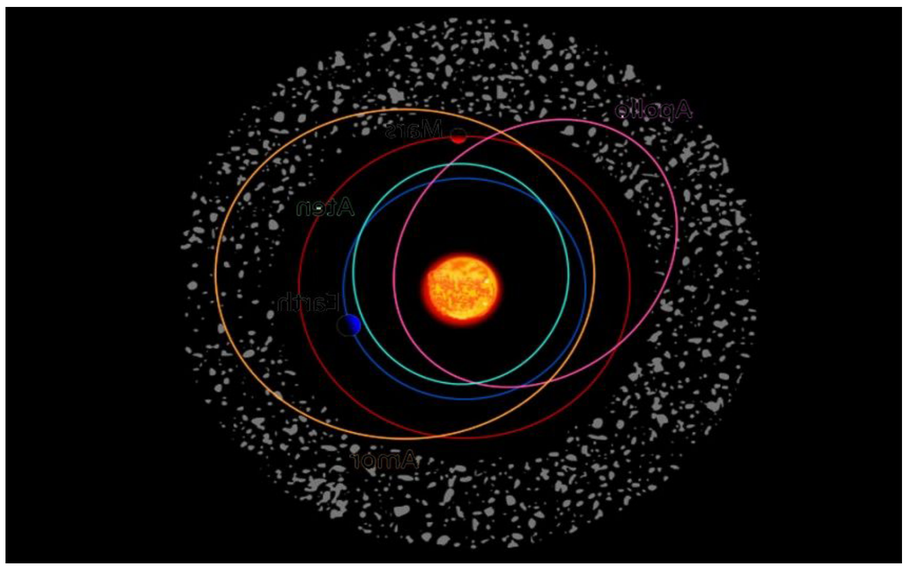

Introduction

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

The digital model of NSA designed to study its dynamics and for making predictions. The observations from ground-based and space systems and dynamic regression adaptive modeling (DRAM) were used for this purpose [1]. It was taken into account that, while modeling the dynamics of discrete time series, one often encounters various violations of the regression analysis schemes, such 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, followed by adaptation in case there are violations [2]. Consequently, for the accurate processing and analyzing of time series, one uses DRAM. This approach allows increasing adequacy by evaluating 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 the other currently existing mathematical systems. For instance, they are ahead of many other similar systems in terms of tasks completion rate. For these reasons, the MatLAB system was chosen for developing the DynamicSimulationModelNSA software package.

Results

The DynamicSimulationModelNSA software package was created for the study of meteoroids in order to integrate it into the LabVIEW system. The DynamicSimulationNSA program is built as several modules. DynamicSimulationModelNSA allows exploring astrophysical and celestial mechanical parameters of near-Earth objects, and, if possible, contains time series of changes in these parameters (e.g. orbital elements, brightness characteristics and associated temperature gradients). As it is known [4], near-Earth objects, according to observational selection, are divided into categories of 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 are 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.

Asteroids	a, a.e	e	q, a.e	i°	Ω°	ω°	T, год	H	D, km	TT
For the meteor shower k Cygnids										
153311 (2001 MG1)	2,50	0,65	0.89	28,42	142,36	218,49	3,95	17,20	1,1 – 2,4[1]	-
385343 (2002 LV)	2,31	0,61	0,91	29,54	132,21	224,21	3,52	16,60	1,73	L,T; QX; S
For the meteor shower Delta Cancrids										
(2014 RS17)	1,94	0,77	0,44	1,63	322,13	274,37	2,7	23,20	0,069 – 0,154[1]	-
(2006 BF56)	2,34	0,79	0,47	0,96	125,25	102,61	3,58	29,60	0,003 – 0,008[1]	-

Fig.1 The NSAs elements of the orbit (2000.0)

Conclusion

The results obtained in this work may find their application at 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 while planning new space missions and observing technologies [9].

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