OPTIMIZATION OF HIGH ELLIPTICAL ORBITS

D.I. Stefanishin, S.O. Davydova

Samara National Research University, Samara, Russia

Background. Increasing the amount of data with which space workers interact, and the number of operations performed that need to be monitored require finding ways to automate many processes. In addition, increasing the accuracy of mathematical and physical models of spacecraft flight, considering interaction with multiple numbers of cosmic bodies, is also one of the desirable tasks of modern space science.

Aim. On the example of observation of polar regions to consider possible methods to optimize the process of this observation.

Methods. One method is to design the most efficient orbit for a given purpose. This process is time-consuming and inaccurate due to approximate orbital construction algorithms based on a system of 6 partial differential equations. For spacecraft designed to be on the Earth's orbits, this may be sufficient, considering periodic adjustments to the spacecraft's flight program, but for systems in which accuracy is one of the main criteria (for example, a space elevator), or the inaccuracy has a cumulative effect (flights beyond the Earth's orbit), it can become critical. To minimize such an error, use of specially trained artificial intelligence, which will be comparing the deviation of the theoretical orbit from the real one can help.

Another option for improving the efficiency of observation is to improve the quality of the target equipment and the processing of observation materials obtained from it. The topic of improving the efficiency of target equipment is generally developed. Producing simulations, the most advantageous characteristics of the target equipment are selected for this mission. The methods of processing a set of visual data, which the target equipment collects, have undergone significant progress in the last decades. With the increase in the performance of computing, as well as the advent of autonomous image processing by neural networks, the processing has become easier.

Outcomes. To continuously observe both polar regions, you can use a series of four satellites synchronized so that while one rises to the apogee, the other descends into the perigee. This synchronization can be done with the help of artificial intelligence, which will adjust the distance between the satellites so that it always remains the same.

It is also possible to use the multi-apogee scheme proposed in Trishenko's work [1], adjusted in such a way as to increase the accuracy of the observations made using the construction of a model of such an orbit and constant adjustment considering the interaction of the satellite with other space bodies.

Interesting in the field of target equipment seemed to me the work of Vladimirov, Yukseyev and Lapukhin [2], in which the target equipment was proposed, which, with an apogee of 23 thousand km, receives a detail of 21 meters per pixel.

Conclusions. There are still many ways to improve the accuracy and efficiency of orbit design and use. One particularly promising area is the introduction of artificial intelligence into a given area, to increase the automation of design and the autonomy of the missions being performed.

Keywords: orbit design; optimization; artificial intelligence; high elliptical orbits.

References

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Information about authors:

Denis I. Stefanishin, student, group 1214, Institute of Aeronautics and Space-Rocket technologies; Samara National Research University, Samara, Russia. E-mail: kosmelf98@gmail.com

Svetlana O. Davydova, senior lecturer of Department of Foreign languages and Russian as a Foreign Language; Samara National Research University, Samara, Russia. E-mail: davidova.so@ssau.ru