



Estimate of sizes of small asteroids (cosmic bodies) by the method of stroboscopic radiolocation



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ARTICLE INFO

Article history:

Received 1 October 2014

Accepted 8 December 2014

Available online 16 December 2014

Keywords:

Near-Earth objects

Asteroids

Radar observations

Stroboscopic measurements

ABSTRACT

Radiolocation methods of probing minor celestial bodies (asteroids) by the nanosecond pulses can be used for monitoring of near-Earth space with the purpose of identification of hazardous cosmic objects able to impact the Earth.

Development of the methods that allow us to improve the accuracy of determining the asteroids size (i.e. whether it measures tens or hundreds meters in diameter) is important for correctly estimating the degree of damage which they can cause (either regional or global catastrophes, respectively). In this paper we suggest a novel method of estimating the sizes of the passive cosmic objects using the radiolocation probing by ultra-high-resolution nanosecond signals to obtain radar signatures. The modulation envelope of the reflected signal, which is a radar portrait of the cosmic object, is subjected to time scale transformation to carrier Doppler frequency by means of radioimpulse strobing. The shift of a strobe within the probing period will be performed by radial motion of the object which will allow us to forgo the special autoshift circuit used in the oscillographic technical equipment.

The measured values of duration of radiolocation portrait can be used to estimate the mean radius of the object by using the average spatial length of the portrait. The method makes it possible to appraise the sizes of cosmic objects through their radiolocation portrait duration, with accuracy that is independent of the objects range.

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1. Introduction

Radiolocation methods of probing of passive cosmic objects (large meteors and asteroids) can be used for surveying the near-Earth space for the purpose of recognition of objects that present danger upon impact with the Earth.

It is known that cosmic objects smaller than 10 m in size do not reach Earth's surface, burning up in the atmosphere [1], and thus are not dangerous for the planet's population. The bodies that are tens meters across are able

to explode and cause serious destruction, while the objects with a size of hundreds meters in extent and larger would lead to a regional or global disaster. With that, the bodies ranging specifically from 70 to 200 m in diameter present the maximum danger for the humanity in its characteristic timescale, since they have greater probability of impacting the Earth than the larger bodies and their average destructive effect is maximal (NASA NEO STD Report [2,3]). Thus the questions of improving accuracy for estimating sizes of cosmic bodies crossing the Earth's orbit are relevant even at present and the interest in them will only increase.

The shortcomings of the optical methods for measurement of linear dimensions of celestial bodies are that error increases proportionally with distance to the measured object. The reason for that is that the optical systems of measurement

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