15.10. ABOUT THE INFLUENCE OF THE DYNAMICS ON LIMIT CYCLES OF AERODYNAMIC PARAMETERSOF THE MOTION OF THE ORBITAL TETHER SYSTEM IN AN ELLIPTICAL ORBIT

Vorontsova V. L.

Institute of Management, Economics and Finance KFU

Butlerov str.4, Kazan, Russia, 420012

In connection with the expansion of space applications for orbital cable systems of long overdue study of the influence of aerodynamics on the motion of an artificial satellite-link the two bodies. For large space systems aero-dynamic effects are very significant.

In this work, investigated limit cycle for an equation of the relative motion of rigid bundles of two bodies orbiting in an elliptical orbit – taking into account the influence of the gravitational effect of the aerodynamic pressure aerogradient and dissipative factors, depending on the growth of the eccentricity e and aerodynamic parameters a. Use the equations of motion associated with the strength of the gravitational gradient and the aerodynamic effects [1].

The influence of aerodynamic parameters on the behavior of limit cycles areresearced. Combining aerogradient promotion bundles with its aerodynamic braking friction results in a limit to the relative equilibrium or to limit cycles of the second kind (it is assumed that the angular velocity is constant along the cycle). For the transition from the phase trajectory to point mapping method is applied point Poincare maps. On the phase plane conclusions the results of numerical integration of the equations of motion only when values of the independent variable is $v = 2\pi n$, $n = 1,2,3...$

With the help of numerical implementation of the method of point mappings Poincare constructed phase portraits and found a second-order limit cycles corresponding to the rotation of the ligament with a large but finite angular velocity.

In the present work we investigated the behavior of limit cycles of eccentricity e = 0.01. The parameters k and b are considered identical ($k = 1$; $b = 0.01$), a parameter is subject to change. If the value of the eccentricity of the orbit $e = 0.1$, and a small value of a limit cycle is absent, but there is a «layer» of chaotic motion. When the value increase up to 15 limit cycle occurs. Points «roll» to the band in vicinity of $\alpha = 18$.

For research using known methods of nonlinear mechanics: the method of Lagrange equations of the first kind, the method of phase plane, the method of point mappings, methods of the theory of stability of motion.

Evaluation factors of aerogradient and aerodynamic friction shows that their relations do not depend on the size of the satellite-weights or by its dynamic characteristics, and depend only on the parameters orbit and height of the atmosphere.

Thus, changing the parameters of the orbit, the height of the atmosphere and the length of the dumbbell can influence the motion of the satellite-weights, including chaotization.

Keywords: dynamics of space systems, qualitative theory of dynamical systems, orbiting a bunch of bodies, cable systems, limit cycles, the phase space, aerodynamic parameters, orbital eccentricity.

References

1. *Alpatov A. P., Beletsky V. V., Dranovskaya V. I., Zakrzewski A. E.*, Pirozhenko A .V., *Troger G., Khoroshilov V. S.* The dynamics of space systems with tether and hinged connections. – Moscow-Izhevsk: «Regular and Chaotic Dynamics' Space Research Institute. 2007 – Ch. 14. – P. 435-450.