Paper ID: 29685
student

ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (1) (3)

Author: Mr. Vasily Nikonov
Lomonosov Moscow State University, Russian Federation, nikon_v@list.ru

Dr. Alexander Burov
A.A.Dorodnicyn Computing Centre, FRC Computer Science and Control, Russian Academy of Sciences, Russian Federation, teormech@gmail.com

COMPLEXIFIED POTENTIALS AND STEADY ROTATIONS OF MUTUALLY GRAVITATING ASTEROID AND SPACECRAFT

Abstract

A problem of motion of mutually gravitating rigid body and massive point is considered. Assuming a mass distribution of the body being irregular one discusses possibilities of description of the potential of attraction using real number field extensions. Existence and stability of steady rotations of the system are investigated within simplifying assumptions concerning mass distribution. Bifurcations of steady motions are discussed in connection of existence and stability of the detected libration points.

Difficulties related to description of motion in a vicinity of bodies with irregular mass distributions are known [1]. Importance of overcoming of related problems became more clear within the recent Rosetta mission. In particular, there is a question about sufficiency of representation of a comet nuclei as a gravitating dumbbell [2,3].

The "dumb-bell" representation can be modified by introduction of "complexified potentials" ([4,5]). Within this approach one effectively uses "complex dipoles" possessing relatively unexpected properties in comparison to the classic real-valued dipole. These properties are also discussed.

The approach based on using complex dipoles seems reasonable for the potential approximation of oblate bodies, arises to the beginning of the space age [6]. Introduced in [7] and studied in [8,9], this approach was effectively used for analytical description of satellite motions in vicinity of oblate planets. This turned out being possible because of integrability of the two fixed-centers problem.

In contrast to the satellite dynamics under attraction of an oblate planet, dynamics of the considered problem looks non-integrable. Complexity of its dynamics is demonstrated via numerical simulation.

1.Scheeres D.J.*Orbital Motion in Strongly Perturbed Environments:Applications to Asteroid,Comet and Planetary Satellite Orbiters* Berlin:Springer,2012,390p.

2.Beletsky V.V.*Generalized Restricted Circular Three-Body Problem as a Model for Dynamics of Binary Asteroids* Cos.Res.,2007,Vol.45,N5,pp.408-416

3.Beletsky V.V.,Rodnikov A.V.*Stability of Triangle Libration Points in Generalized Restricted Circular Three-Body Problem* Cos.Res.,2008,V.46,N1,pp.40-48

4.Beletsky V.V.,Rodnikov A.V.*Libration Points of the Generalized Restricted Circular Problem of Three Bodies in the case of imaginary distance between attracting centers* Rus.J.Nonlin.Dyn.,2012,V.8,N5, pp.931-940

5.Rodnikov A.V.*Coplanar libration points of the generalized restricted circular problem of three bodies for conjugate complex masses of attracting centers* Rus.J.Nonlin.Dyn.,2013,V.9,N4,pp.697-710

6.Aksenov E.P.,Grebenikov E.A.,Demin V.G.*The generalized problem of motion about two fixed centers and its application to the theory of artificial earth satellites* Soviet Astronomy.1963,V.7,N2,pp.276-282.

7.Kislik M.D.*Motion of an artificial satellite in the normal gravitational field of Earth* Iskusstvennye Sputniki Zemli,1960,V.4,pp.3-17.

8.Demin V.G. *Orbits in the problem of two fixed centers* Soviet Astronomy,1963,V.4,N6,pp.1005-1012.
9.Vinti J.P. *Theory of accurate intermediate orbit for satellite astronomy* Journ.Res.Nat.Bur.Standards, 63B math.and math.physics,1961,N3,pp.169-201