New conditional integrable cases of motion of a rigid body with Kovalevskaya's configuration

Author(s):
Yehia, HM (Yehia, H. M.)[1]
; Elmandouh, AA (Elmandouh, A. A.)[1]
Mansoura Univ, Dept Math, Fac Sci, Mansoura 35516, Egypt
E-mail: hyehia@mans.edu.eg

Abstract:
We consider the general problem of motion of a rigid body about a fixed point under the action of an axisymmetric combination of potential and gyroscopic forces. We introduce two new cases of this problem which are integrable on the zero level of the cyclic integral. The new cases are combined generalizations of several previously known ones, namely those of Kovalevskaya, Yehia, Sokolov, Yehia and Bedweihi and Goriatchev, by the introduction of additional parameters to the structure of each.

KeyWords: DYNAMICS; FORCES
Published in : JOURNAL OF PHYSICS A-MATHEMATICAL AND THEORETICAL Volume: 44 Issue: 1 Article Number: 012001 DOI: 10.1088/1751-8113/44/1/012001 Published: JAN 7 2011

References

1] Leimanis E 1965 *The General Problem of Motion of Coupled Rigid Bodies About a Fixed Point* (Berlin: Springer)
[2] Kowalevski S and Kovalevskaya S V 1889 Sur le probleme de la rotation d'un corps solide autour d'un point fixe *Acta Math.* **12** 177-232
[3] Yehia H M 1997 New generalizations of the integrable problems in rigid body dynamics *J. Phys. A: Math. Gen.* **30** 7269-75 IOPscience
[4] Yehia H M 1999 New generalizations of all the known integrable problems in rigid body dynamics *J. Phys. A: Math. Gen.* **32** 7565-80 IOPscience
[5] Borisov A V and Mamaev I S 2005 *Rigid Body Dynamics. Hamiltonian Methods, Integrability and Chaos* (Moscow Izhevsk: Regular and Chaotic Dynamics) (in Russian)
[6] Yehia H M 2006 The master integrable two-dimensional system with a quartic second integral *J. Phys. A: Math. Gen.* **39** 5807-24
IOPscience
[7] Yehia H M 2007 Atlas of two-dimensional irreversible conservative Lagrangian mechanical systems with a second quadratic integral *J. Math. Phys.* **48** 082902
[8] Yehia H M 1986 On the integrability of certain problems in particle and rigid body dynamics *J. Mécan. Théor. Appl.* **5** 55-71
[9] Yehia H M 1986 On the motion of a rigid body acted upon by potential and gyroscopic forces: I. The equations of motion and their transformations *J. Mécan. Théor. Appl.* **5** 747-54
[10] Sokolov V V 2002 A generalized Kowalevski Hamiltonian and new integrable cases on e(3) and so(4) *Kowalevski Property (CRM Proceedings & Lecture Notes)* ed V B Kuznetsov (Providence, RI: American Mathematical Society) pp 307-15
[11] Sokolov V V 2001 New integrable case for Kirchhoff's equations *Teor. Mat. Fiz.* **129** 31-6
[12] Yehia H M and Bedweihi N 1987 Certain generalizations of Kovalevskaya's case *Mansoura Sci. Bull.* **14** 373-86
[13] Yehia H M 1996 New integrable problems in the dynamics of rigid bodies with the Kovalevskaya configuration: I. The case of axisymmetric forces *Mech. Res. Commun.* **23** 423-7

[14] Yehia H M 2003 Kovalevskaya's integrable case: generalizations and related new results *Reg. Chaot. Dyn.* **8** 337-48
[15] Yehia H M 2006 Two-dimensional conservative mechanical systems with quartic second integral *Reg. Chaot. Dyn.* **11** 103-22
[16] Whittaker E T 1937 *A Treatise on the Analytical Dynamics of Particles and Rigid Bodies* 4th edn (Cambridge: Cambridge University Press)
[17] Magnus K 1974 *Kreisel. Theorie und Anwendungen* (Berlin: Springer) (Russian translation, Mir, Moscow)
[18] Hietarinta J 1987 Direct methods for the search of the second invariant *Phys. Rep.* **147** 87-154

New integrable systems with a quartic integral and new generalizations of Kovalevskaya's and Goriatchev's cases

Author(s):
Yehia, HM (Yehia, H. M.)[1]
; Elmandouh, AA (Elmandouh, A. A.)[1]
Mansoura Univ, Dept Math, Fac Sci, Mansoura 35516, Egypt
E-mail: hyehia@mans.edu.eg

Abstract:
In his paper [1], one of us has introduced a method for constructing integrable conservative two-dimensional mechanical systems, on Riemannian 2D spaces, whose second integral is a polynomial in the velocities. This method was applied successfully in [2] to construction of systems admitting a cubic integral and in [3, 4] and [5] to cases of a quartic integral. The present work is devoted to construction of new integrable systems with a quartic integral. The potential is assumed to have the structure

KeyWords: integrability; quartic integral
Published in : REGULAR & CHAOTIC DYNAMICS Volume: 13 Issue: 1 Pages: 57-69 DOI: 10.1134/S1560354708010073 Published: FEB 2008

References

1- Title: [not available]
Author(s): BOLSINOV AV
Source: RUSS MATH SURV Volume: 50 Pages: 573 Published: 1995
2- Title: [not available]
Author(s): CHAPLYGIN SA
Source: T OTD FIZ NAUK MOSK Volume: 6 Pages: 20 Published: 1894
3- Title: [not available]
Author(s): GORIATCHEV DN
Source: WARSHAV U IZV Volume: 3 Pages: 1 Published: 1916
4- Title: On the case of Kovalevskaya and new cases of integrable conservative systems on S²
Author(s): Hadeler, KP; Selivanova, EN.
Source: Reg. Chaot. Dyn. Volume: 4 Pages: 45-52 DOI: 10.1070/rd1999v004n03ABEH000115 Published: 1999
5- Title: [not available]
Author(s): HIETARINTA J
Source: PHYS REP Volume: 38 Pages: 3547 Published: 2005
6- Title: INTEGRABLE MODELS OF MOTION OF 2 INTERACTING PARTICLES IN THE EXTERNAL-FIELD
Author(s): INOZEMTSEV, VI
Source: JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL Volume: 17 Issue: 4 Pages: 815-818 DOI: 10.1088/0305-4470/17/4/021 Abstract Number: A1984-047854 Published: 1984
7-Title: Sur le probleme de la rotation d'un corps solide autour d'un point fixe
Author(s): Kovalevskaya, S.
Source: Acta Math. Volume: 12 Pages: 177-232 Published: 1889
Times Cited: 51 (from All Databases)
8- Title: New families of conservative systems on S-2 possessing an integral of fourth degree in momenta
Author(s): Selivanova, EN
Source: ANNALS OF GLOBAL ANALYSIS AND GEOMETRY Volume: 17 Issue: 3 Pages: 201-219 DOI: 10.1023/A:1006534224575 Published: JUN 1999

Times Cited: 8 (from All Databases)
9-Title: A new integrable system on S-2 with the second integral quartic in the momenta
Author(s): Tsiganov, AV
Source: JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL Volume: 38 Issue: 16 Pages: 3547-3553 DOI: 10.1088/0305-4470/38/16/006 Abstract Number: A2005-12-0320-002 Published: APR 22 2005
Times Cited: 4 (from All Databases)
10-Title: NEW INTEGRABLE CASES IN THE DYNAMICS OF RIGID BODIES
Author(s): YEHIA, H
Source: MECHANICS RESEARCH COMMUNICATIONS Volume: 13 Issue: 3 Pages: 169-172 DOI: 10.1016/0093-6413(86)90059-5 Abstract Number: A1987-024413 Published: MAY-JUN 1986
11- Title: ON THE INTEGRABILITY OF CERTAIN PROBLEMS IN PARTICLE AND RIGID BODY DYNAMICS
Author(s): YEHIA, HM
Source: JOURNAL DE MECANIQUE THEORIQUE ET APPLIQUEE Volume: 5 Issue: 1 Pages: 55-71 Abstract Number: A1986-121844 Published: 1986
12- Title: The master integrable two-dimensional system with a quartic second integral
Author(s): Yehia, HM
Source: JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL Volume: 39 Issue: 20 Pages: 5807-5824 DOI: 10.1088/0305-4470/39/20/012 Published: MAY 19 2006
13- Title: On certain two-dimensional. conservative mechanical systems with a cubic second integral
Author(s): Yehia, HM
Source: JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL Volume: 35 Issue: 44 Pages: 9469-9487 Article Number: PII S0305-4470(02)38280-5 DOI: 10.1088/0305-4470/35/44/314 Abstract Number: A2003-02-0320-011 Published: NOV 8 2002
14- Title: GENERALIZED NATURAL MECHANICAL SYSTEMS OF 2-DEGREES OF FREEDOM WITH QUADRATIC INTEGRALS
Author(s): YEHIA, HM
Source: JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL Volume: 25 Issue: 1 Pages: 197-221 DOI: 10.1088/0305-4470/25/1/024 Abstract Number: A1992-07-0320-005 Published: JAN 7 1992
15- Title: [not available]
Author(s): YEHIA HM
Source: MANSOURA SCI B Volume: 14 Pages: 373 Published: 1987
Times Cited: 10 (from All Databases)
16- Title: New integrable problems in the dynamics of rigid bodies with the Kovalevskaya configuration .1. The case of axisymmetric forces.
Author(s): Yehia, HM
Source: MECHANICS RESEARCH COMMUNICATIONS Volume: 23 Issue: 5 Pages: 423-427 DOI: 10.1016/0093-6413(96)00041-9 Published: SEP-OCT 1996
Times Cited: 12 (from All Databases
17- Title: NEW INTEGRABLE CASES IN THE DYNAMICS OF RIGID BODIES-III
Author(s): YEHIA, HM
Source: MECHANICS RESEARCH COMMUNICATIONS Volume: 14 Issue: 3 Pages: 177-180 DOI: 10.1016/0093-6413(87)90073-5 Abstract Number: A1988-000083 Published: MAY-JUN 1987

18-Title: Two-dimensional conservative mechanical systems with quartic second integral
Author(s): Yehia, HM
Source: REGULAR & CHAOTIC DYNAMICS Volume: 11 Issue: 1 Pages: 103-122
DOI: 10.1070/RD2006v011n01ABEH000337 Published: 2006
Times Cited: 3 (from All Databases)
19- Title: Kovalevskaya's integrable case: Generalizations and related new results
Author(s): Yehia, HM
Source: REGULAR & CHAOTIC DYNAMICS Volume: 8 Issue: 3 Pages: 337-348
DOI: 10.1070/RD2003v008n03ABEH000250 Published: 2003