Research Report 2015

Hiroaki Yoshimura
Department of Applied Mechanics and Aerospace Engineering

Publications

1. Fernando Jimenez and Hiroaki Yoshimura, Dirac structure in vakonomic mechanics, J. Geom. Phys.,Vol.94, pp.158-178, 2015.
2. Francois Gay-Balmaz and Hiroaki Yoshimura, Dirac reduction for nonholonomic mechanical systems and semidirect products, Advances in Applied Mathematics, Vol.63, pp.131-213, 2015.
3. Eduardo Garicia-Torano Andres, Tom Mestdag and Hiroaki Yoshimura, Implicit Lagrange– Routh equations and Dirac reduction, J.Geometry and Physics, vol. 104, pp.291-304, 2016.
4. Makoto Horikawa, Yasuhiro Kawakatsu and Hiroaki Yoshimura, Low Energy Escape Trajectory for the Mars Moon Sample Return Mission, Proc. 26th AAS/AIAA Space Flight Mechanics Meeting, AAS Paper 16-372, 10 pages, 2016.
5. Kaori Onozaki, Hiroaki Yoshimura and Shane, D. Ross, The Earth-Moon Low-Energy Transfer in the 4-body Problem, Proc. 26th AAS/AIAA Space Flight Mechanics Meeting, AAS Paper 16-405, 16 pages, 2016.
6. Kaori Onozaki, Hiroaki Yoshimura and Shane, D. Ross, Low energy transfer from the Earth to the Moon in the coupled Planar Circular 3-Body system, Proc. 6th International Conference on Astrodynamics Tools and Techniques(ICATT), March 14-17, 2016, Darmstadt, 7 pages.

Research Activities

1. 吉村浩明，非線形ダイナミクスと制御の最新研究動向，三菱電機先端技術総合研究所，2016 年 2 月 22 日（in Japanese）
2. Hiroaki Yoshimura, Interconnection, Variational Structures and Lagrange-Dirac Systems, 5th IFAC Workshop on Lagrangian and Hamiltonian Methods for Nonlinear Control, Lyon, July 4-7, 2015.
3. Hiroaki Yoshimura and Francois Gay-Balmaz, Lie-Dirac reduction for nonholonomic systems on semidirect products, 2015 SIAM Conference on Applications of Dynamical Systems, Snowbird, May 17, 2015.
4. Hiroaki Yoshimura, Mathematical Modeling in Mechanics, Multiscale Analysis, Modeling and Simulation, Kickoff Meeting, Mathematics & Physics Unit, Top Global University Project, Waseda University, Feb. 15, 2015.

5. K. Onozaki, T. Nakamura and H. Yoshimura，Tube Dynamics and Trajectory Design for Capturing the Lyapunov Orbit in the Coupled Restricted Three-Body Problem and Its Application to the DESTINY Mission, Proc.24th Workshop on Astrodynamics and Flight Mechanics, 6 pages, 2015.
6. 吉村浩明，ディラック構造と非ホロノミック系の力学，力学系の応用研究集会，京都大学， 2015 年 3 月 29 日．（in Japanese）
7. 小野崎香織，吉村浩明，力学系理論を応用した宇宙機の軌道設計，力学系の応用研究集会，京 都大学，2015 年 3 月 29 日．（in Japanese）
8. 堀川真，中村友彦，小野崎香織，吉村浩明，チューブダイナミクスとホーマン軌道による火星 への軌道設計，第 59 回システム制御情報学会の講演論文集, 5 pages, 2015 年 5 月 20 日．（in Japanese）
9. K. Onozaki, H. Yoshimura, Invariant manifolds and space mission design in the restricted four-body problem, 2015 SIAM Conference on Applications of Dynamical Systems, Snowbird, May 18, 2015.
10. H. Yoshimura and Francois Gay-Balmaz, Lie-Dirac reduction for nonholonomic systems on semidirect products, 2015 SIAM Conference on Applications of Dynamical Systems, Snowbird, May 17, 2015.（国際会議講演）

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(1) We established a general theory of Dirac structures on the semi-direct product of Lie groups together with its associated Lagrange-Dirac systems. We clarified, from a variational standpoint, the relation between the Hamilton-Pontryagin principle with advected parameters and the Lagrange-Dirac system. Moreover, we successfully characterized the motion of perfect fluids and rigid bodies with non-holonomic constraints in the general framework of Euler-Poincare reduction. We proposed a reduction procedure called “Lie-Dirac reduction” for the Dirac structure induced by G-invariant non-holonomic constraints and with the associated implicit Lagrangian systems and we illustrated our theory by examples of Revilin-Ericksen fluids, which are second order non-Newtonian fluids, and compressible ideal fluids.

(2) In connection with multi-body mechanics such as space mission for deep space exploration, we developed a method of low-energy orbit design, exploiting the structure of the invariant manifold called “tube”. In particular, we made a model for the orbit design from Earth to the Moon by a four-body problem of the Earth-Sun-Moon-Spacecraft system because of perturbation of the gravity of Sun or that of the Moon. We derived the time dependent invariant manifold of the four-body system

by computing the Lagrange Coherent Structure (LCS), which is also a recent popular topic in fluid mechanics, where we applied the method to our orbit design.