２０１７年度研究実績の概要

１）非平衡熱力学系の新しい変分的定式化を提案した．特に，非線形かつ非ホロノミックな拘束を受ける有限次元および無限次元ラグランジュ系の枠組みで捉え，物質移動や化学反応を伴う膜ダイナミクス，物質移動および熱伝導を伴う粘性流体のナヴィエ・ストークス・フーリエ方程式の変分法的な定式化を行った．非平衡熱力学系の新しい変分的定式化に関連して，背後に存在する，有限次元の孤立系の場合のディラック構造を明らかにした．

２）太陽-地球-月-宇宙機の制限４体系を太陽-地球-宇宙機＋月摂動及び地球-月-宇宙機＋太陽摂動の２つの制限３体系＋摂動の結合系と見なし，従来のチューブダイナミクスを拡張し，近似的に周期的なリヤプノフ軌道を導出した．

３）有限次元リヤプノフ指数場及びラグランジアンコヒーレント構造に関する数値解析から結合摂動制限３体系のチューブ構造を明らかにし，地球低軌道から月低軌道を境界条件として与えた場合のエネルギー条件から軌道の族を算出し，２つの軌道の族の交わりの中から最も低エネルギーとなる軌道の設計手法を開発した．

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1) We proposed a novel variational approach to nonequilibrium thermodynamics, in particular, in the context of Lagrangian systems with nonlinear nonholonomic constraints. We illustrated the variational method by illustrative examples of membrane dynamics including mass transfer and chemical reactions as well as viscous fluids with heat and mass transfer that are represented by Navier-Stokes-Fourier equations.

2) We consider the 4-body system of the Earth-Sun-Moon-Spacecraft system as the coupled system of the Sun-Earth-spacecraft 3-body system perturbed by the Moon (Moon-perturbed system) and the Earth-Moon-spacecraft 3-body system perturbed by the Sun (Sun-perturbed system). We computed tube structures of stable and unstable manifolds numerically by using the notion of Lagrangian coherent structures.

3) Using the characteristics of the tube structures, we obtained the family of trajectories that depart from the LEO and the family of those that arrive into the LLO. Finally we showed how a low energy Earth-Moon transfer can be constructed by choosing an appropriate orbit from each family such that the required Delta V is minimized under given conditions.

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