

Ryota Nakano – Curriculum Vitae

Space Technology Applications Research (STAR) Lab,
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EDUCATION

Ph.D. student in Aerospace Engineering, Auburn University Aug. 2019 - 2024 (Expected)
GPA: 4.00/4.00
B.S., Aerospace Engineering, The University of Alabama in Huntsville May 2019
GPA: 3.99/4.00, Summa Cum Laude

PROFESSIONAL EXPERIENCE

Graduate Research Assistant, STAR Lab, Auburn University Aug. 2019 - Present
Advisor: Prof. Masatoshi Hirabayashi
Graduate Teaching Assistant, Auburn University Aug. 2019 - May 2020
Undergraduate Research Assistant, UAHuntsville
- **KangLab** May 2018 - May 2019
Advisor: Prof. Chang-kwon Kang
- **Plasma and Electrodynamics Research Lab** Oct. 2016 - Jul. 2018
Advisor: Prof. Gabe Xu

RESEARCH TOPICS/PROJECTS

Numerical investigation of Binary-YORP effect Jan. 2022 - Present
- Investigating the BYORP effect in unprecedented detail by combining the dynamical and thermophysical models
- Publications: (C1)
Thermophysical modeling of celestial bodies May 2020 - Present
- Developing a Finite Element Method approach 3D thermophysical model to investigate the Yarkovsky and YORP effects
- Publications: (J1), (C4)-(C7), (C9), (PP2), (PP3)
Dynamics modeling of binary asteroid systems Aug. 2019 - Present
- Investigating how shape modification affects mutual body dynamics
- NASA/Double Asteroid Redirection Test (DART) Dynamics Working Group member
- Publications: (J2)-(J4), (C8), (PP1), (PP4)
Structural analysis of small solar system bodies Aug. 2019 - Present
- Developed a semi-analytical model to predict the rotationally induced structural failure condition of small bodies
- Publications: (J5)-(J7), (C11)-(C14), (PP5)
Marsbee Project - NIAC 2018 Phase-I May 2018 - May 2019
- Role: Undergraduate Research Assistant
- Developed 6-DoF computational model that couples the flight dynamics and aerodynamics of insect-scale flapping wing vehicles

Development of a metronome thrust stand

Aug. 2017 - Jul. 2018

- Proposed the metronome configuration as a unique design solution and archived significant reduction in size compared to traditional thrust stands
- Publications: (C15)

Development of cylindrical Hall effect thruster

Oct. 2016 - Jul. 2018

- Developed a thruster for small satellites using 3D-printed materials
- Publications: (C15), (PP6)

AWARDS/FELLOWSHIPS

Future Investigators in NASA Earth and Space Science and Technology

2022 - 2024

- Proposal title: *BYORP's Nightmare Induced by Geophysical and Dynamical Properties of Binary Asteroids Revealed by FEM Approach*
- Total of \$135,000 research funding (including supports for stipend, tuition, travel, etc.)

1st Place in NESF Student Poster Competition

Jul. 2020

- Awarded for: *Mass-shedding Activities of Asteroid (3200) Phaethon Enhanced by Its Rotation* at NASA Exploration Science Forum, (PP5)

Presidential Graduate Research Fellowship

2019 – 2022

- Awarded from Auburn University
- Three-year full funding for graduate study

Undergraduate Super Scholar Transfer Scholarship

2016 – 2018

- Awarded from The University of Alabama in Huntsville
- Two-year stipend funding for undergraduate study

JOURNAL PUBLICATION

- (J1) (in Preparation) **R. Nakano** and M. Hirabayashi, “Finite Element Method Approach 3-Dimensional Thermophysical Model for YORP torque computation,” *The Planetary Science Journal*
- (J2) (Submitted) **R. Nakano**, and 8 authors, “NASA/Double Asteroid Redirection Test (DART): Mutual Orbital Period Change Due to Reshaping in the Near-Earth Binary Asteroid System (65803) Didymos,” *The Planetary Science Journal*
- (J3) (Submitted) D. Richardson, and 35 authors (**R. Nakano**, the 25th author), “Predictions for the Dynamical States of the Didymos System Before and After the Planned DART Impact,” *The Planetary Science Journal*
- (J4) (Submitted) M. Hirabayashi, and 13 authors (**R. Nakano**, the 4th author), “Double Asteroid Redirection Test (DART): Structural and dynamic interactions between asteroidal elements of Binary Asteroid (65803) Didymos,” *The Planetary Science Journal*
- (J5) P. M. Jackson, **R. Nakano**, Y. Kim, and M. Hirabayashi, “Active Main-Belt Asteroid (6478) Gault – Constraint on Its Cohesive Strength and the Fate of Ejected Particles in the Solar System,” *The Planetary Science Journal*, 3, 16, 2022, doi: 10.3847/PSJ/ac4031
- (J6) M. Hirabayashi, **R. Nakano**, and 15 authors, “Spin-driven evolution of asteroids’ top-shapes at fast and slow spins as seen from (101955) Bennu and (162173) Ryugu,” *Icarus*, 352, 2020, doi: 10.1016/j.icarus.2020.113946
- (J7) **R. Nakano** and M. Hirabayashi, “Mass-shedding Activities of Asteroid (3200) Phaethon Enhanced by Its Rotation,” *The Astrophysical Journal Letters*, 899(2), L22, 2020, doi: 10.3847/2041-8213/ab7d36

CONFERENCE PROCEEDINGS

- (C1) (Submitted) **R. Nakano** and M. Hirabayashi, “A new binary-YORP effect model combining full two rigid body dynamics and 3-dimensional thermophysics,” *AAS Division of Dynamical Astronomy Meeting*, Manhattan, NY, 2022
- (C2) **R. Nakano** and M. Hirabayashi, “Dimorphos’ reshaping-induced orbital period change after the DART impact.” *53rd Lunar and Planetary Science Conference*, The Woodlands, TX, 2022, LPSC2022-2025
- (C3) **R. Nakano**, Ehsan Taheri, and M. Hirabayashi, “Time-Optimal and Fuel-Optimal Trajectories for Asteroid Landing via Indirect Optimization,” *AIAA SciTech Forum and Exposition*, San Diego, CA, 2022, AIAA 2022-1128, doi: 10.2514/6.2022-1128
- (C4) **R. Nakano** and M. Hirabayashi, “Finite Element Thermophysical Model for The Yarkovsky and YORP Effect Investigations – The YORP Effect’s Insensitivity to Small Topographic Features,” *American Geophysical Union Fall Meeting*, 2021
- (C5) **R. Nakano** and M. Hirabayashi, “Finite element thermophysical model for the Yarkovsky and YORP calculations, insensitive to small topographic effects,” *AAS Division for Planetary Sciences Meeting*, virtual meeting, 2021
- (C6) **R. Nakano** and M. Hirabayashi, “Investigation of the YORP effect on asteroid (162173) Ryugu – An application of FEM approach thermophysical model,” *Europlanet Science Congress*, virtual meeting, 2021, EPSC2021-441, doi: 10.5194/epsc2021-441
- (C7) **R. Nakano** and M. Hirabayashi, “Finite Element Modeling Approach Thermophysical Model to Characterize Irregularly Shaped Bodies’ Temperature Variation,” *NASA Exploration Science Forum & European Lunar Symposium*, virtual meeting, 2021
- (C8) **R. Nakano** and M. Hirabayashi, “NASA/Double Asteroid Redirection Test: Orbital perturbation by the ejecta-collision driven reshaping of Didymos after the impact event,” *7th IAA Planetary Defense Conference*, virtual meeting, 2021
- (C9) **R. Nakano** and M. Hirabayashi, “Finite Element Modeling Approach to Characterize Temperature Variations of Irregularly Shaped Bodies,” *52nd Lunar and Planetary Science Conference*, virtual meeting, 2021, LPSC2021-1292
- (C10) **R. Nakano**, M. Hirabayashi, and 10 authors, “Dimorphos’ orbital perturbation induced by shape modification of Didymos after the DART impact,” *American Geophysical Union Fall Meeting*, virtual meeting, 2020, NH037-0004
- (C11) M. Hirabayashi, **R. Nakano**, and 15 authors, “Spin-driven evolution of asteroids’ top-shapes at fast and slow spins as seen from (101955) Bennu and (162173) Ryugu,” *AAS Division for Planetary Science Meeting*, virtual meeting, 2020
- (C12) **R. Nakano** and M. Hirabayashi, “Mass-shedding Activities of Asteroid (3200) Phaethon Enhanced by Its Rotation - Implication to Asteroid Pairs,” *Europlanet Science Congress*, virtual meeting, 2020, EPSC2020-540, doi: 10.5194/epsc2020-540
- (C13) **R. Nakano** and M. Hirabayashi, “Mass-shedding Activities of Asteroid (3200) Phaethon Enhanced by Its Rotation,” *NASA Exploration Science Forum*, virtual meeting, 2020
- (C14) **R. Nakano** and M. Hirabayashi, “Mass-shedding Activities of Asteroid (3200) Phaethon Enhanced by Its Rotation,” *51st Lunar and Planetary Science Conference*, The Woodlands, TX, 2020, LPSC2020-1742 (Canceled due to COVID19 pandemic)
- (C15) **R. Nakano** and K.G. Xu, “Development of a Metronome Thrust Stand for Miniature Electric Propulsion,” *AIAA Propulsion and Energy Forum*, Cincinnati, OH, 2018

PRESENTATIONS

Oral

- (PO1) “Time-Optimal and Fuel-Optimal Trajectories for Asteroid Landing via Indirect Optimization,” at *AIAA SciTech Forum and Exposition*, virtual meeting, 2022
- (PO2) “Finite Element Thermophysical Model for The Yarkovsky and YORP Effect Investigations – The YORP Effect’s Insensitivity to Small Topographic Features,” at *American Geophysical Union Fall Meeting*, virtual meeting, 2021
- (PO3) “Finite element thermophysical model for the Yarkovsky and YORP calculations, insensitive to small topographic effects,” at *AAS Division for Planetary Sciences Meeting*, virtual meeting, 2021
- (PO4) “Investigation of the YORP effect on asteroid (162173) Ryugu – An application of FEM approach thermophysical model,” at *Europlanet Science Congress*, virtual meeting, 2021
- (PO5) “NASA/Double Asteroid Redirection Test: Orbital perturbation by the ejecta-collision driven reshaping of Didymos after the impact event,” at *7th IAA Planetary Defense Conference*, virtual meeting, 2021
- (PO6) “Mass-shedding Activities of Asteroid (3200) Phaethon Enhanced by Its Rotation - Implication to Asteroid Pairs,” at *Europlanet Science Congress*, virtual meeting, 2020
- (PO7) “Development of a Metronome Thrust Stand for Miniature Electric Propulsion,” at *AIAA Propulsion and Energy Forum*, Cincinnati, OH, 2018

Poster

- (PP1) “Dimorphos’ reshaping-induced orbital period change after the DART impact,” at *53rd Lunar and Planetary Science Conference*, The Woodlands, TX, 2022
- (PP2) “Finite Element Modeling Approach Thermophysical Model to Characterize Irregularly Shaped Bodies’ Temperature Variation,” at *NASA Exploration Science Forum & European Lunar Symposium*, virtual meeting, 2021
- (PP3) “Finite Element Modeling Approach to Characterize Temperature Variations of Irregularly Shaped Bodies,” at *52nd Lunar and Planetary Science Conference*, virtual meeting, 2021
- (PP4) “Dimorphos’ orbital perturbation induced by shape modification of Didymos after the DART impact,” at *American Geophysical Union Fall Meeting*, virtual meeting, 2020
- (PP5) “Mass-shedding Activities of Asteroid (3200) Phaethon Enhanced by Its Rotation,” at *NASA Exploration Science Forum*, virtual meeting, 2020
- (PP6) “Cylindrical Hall effect thruster with 3D printed components for small satellite propulsion,” at *AAS 10th Wernher von Braun Memorial Symposium*, Huntsville, AL, 2017