

Rahil Makadia

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EDUCATION

Ph.D. in Aerospace Engineering, University of Illinois at Urbana-Champaign	Jan 2021 - present
B.S. in Aerospace Engineering, University of Illinois at Urbana-Champaign	Aug 2017 - Dec 2020

RESEARCH EXPERIENCE

Astrodynamics and Planetary Exploration Research Group Advisor: Dr. Siegfried Eggel

Double Asteroid Redirection Test (DART) Mission May 2020 - present

- Analyzed high-fidelity kinetic impactor simulation results from NASA's Jet Propulsion Laboratory (JPL) for impacts in the (65803) Didymos binary asteroid system.
- Implemented a novel method to impart momentum changes in the Didymos system after the DART impact.
- Produced a post-deflection impact risk assessment for Didymos using parallelized Monte Carlo simulations.
- Generated updated B-plane maps to conclude that the Didymos system will not collide with the Earth after the DART impact.
- Wrote MATLAB and Python parameter estimation packages to assess measurability of the heliocentric momentum enhancement from the DART impact.

Aerospace Mission Analysis Laboratory Advisor: Dr. Zachary Putnam

Venus Aerogravity Assist Performance Assessment Aug 2022 - Jan 2023

- Analyzed the performance of blunt-body vehicles in Venus aerogravity assist missions.
- Implemented a MATLAB analysis pipeline to perform parameter sweeps for varying trajectories and vehicle configurations and used it to assess performance of blunt-body vehicles and waveriders.

WORK EXPERIENCE

NASA Jet Propulsion Laboratory Advisors: Steven Chesley, Davide Farnocchia

NSTGRO Visiting Technologist May 2023 - Aug 2023

- Created an efficient solar system propagator with sub-1 km position accuracy over 250 years compared to JPL's internal small body software.
- Wrote an orbit determination submodule alongside the propagator that has sub- 1σ agreement with JPL small-body orbit solutions.
- Developed a publicly available Python package, GRSS, to allow the scientific community to accurately propagate and determine the orbits of solar system bodies.

NASA Goddard Space Flight Center Advisors: Kenneth Getzandanner, Andrew Liounis

OSIRIS-REx/OSIRIS-APEX CelNav Intern Jun 2022 - Aug 2022

- Developed simulations to assess performance of celestial navigation using onboard optical instruments during the OSIRIS-APEX cruise phase.
- Simulated more than 8,000 solar system bodies to obtain optimal observable clusters for the spacecraft.
- Performed covariance analysis using NASA's MONTE software to study the spacecraft's state uncertainty on its way to asteroid (99942) Apophis.

TEACHING EXPERIENCE

University of Illinois at Urbana-Champaign

Instructor: Dr. Siegfried Eggli

Teaching Assistant for AE 352: Aerospace Dynamical Systems

Aug 2021 - Dec 2021

- Focused on developing and teaching the aerospace curriculum's core dynamics course with aerospace applications.
- Syllabus emphasized on covering Newtonian, Lagrangian, and Hamiltonian mechanics to represent particle motion.
- Assisted 16 student teams with Project Clear Constellation, which called for novel methods to remove orbital debris.

University of Illinois at Urbana-Champaign

Instructor: Dr. Huy Tran

Undergraduate Course Assistant for AE 199: Aerospace Computing

Jan 2020 - May 2020

- Assisted with grading for a new course focused on using Python to solve problems such as analyzing air traffic data and designing Martian landers.
- Worked with instructor to augment course for a fully online learning environment without affecting students due to the COVID-19 pandemic.

SKILLS

Programming Languages	Python, C++, MATLAB
Software Tools	L ^A T _E X, Git
Prepackaged Tools	MONTE, GMAT, FreeFlyer, Siemens NX
Operating Systems	Windows, Linux, MacOS
Languages	English, Gujarati, Hindi, French

AWARDS AND AFFILIATIONS

NASA Space Technology Graduate Research Opportunities Fellow

Aug 2022 - present

NSTGRO award from NASA Space Technology Mission Directorate (STMD)

Double Asteroid Redirection Test (DART) Investigation Team Member

Dec 2020 - present

NASA/Johns Hopkins University Applied Physics Laboratory (APL)

John C. Mather Nobel Scholar

Jul 2022 - Jun 2023

National Space Grant Foundation

Fellowship for Outstanding Academic and Research Achievement

Apr 2023

Aerospace Engineering Department at the University of Illinois at Urbana-Champaign

President's Award

Aug 2017 - Dec 2020

University of Illinois at Urbana-Champaign

Hans von Muldau Team Award

October 2019

70th International Astronautical Congress (IAC), Washington D.C.

Dean's List

Spring 2019, Spring 2020

University of Illinois at Urbana-Champaign

JOURNAL ARTICLES

- ¹**R. Makadia** et al., “Measurability of the heliocentric momentum enhancement from kinetic impactors: Applications to the Double Asteroid Redirection Test (DART) mission”, *The Planetary Science Journal* **in prep.** (2023).
- ²D. C. Richardson et al., “The Dynamical State of the Didymos System Before and After the DART Impact”, *The Planetary Science Journal* **in prep.** (2023).
- ³J.-Y. Li et al., “Ejecta from the DART-produced active asteroid Dimorphos”, *Nature* **616**, 452–456 (2023).
- ⁴T. S. Statler et al., “After DART: Using the First Full-scale Test of a Kinetic Impactor to Inform a Future Planetary Defense Mission”, *The Planetary Science Journal* **3**, 244 (2022).
- ⁵**R. Makadia** et al., “Heliocentric Effects of the DART Mission on the (65803) Didymos Binary Asteroid System”, *The Planetary Science Journal* **3**, 184 (2022).
- ⁶D. C. Richardson et al., “Predictions for the Dynamical States of the Didymos System before and after the Planned DART Impact”, *The Planetary Science Journal* **3**, 157 (2022).

CONFERENCE AND MEETING PROCEEDINGS

- ¹**R. Makadia** et al., “The DART mission: Measurability of the heliocentric changes to the (65803) Didymos system”, in *14th Asteroids, Comets, Meteors Conference* (June 2023).
- ²**R. Makadia** et al., “Measurability of the heliocentric momentum enhancement of the Didymos system from the DART impact”, in *8th IAA Planetary Defense Conference* (Apr. 2023).
- ³D. Engel, **R. Makadia**, and Z. Putnam, “Assessment of aerogravity assist at Venus using blunt-body vehicles”, in *33rd AAS/AIAA Space Flight Mechanics Meeting* (Jan. 2023).
- ⁴**R. Makadia** et al., “Post-impact prediction of changes to the heliocentric orbit of the (65803) Didymos system due to the DART mission”, in *2022 AGU Fall Meeting* (Dec. 2022).
- ⁵**R. Makadia**, S. Eggl, and E. Fahnestock, “The Double Asteroid Redirection Test (DART): Expected changes to the heliocentric orbit of (65803) Didymos”, in *44th AAS Guidance, Navigation, and Control Conference* (Feb. 2022).
- ⁶**R. Makadia**, S. Eggl, and E. Fahnestock, “Changes to the heliocentric orbit of (65803) Didymos system due to DART: Simulation and momentum enhancement estimation”, in *53rd AAS Division for Planetary Sciences Meeting* (Oct. 2021).
- ⁷**R. Makadia** et al., “Changing the heliocentric orbit of the Didymos system with DART”, in *7th IAA Planetary Defense Conference* (Apr. 2021).