

Mackenzie Mangette

306 Engineering Unit B, Pennsylvania State University, State College, PA.

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Objective

A passionate and determined Master's student in Aerospace Engineering experienced in academic research and dedicated to going the extra mile to achieve innovative goals. Eager to contribute to the future of space exploration with strong skills in collaboration, time management, and adaptability.

Interests

Astrodynamic, Orbital Mechanics, Dynamical Systems Theory, Trajectory Optimization, Space Situational Awareness, Guidance, Navigation & Control (GNC), Estimation, Modeling & Simulation, Machine Learning

Education

Pennsylvania State University

MS in Aerospace Engineering

State College, PA

January 2022 - present

Thesis: Exploration of Transfer Opportunities to Low Lunar Orbits in the Cislunar Framework [tentative]

Advisor: Dr. Roshan T. Eapen

• **GPA:** 4.00

• **Notable Coursework:** Modern Computational Astrodynamics, Linear Systems Theory, System Analysis, Astrodynamics

• **Anticipated Coursework:** System Identification, Convex Optimization, Advanced Dynamics, Pattern Recognition and Machine Learning

Xavier University

Cincinnati, OH

BS in Applied Physics with Honors

Thesis: Characterizing Chaotic Behavior of Asteroid Orbits

Advisor: Dr. Marco Fatuzzo

• **GPA:** 3.98

• **Notable Coursework:** Control Systems, Theoretical Mechanics, Applied Linear Algebra

• **Extracurricular:** University Scholars Program, NCAA Women's Volleyball Team

August 2018 - December 2021

Research Experience

Graduate Research Assistant

State College, PA

Aerospace Engineering Department, Pennsylvania State University

January 2022 - present

Hauck Foundation Undergraduate Researcher

Cincinnati, OH

Physics Department, Xavier University

Summer 2020 & 2021

Part-Time Funded Undergraduate Researcher

Cincinnati, OH

Physics Department, Xavier University

May 2019 - August 2019

Awards & Scholarships

2022 **Frederick A. Hauck Physics Research Award**, for success in summer research work

Xavier University

2021 **Distinguished Professors' Scholarship**, for academic achievement and notable passion for physics

Xavier University

2021 **Frederick A. Hauck Physics Research Award**, for success in summer research work

Xavier University

2020 **Theodore A. Kent/Bozhidar Kantarjiev Award**, for completing first year with highest distinction

Xavier University

Skills

Programming FORTRAN, MATLAB, C/C++, Python, Java

Miscellaneous LaTeX, Mercury N-Body Integrator, Microsoft Office, Agile Methodology

Languages English [native], Japanese [intermediate]

Projects

Exploration of Transfer Opportunities to Low Lunar Orbits in the Cislunar Framework

January 2022 - current

This research is part of my current thesis in MS at Pennsylvania State University included in the responsibilities of Graduate Research Assistant. The purpose of this project is to explore families of cislunar transfers with lunar surface access from L_1 and L_2 Halo orbits in the Circular Restricted Three-Body Problem (CR3BP) framework.

- Evaluating two-point boundary value problems to utilize trajectory optimization techniques.
- Characterizing accessible low lunar orbits (LLO) by shifting framework from the CR3BP to a two-body problem.
- Evaluating results in light of crewed missions to balance low transfer times and constrained delta-v costs.

Characterizing Chaotic Behavior of Asteroid Orbits

January 2021 - December 2021

This research was done as part of my thesis during BS at Xavier University and partially funded by the Hauck Foundation under the supervision of Dr. Marco Fatuzzo and in collaboration with Dr. Fred Adams (University of Michigan). The purpose of this project was to quantify how asteroid orbits develop over series of close encounters with celestial bodies through simulating N-body dynamics.

- Used high-fidelity modeling equipped by Mercury N-Body Integrator to propagate asteroid trajectories over millions of years to characterize growth of asteroids groups initially at similar orbital characteristics.
- Evaluated and quantified behavior of asteroid cluster in Keplerian space using Lyapunov exponents.
- Tracked probability of close approaches and impacts with Earth and other celestial bodies and their affects on asteroid trajectories over time.

Deflection of Near-Earth Asteroids

May 2020 - August 2020

This research was funded by the Hauck Foundation under the supervision of Dr. Marco Fatuzzo and in collaboration with Dr. Fred Adams (University of Michigan). The purpose of this project was to visualize near-Earth asteroid trajectories in the inertial frame through simulating close approaches with two-body dynamics.

- Determined influence of Earth's moon on earthbound asteroid paths in planar and three-dimensional setting using Monte Carlo simulations.
- Inspected impact velocities of asteroids with varying semi-major axes originating in the Asteroid Belt.
- Simplified motion of asteroids' close approaches with Earth in the inertial reference frame as hyperbolic trajectories in the two-body problem.

Perturbation of Earthbound Asteroids

May 2019 - August 2019

This research was funded by the Xavier Physics Department under the supervision of Dr. Marco Fatuzzo.

The purpose of this project was to test the magnitude and direction of perturbation needed to push an asteroid and change its Earthbound trajectory.

- Ran Monte Carlo simulations testing distances (measured in time) from Earth-impact perturbation was applied to miss Earth by at least one Earth radius.
- Developed understanding of propagation of two-body and restricted three-body dynamics.

Conferences

2022 **AAS/AIAA Astrodynamics Specialist Conference**, Penn State University

Charlotte, NC

2019 **Conference for Undergraduate Women in Physics**, Xavier University

Pittsburgh, PA

Presentations

Mangette, M., Fatuzzo, M., Adams, F. *Characterizing Chaotic Behavior of Asteroid Orbits*, 2021, oral, to Xavier University Physics, Chemistry, & Biology Departments

Mangette, M., Fatuzzo, M., Adams, F. *Deflection of Near-Earth Asteroids*, 2020, oral, to Xavier University Physics Department

Mangette, M., Fatuzzo, M. *Perturbation of Earthbound Asteroids*, oral, 2019 Xavier University Undergraduate Research Symposium

No relevant publications.

Affiliations

Sigma Pi Sigma national physics honor society

Phi Beta Kappa national undergraduate honor society

American Astronomical Society (AAS)