

# Anthony Aborizk

CURRICULUM VITAE 01/2023

Space Systems Group Ph.D. Candidate  
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## RESEARCH INTEREST

- Autonomous Rendezvous, Proximity Operations, and Docking of Spacecraft
- Reinforcement Learning, Optimal Control, and Hybrid/Hierarchical Control
- Underactuated Small Satellites

## EDUCATION

### Ph.D. Aerospace Engineering

Present—May 2025

GPA: 3.71

Dissertation: *Autonomous Docking of Spacecraft via Hierarchical Reinforcement Learning and Model Predictive Control*

Committee Chair: Prof. Norman Fitz-Coy

Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, Florida

### M.S. Aerospace Engineering

April 2022

GPA: 3.68

Focus: Dynamic Systems and Controls

Graduate Certificate: Machine Learning

Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, Florida

### B.S. Mechanical Engineering

August 2020

GPA: 3.27

Undergraduate Research Assistant in the DebrisSat Lab

Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, Florida

## HONORS AND AWARDS

National Science Foundation Graduate Research Fellow Program	2021
Graduate School Preeminence Award	2020
Steve and Julie Weintraub Hands Across the Bay Foundation Scholarship	2017
Honors College Scholarship	2015, 2016
SPC Foundational Study Abroad Scholarship	2015, 2016
Vivian T. Greve Scholarship Fund	2015
Susan M. Reiter Scholarship Fund	2015

## JOURNAL PUBLICATIONS (1)

1. **A. Aborizk**, N. Fitz-Coy “*Multiphase Autonomous Docking via Model Based and Hierarchical Reinforcement Learning*”, Journal of Spacecraft and Rockets, In processing.

## CONFERENCE PRECEEDINGS (4)

1. **A. Aborizk**, N. Fitz-Coy, A. Soderlund “*Resilient Solutions to Underactuated Autonomous Rendezvous and Docking Operations*” IEEE Aerospace Conference, Big Sky, Montana, Mar. 2024
2. **A. Aborizk**, S. Nivison, N. Fitz-Coy “*Autonomous Rendezvous and Docking of Spacecraft Using Hierarchical Model Based Reinforcement Learning*” AAS/AIAA Astrodynamics Specialist Conference, Aug. 2022
3. J. B. Bacon, **A. R. Allen**, J. M. Ferrer, J. N. Opiela, M. A. Ward “*X-ray Imagery as the Record of All Data of Interest in Hypervelocity Impact Fragment Studies*” 8<sup>th</sup> European Conference on Space Debris, Apr. 2021
4. **A. R. Allen**, and J. B. Bacon “*Macro-Scale Findings of the DebrisSat Debris Field Obtained from X-Rays of the Catch Panels*” International Orbital Debris Conference, Dec. 2019

## RESEARCH EXPERIENCE

### Space Systems Group (SSG), University of Florida

**Aug. 2021 – Present**

*Graduate Research Fellow*

*Gainesville, FL*

- Contributing to the development of spacecraft autonomy research with the aim to reduce the dependence on human-in-the-loop control, especially as near-Earth orbits become more cluttered.
- Advancing research in small satellite docking control by devising optimal control solutions for highly constrained missions, including keep-out-zones and underactuated systems.
- Exploring methods for quantifying uncertainty in controller designs and implementing hierarchical task management techniques to simplify complex spacecraft maneuvers, informing novel docking strategies.
- Developed multiple Python-based OpenAI gym environments for spacecraft docking simulations, covering a range of scenarios from linear 2D to nonlinear underactuated 3D relative spacecraft dynamics.
- Formalized model-based reinforcement learning (RL) and control methods to enable spacecraft autonomy in simulated rendezvous, proximity, and docking (RPOD) missions.
- Demonstrated the feasibility of model-based RL to hierarchically manage third-party controllers.

### Advanced Autonomous Multiple Spacecraft Lab, University of Florida Aug. 2020 – May 2021

*Graduate Research Assistant*

*Gainesville, FL*

- Explored multivariate mixture models and neural networks in time series to predict energy distributions of warhead detonations.

**DebrisSat Lab, University of Florida***Undergraduate Research Assistant***Jan. 2018 – Jun. 2020***Gainesville, FL*

- Located and digitally replicated 3D satellite fragments embedded in foam panels using stereoscopic, filtering, color alteration and various other image processing methods on 2D X-ray images generated from a TSA luggage scanner.
- Coordinated activity of 40+ DebrisSat employees, defined and prioritized workloads.

**WORK EXPERIENCE****Air Force Research Laboratory (AFRL)***Control and Reinforcement Learning Intern**Kirtland Air Force Base, NM***May 2023 – Aug. 2023**

- Developed 6 degrees of freedom (DoF) relative astrodynamics simulations for underactuated spacecraft, employing Hill's equations and modified Rodrigues parameters.
- Formulated optimal control and model-based reinforcement learning (RL) solutions for the above simulations, addressing dynamic, control input, and state constraints.
- Demonstrated that a small satellite only needs one unilateral thruster and three reaction wheels to accomplish a docking mission, overall resulting in weight and fuel reduction when compared to a fully actuated system.

*Control and Reinforcement Learning Intern***Jun. 2022 – Aug. 2022**

- Engineered novel RL algorithms from scratch to design trajectories for complex, data-driven spacecraft control simulations.
- Explored state-of-the-art reinforcement learning (RL) strategies using RLLib for comparison to innovative techniques.
- Improved readability and performance of an OpenAI compatible simulations of multi-agent spacecraft dynamics in Python, reducing the learning curve from 2 months to 2 weeks.

*Control and Reinforcement Learning Intern***Jun. 2021 – Aug. 2021**

- Explored reinforcement learning (RL)-based strategies to estimate control policies.
- Researched autonomous systems, model-based RL, model predictive control, uncertainty quantification, and sparse learning strategies.
- Developed an online, data-driven orbital mechanics control simulation using model-based RL in tandem with model predictive control.

**Ansaldo Energia, Power Systems Manufacturing***Monitoring and Diagnostics Intern**Jupiter, FL***Jun. 2020 – Aug. 2020**

- Utilized long short-term memory (LSTM) units, encoder/decoder, and attention-based techniques to predict anomalous activity in gas turbines.
- Synthesized the above algorithms to estimate normal behavior of gas turbines from sensory data and forecasted anomalies.
- The above technology will save the company ~\$45k/month compared to vendor services when implemented.

### *Manufacturing Engineer Intern*

**May 2019 – Aug. 2019**

- Improved manufacturing processes of 9FA turbine blades using GOM results, statistical analysis, and least squared regression fits.
- Monitored custom ordered parts throughout manufacturing process and presented finished components to customers.
- Created instructional documentation and standard operating procedures for ubiquitous SAP software.

### **NASA Johnson Space Center**

**Jan. 2019 – May 2019**

#### *Orbital Debris Program Office Intern*

*Houston, TX*

- Developed an X-ray image processing algorithm in MATLAB to measure satellite debris generated from a hypervelocity impact test.
- Modeled size, shape, and radar and optical properties of debris items using regression analysis.
- Constructed a 3D database in MATLAB to analyze the anisotropy of the breakup and track fragment location.

## **TEACHING AND MENTORING**

### **Research Mentor**

Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, FL

#### *Space Systems Group*

- Anthony Hawkman, Undergraduate Research Assistant      Spring-Summer 2023
- Joshua Thompson, Undergraduate Research Assistant      Summer 2022

Air Force Research Laboratory, Kirtland Air Force Base, NM

#### *Space Scholar*

- Michael Sola, Graduate Research Assistant      Summer 2022 & 2023
- Rohan Kulkarni, Undergraduate Research Assistant      Summer 2022

Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, FL

#### *Debrisat*

- Lab manager/trainer (~30 students/semester)      Fall 2018, Spring 2020

### **Graduate Teaching Assistant**

Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, Florida

- Astrodynamics (~100 students)      Spring 2021

### **Tutor**

Department of Mathematics, St. Petersburg College, Tarpon Springs, FL

- Algebra, calculus, differential equations, and physics      Spring 2016 – Fall 2016

### **Talks**

- “Understanding and Preparing for the Transition to graduate school”, November 2021, University of Florida, Gainesville, FL

## **PROFESSIONAL SOCIETIES**

IEEE Student Member

AIAA Student Member

Sigma Gamma Tau, Aerospace Engineering Honor Society

Phi Theta Kappa International Honor Society

St. Petersburg College, Alpha Zeta Tau Chapter President

Golden Key International Honor Society