

Caleb Harris, M.S.

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EDUCATION

Georgia Institute of Technology, Atlanta, GA

PhD in Computational Science and Engineering (Interdisciplinary w/ Aerospace)

expected August 2022

Master's of Science in Computational Science and Engineering

May 2021

Master's of Science in Aerospace Engineering

Dec 2019

University of Memphis, Memphis, TN

Bachelor's of Science in Mechanical Engineering

May 2017

EXPERIENCE

Georgia Institute of Technology, Aerospace Systems Design Lab, Atlanta, GA

August 2017 - Present

Graduate Research Associate

- Rotorcraft flight safety for wirestrike prevention using wire database formed from deep learning on aerial imagery, and electrified aircraft trajectory energy management using flight path predictions.
- Aerial trajectory optimization using iterative methods such as DDP and MPC, and vision-based vehicle operations for navigation tasks.
- Electric aerial vehicle optimal path planning and energy management using kinodynamic RRT* path planning algorithms

Boeing Research & Technology, Remote Work

May 2021 - August 2021

Graduate Researcher - Guidance, Navigation, Control & Autonomy

- Involved in the continued development of the All Source PNT software architecture for robust navigation, even in GPS-denied scenarios.
- Actively writing and documenting C++ code for mathematical and data-handling classes
- Assisting in new capabilities for collaborative navigation using loosely and tightly-coupled networks and vision-based navigation using feature-based and semi-direct based visual odometry.

Collins Aerospace, Mission Systems, Remote Work

May 2020 - August 2020

Systems Engineering Intern (SEPP Program)

- Investigated precise and safe vision-based navigation of aerial vehicles during landing, with the use of both hardware (NVIDIA TX2, ZED stereo camera) and simulation environments (ROS, Gazebo).
- Assisted in implementation and tuning of a high-integrity vision-based state estimation algorithm and a centralized state-machine for flight mode and abort decisions.
- Developed a C++ module and ROS package for collision detection and avoidance by distinguishing ground and obstacles in point cloud data.

Express Drone Parts, LLC, Memphis, TN

April 2017 - August 2018

Research Assistant

- Assisted in robotics division to design and test UAS for package delivery and monitoring.
- Integrated aerial platforms with PX4 for flight and Raspberry Pi for subsystem operations.

SKILLS AND CERTIFICATIONS

- Programming Languages: Python, MATLAB, C++, Java, VBA
- Key Packages: PyTorch, TensorFlow, GeoPandas, Numpy, Scikit, OpenCV, ROS, Git
- Hardware: NVIDIA Jetson TX2, ZED Stereo Camera, Raspberry Pi, PX4, CrazyFlie, Vicon
- Certifications: FAA Part 107 Remote Pilot Certification

KEY COURSES

- Aerospace Engineering: Linear Control, Aircraft Flight Dynamics, Systems of Systems, Rotorcraft Design
- Computer Science and Robotics: Principles of Planning and Decision-Making for Autonomy, Adaptive Control and Reinforcement Learning, Robotics Research Introduction/Lab, Computer Vision

- Computational Science and Engineering: Machine Learning, Modeling & Simulation, Algorithms, Numerical Linear Algebra
- Fundamentals: Probability and Statistics, Linear Algebra, Optimization

KEY PROJECTS

Emergency Landing Zone Detection and Planning using Aerial Imagery *Conference Proceedings*

July 2020 - Present

- Implementing a two-stage process for semantic and geometric feature detection using deep learning techniques to provide risk assessments for aerial trajectories in urban environments
- Data processing and visualization using Google Cloud ecosystem of EarthEngine, Tensorflow, and Colab.

Vision-based Obstacle Avoidance using Imitation Learning *Master's Special Problem and Conference Proceedings*

January 2019 - Present

- Comparing integrated frameworks of data-driven methods, including imitation learning with deep neural networks in PyTorch, to path-planning techniques, such as A* and Model Predictive Control, for vision-based obstacle avoidance in aerial systems
- Integrating environment in simulation using ROS and Gazebo and testing performance on hardware

Methods for Predicting Power Line Locations to Improve Aircraft Safety *Sponsored Project and Conference Proceedings*

October 2019 - January 2021

- Comparing tile classification networks with transfer learning (Xception architecture) to semantic segmentation networks (U-Net architecture) trained on publicly available datasets of power lines in rural and urban environments.
- Predicting and visualizing complete power line networks using many-to-many graph search techniques and carefully selected and tuned weights from power grid indicators.

UAS Swarm Selection for Monitoring Migrant Border Crossings *Aerospace Systems Design Lab Grand Challenge and Conference Proceedings*

August 2017 - May 2018

- Utilized and advanced a Java-based simulation environment to conduct operations analysis on the use of UAS swarms and surface fleet assets in monitoring the Mediterranean for migrant ships.
- Implemented UAV agents using unicycle dynamics and finite state machines, and swarm architectures using Reynold's flocking behaviors.

PUBLICATIONS AND CONFERENCES

CONFERENCE PROCEEDINGS

- **C. Harris**, S. Kim, and D. Mavris. "Emergency Planning for Aerial Vehicles by Approximating Risk with Aerial Imagery and Geographic Data". 2022 AIAA Scitech Forum. January 2022. (Abstract Submitted)
- H. Lee, **C. Harris**, A. Payan, and D. Mavris. "Risk-Aware Trajectory Planning Using Energy-based Analysis for Aerial Vehicles". 2021 AIAA Aviation Forum. August 2021.
- S. Beedie, **C. Harris**, J. Verberne, C. Justin, and D. Mavris. "Modeling Framework for Identification and Analysis of Key Metrics for Trajectory Energy Management of Electric Aircraft". 2021 AIAA Aviation Forum. August 2021.
- **C. Harris**, A. Payan, and D. Mavris. "Obstacle-free Landing Zone Detection for Emergency Scenarios in Cluttered Environments with Aerial Systems". 2021 Autonomous VTOL Technical Meeting and Electric VTOL Symposium Meeting. February 2021.
- **C. Harris**, Y. Choi, and D. Mavris. "Imitation Learning for UAS Navigation in Cluttered Environments". 2021 AIAA SciTech Conference. January 2021.
- **C. Harris**, G. Achour, A. Payan, and D. Mavris. "Use of Machine Learning to Create a Database of Wires for Helicopter Wire Strike Prevention". 2021 AIAA SciTech Conference. January 2021.
- H. Lee, **C. Harris**, J. Gladin, and D. Mavris. "A Method for Simultaneous Optimization of Power Split and Flight Path Trajectory for Hybrid Electric Aircraft". 2021 AIAA SciTech Conference. January 2021.
- **C. Harris**, M. Sokollek, L. S. Nunez, J. T. Valco, M. Balchanos, and D. Mavris. "Simulation-based UAS Swarm Selection for Monitoring and Detection of Migrant Border Crossings". 2018 AIAA Aviation Conference. June 2018.