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 May 2022*
Master's of Science in Computational Science and Engineering *expected 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

- Wire strike prevention involving creation of a wire database, onboard sensor fusion with wire database, and modeling and simulation of wire cutter devices on helicopters.
- Energy management safety and visualization using onboard trajectory planning and prediction
- Internal research for aerial systems for warehouse operations and package delivery involving agile trajectory optimization using DDP and MPC, and vision-based obstacle avoidance using deep learning and A* planning in occupancy grid.
- Multiple sponsored tasks for integrated design and performance of UAM and FVL rotorcraft resulting in Python-based environment for cost-capability tradeoffs.

Collins Aerospace, Mission Systems, Remote Work May 2020 - August 2020
Systems Engineering Intern (SEPP Program)

- Focused on 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 with an onboard stereo camera.

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, C++, MATLAB, 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
- Fundamentals: Probability and Statistics, Linear Algebra, Optimization

KEY PROJECTS

Emergency Landing Zone Detection and Planning using Aerial Imagery July 2020 - Present
Academic Research and Future Conference Proceedings

- Implementing a two-stage process for semantic and geometric feature detection using deep learning techniques
- Providing safety and risk assessments for aerial path planning in urban environments
- Using Python, TensorFlow, and open source aerial imagery datasets

Methods for Predicting Power Line Locations to Improve Aircraft Safety October 2019 - Present
Federal Aviation Administration funded project

- Comparing tile classification networks with transfer learning to semantic segmentation networks 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 indicators.

Deep Learning for UAS Navigation in a Cluttered Environment January 2019 - Present
Master's Special Problem and Conference Proceedings

- Comparing integrated frameworks of data-driven methods, such as imitation learning, to path-planning techniques, such as A* and MPC, for vision-based obstacle avoidance in aerial systems
- Integrating environment in simulation using ROS and Gazebo and testing performance on hardware such as Raspberry Pi, NVIDIA Jetson TX2, and ZED stereo camera.

UAS Swarm Selection for Monitoring Migrant Border Crossings August 2017 - May 2018
Aerospace Systems Design Lab Grand Challenge and Conference Proceedings

- 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**, 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.
- **C Harris**, Y. Choi, and D. Mavris. "Imitation Learning for UAS Navigation in Cluttered Environments". 2021 AIAA Scitech Conference.
- **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.
- 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.
- **C Harris**, A. Payan, and D. Mavris. "Obstacle-free Landing Zone Detection for Emergency Scenarios in Cluttered Environments with Aerial Systems". 2021 Autonomous VTOL Aircraft Technical Meeting.

TECHNICAL REPORTS:

- J. Robinson, **C Harris**, K Collins, B. Ahn. and D. Mavris. "Cost-Capability Assessment and Technology Evaluation for Future Vertical Lift Aircraft", *Technical Report for US Army Research Lab*, May 2019.

PRESENTATIONS:

- **C Harris**. "Diffuser Optimization for Harnessing Hydrokinetic Energy", Undergraduate Research Thesis, University of Memphis Honors Repository — Presented at Posters at the Capital, Tennessee State Capitol, March 2017.
- **C Harris**, and M. Sokollek. "UAS Swarm Selection for Monitoring and Detection of Migrant Border Crossings", Presented at Aerospace Systems Design Laboratory's Annual External Advisory Board, April 2018.
- **C Harris**, "Obstacle Avoidance for UAS via Imitation Learning", Presented at Aerospace Systems Design Laboratory's Annual External Advisory Board, April 2019.