CHRIS HAYNER

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EDUCATION

Ph.D. in Aeronautical and Astronautical Engineering | **University of Washington** — September 2026 (Expected)

Fellowships:

NASA Space Technology Graduate Research Opportunities (NSTGRO) Fellowship
Washington NASA Space Grant Fellowship

Co-Advised by Prof. Behçet Açıkmeşe and Prof. Karen Leung

BS in Applied Physics | **University of Washington** — June 2021

Minor in Aeronautical and Astronautical Engineering

EXPERIENCE

Research Scientist Intern | **Amazon**

July - Oct. 2025 — Seattle, WA

- I was a Research Scientist Intern in the Flight Controls group at Amazon Prime Air.

Research Intern | **Mitsubishi Electric Research Laboratories**

March - July 2025 — Boston, MA

- I work on trajectory optimization for drones with controllable sensors.

Visiting Technologist | **NASA Johnson Space Center**

Oct. - Jan 2025 — Houston, TX

- I used the NASA Simulation, Emulation, Navigation, Sense and STAR (SENSS Lab) which includes the Six-Degrees-of-Freedom Tendon Actuated Robot (STAR) to test real-time perception-aware entry descent and landing under line-of-sight constraints using a high-resolution physical lunar terrain model and Avea LiDAR sensor.

Visiting Technologist | **NASA Johnson Space Center**

Mar. - June 2024 — Houston, TX

- Developed Line-of-Sight guidance methods for entry, descent, and landing applications.

Graduate Research Assistant | **University of Washington**

Dec. 2021 - Current — Seattle, WA

- Participate in research across the Autonomous Controls Laboratory (ACL) and Control and Trustworthy Robotics Laboratory (CTRL).

Graduate Intern | **Air Force Research Laboratory**

June - Sept. 2022 — Dayton, OH

- Worked on vision-based algorithms, such as Visual Odometry, for alternative forms of navigation for autonomous systems.

Teaching Assistant | **University of Washington**

Sept. - Dec 2021 — Seattle, WA

- **AA310 Orbital and Space Flight Mechanics:** Worked to develop homework assignments and exam problems for a class of >70 students.
- Held office hours, mentored students to think critically and logically about engineering problems.

Intern | **Applewhite Aero**

June - Sept. 2021 — Seattle, WA

- Tested and tuned various UAV platforms. Integrated a variety of sensors and embedded computing payloads with computer vision algorithms onto UAV platforms. Assisted in the design of UAVs.

PUBLICATIONS

Journal Publications

[J1] **Christopher R. Hayner**, John M. Carson III, Behçet Açıkmeşe, Karen Leung, *"Continuous Time Line-of-Sight Constrained Guidance for Six Degree of Freedom Systems,"* IEEE Robotics and Automation Letters, vol. 10, no. 5, pp. 4332-4339, May 2025, doi: 10.1109/LRA.2025.3545299.

[J2] Kazuya Echigo, **Christopher R. Hayner**, Avi Mittal, Selahattin Burak Sarsılmaz, Behçet Açıkmeşe, Matthew Harris, *"Linear Program Approach to Close Proximity Operation with Element-wise Quantized Control,"* IEEE L-CSS 2023.

Conference Publications

[C1] **Christopher R. Hayner**, Natalia Pavlasek, John M. Carson III, Karen Leung, Behçet Açıkmeşe, *"Information-Aware Powered Descent Guidance for Entry, Descent and Landing,"* Entry, Descent, and Landing Invited Session at AIAA Scitech 2025 Forum.

[C2] **Christopher R. Hayner***, Samuel C. Buckner*, Daniel Broyles, Evelyn Madewell, Karen Leung, Behçet Açıkmeşe, *"HALO: Hazard-Aware Landing Optimization for Autonomous Systems,"* 2023 IEEE ICRA.

[C3] Kazuya Echigo, **Christopher R. Hayner**, Avi Mittal, Selahattin Burak Sarsılmaz, Behçet Açıkmeşe, Matthew Harris, *"Convex Trajectory Planning for Proximity Operations using Electric Propulsion with Quantized Thrust,"* AIAA 2023-0493. *AIAA Scitech 2023 Forum.*

[C4] Daniel Broyles*, **Christopher R. Hayner**** Denotes equal contribution, Karen Leung, *"WiSARD: A Labeled Visual and Thermal Image Dataset for Wilderness Search and Rescue,"* 2022 IEEE IROS.

[C5] **Christopher R. Hayner**, Timothy Zhou, Neil Gupta, Echo Liu, Parker Mayhew, and Juris Vagners. *"Real-time Human Detection with integration of Visual and Thermal Data from High Altitude sUAS,"* AIAA 2021-0397. AIAA Scitech 2021 Forum.

Workshops

[W1] Natalia Pavlasek, **Christopher R. Hayner**, Sarah Li, Behçet Açıkmeşe, Meeko Oishi, and Claus Danielson. *"Generating Blamelessly Optimal Control for Prioritized Constraint Sets,"* 2023 RSS Workshop: Towards Safe Autonomy: New Challenges and Trends in Robot Perception.

Symposium Presentations

[P1] **Christopher R. Hayner**, Echo Liu, Howard Peng. Parker Mayhew, Neil Gupta, Helen Kuni, Juris Vagners, *"An Autonomous Machine Learning Approach to Search and Locate Operations,"* AIAA PNW Symposium 2020.

PROJECTS

Graduate Projects

Canted Quadrotor Design

- Designed and tested the quadrotor frame and all other physical components in CAD
- Designed the custom circuit board schematic and layouts and integrated with NVIDIA Orin NX and Rasberry Pi Compute 4 Module processors
- Performed system identification to model actuator dynamics
- Implemented and tuned higher-order loop-shaped cascaded controllers and allocator

Perception-Aware Trajectory Planning [J1], [C1], [C2]

- Formulated and implemented a Sequential Convex Programming-based trajectory planning method which ensures keypoints or landmarks, commonly used in many perception algorithms, are kept within the LoS of a sensor throughout robot movement.
- Designed a tightly coupled perception and planning systems to determine safe landing sights and plan robust contingency-aware trajectories to them. A video demonstration can be found *here*.
- Implemented successive convexification (SCvx) to solve for a control trajectory.

Real-time optimization based trajectory planning for spacecraft [J2], [C3], Article: *Tugs in Space*

- Formulated and implemented real-time convex optimization methods to compute trajectories for spacecraft rendezvous, proximity operations and docking with electric propulsion subject to quantized thrust constraints.

Undergraduate Projects

Wilderness Search and Rescue [C4], [C5], [P1] Article: *Hide and Seek: Training a drone to save lives*

- Created and compiled a large visual and thermal dataset for human identification in a wilderness environment.
- Used a variety of computer vision algorithms to train models.
- Tested models on UAV platforms using onboard- and ground-based computing for inference on live thermal and visual imagery.

Aerial Mapping of Fire Behavior

- Created orthomosaic maps and point clouds of land utilizing visual and SWIR UAV based photogrammetry for calculating biomass to predict wild fire propagation.

Drone-based Air Quality Surveys, Article: *Can Trees Clean Jet Pollution*

- Integrated drone-mounted sensors to detect pollutants near SeaTac airfield and surrounding highways.

Ground Penetrating Radar, Article: *Peering into Snow*

- Integrated large GPR payloads as well as RTK GNSS onto UAV with the goal of remotely sensing and mapping snow depth.

OPEN SOURCE SOFTWARE

OpenSCvx

- A JAX-based open source library for modeling and solving nonconvex trajectory planning in Python. The Github can be found here.

SKILLS

General: Convex Optimization, Dynamics Modeling and System Identification, Simulation, Geometric Modeling, Classical Feedback Control, Model Predictive Control
Programming Languages: `MATLAB`, `Python`, `Julia`, `C/C++`
Frameworks and Libraries: JAX, Pytorch, CVXPy, ROS, OpenCV
Software: Solidworks, Unreal Engine, Adobe Suite, Optitrack Motive
Hardware: Embedded Systems (NVIDIA Jetson, Rasberry Pi, STM32 Microsprocessor), SLA and FDM 3D Printing, Soldering, Motion Capture, Servers

PUBLIC OUTREACH

UW Women of Aerospace — 2022 - Current
Worked to expand women's opportunities for leadership and increase their visibility in the aerospace community through mentorship and outreach activities.

UW Discovery Days Volunteer — 2019 - Current
Set up interactive stand for 4th - 8th graders which showed off my lab's current research projects in an effort to increase students' interest in STEM.

AWARDS

AA Student Excellence Award for Doctoral Research — 2023
1st Place Poster - UW Graduate Research Showcase — 2023

REFERENCES

Behçet Açıkmeşe
Position: Professor, Aeronautics and Astronautics Department, University of Washington
Relationship: Ph.D. Co-Advisor, Autonomous Controls Laboratory PI
Email: behcet [at] uw [dot] edu

Karen Leung
Position: NVIDIA Research Scientist Autonomous Vehicles; Assistant Professor, Aeronautics and Astronautics Department, University of Washington
Relationship: Ph.D. Co-Advisor, Control and Trustworthy Robotics Laboratory PI
Email: kymleung [at] uw [dot] edu

Juris Vagners
Position: Professor Emeritus, Aeronautics and Astronautics Department, University of Washington
Relationship: Undergraduate Advisor, Autonomous Flight Systems Laboratory PI
Email: vagners [at] uw [dot] edu

David Shean
Position: Assistant Professor, Civil and Environmental Engineering Department, University of Washington
Relationship: Undergraduate Advisor, Terrain Anlysis and Cryosphere Observation Laboratory PI
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