

CARRIE LAI

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EDUCATION

University of Southern California

January 2023 - Spring 2025

Master of Science in Aerospace Engineering

Coursework: Space Physics, Computational Fluid & Plasma Dynamics, Combustion and Rocket Propulsion

University of Washington (Seattle)

August 2017 - June 2021

Bachelors of Science in Aeronautical and Astronautical Engineering

Coursework: Aircraft & Spacecraft Dynamics and Control, Unmanned Aerial Vehicle & CubeSat design

HONORS

Selected Participant, National Science Foundation (NSF) Sponsored Program - USC Advanced Programming and Computational Fluid Dynamics, USC Center for Advanced Research Computing (Summer 2024)

- Developed advanced CFD programming skills in Python, MPI, CUDA, and Kokkos with USC High Performance Computing Cluster (HPC)
- Designed deep learning systems and applied neural networks for scientific computing and optimization

EXPERIENCE

Space Physics Research Intern, Space Weather Modeling Framework (SWMF)

June 2025 - August 2025

Professor Shasha Zou, University of Michigan, Ann Arbor, MI

- Analyzed electron velocity distribution evolution of the Bursty Bulk Flows (~10mins, ~400km/s) from magnetic reconnection in Earth's magnetotail, observed from a substorm event by Magnetospheric Multiscale Satellite
- Developed Python scripts to post-process these BBFs datasets from NASA Pleiades supercomputer, applying Maxwellian fits to quantify electron temperatures and anisotropies, and visualizing particle distributions
- Collaborated with a professor and postdoctoral researcher to optimize code performance, improve Maxwellian fitting methods, and interpret physics results, contributing to NASA-funded space weather modeling research

Researcher, Combustion Physics Laboratory

July 2024 - May 2025

Professor Paul Ronney, University of Southern California, Los Angeles, CA

- Simulated nanosecond-pulsed, non-thermal plasma-assisted combustion in a spherical Jet-Stirred Reactor (JSR) using 1D and 2D Particle-in-Cell (PIC) models; analyzed transient sheath formation, charge separation and electric field evolution
- Investigated pulse-duration optimization strategies to enhance plasma uniformity and ionization efficiency based on observed post-pulse plasma relaxation and oscillations
- Lead author on "*Exploring Plasma-Assisted Combustion in a Jet-Stirred Reactor Using Particle-In-Cell Simulation*", selected for presentation at the 14th U.S. National Combustion Meeting (USNCM 2025) in Boston
- Contributed to research "*Design and Restrictions on Spherical Jet-Stirred Plasma Reactor*", selected for presentation at the 2024 Gaseous Electronics Conference (GEC) in San Diego, a premier event hosted by the APS Division of Atomic, Molecular, and Optical Physics (DAMOP)

Researcher, Plasma Modeling

January 2024 - June 2024

Professor Lubos Brieda, University of Southern California, Los Angeles, CA

- Developed 1D two-fluid Magnetohydrodynamics (MHD) codes to model plasma sheath dynamics, and evaluated numerical noise characteristics by comparing results with Particle-in-Cell (PIC) methods
- Simulated the ion thruster backflow plume using a C++ framework developed by Prof. Brieda, based on a legacy Fortran model originally created at NASA's Jet Propulsion Laboratory for the Deep Space 1 mission, to study how charge exchange ions drift back and interact with spacecraft surfaces
- Customized the simulation by implementing mass flow-based particle injection, reflective boundary conditions, and charge exchange (CEX) collision physics to analyze plume-surface interactions and assess potential damage in electric propulsion systems

Fluid System Dev. Engineer

January 2023 - August 2023

USC Liquid Rocket Propulsion Laboratory, Los Angeles, CA

- Designed and modeled flight vehicle components in CAD, including a mounting mechanism and assembly for a Composite Overwrapped Pressure Vessel (COPV), ensuring compatibility with structural and dimensional constraints

GNC Team Lead, UW Aeronautics & Astronautics CubeSat Team

September 2020 - June 2021

The Maratus Mission (6U CubeSat), Seattle, WA

- Led the design of controls system architecture, mission objectives, and Concept-of-Operations (CONOPs) for satellite guidance, navigation, and controls Team and examined mission requirements, including attitude control, angular momentum management, and pointing accuracy

- Modeled environmental disturbance torques (e.g., atmospheric drag, gravity gradients, solar pressure) to assess impact on satellite dynamics and integrated actuators and sensors for the Attitude Determination and Control System (ADCS), ensuring effective torque and momentum management

Avionics Team Member

September 2020 - April 2021

UW Design, Build and Fly Team, Seattle, WA

- Supported avionics design of a UAV, including motor selection, sensor integration, and flight control tuning, achieving 15-minute flights at 20 m/s with a 37-lb payload aircraft

Communication Engineer, UW Aeronautics & Astronautics CubeSat Team

January 2020 - August 2020

SOC-I Mission (2U CubeSat), Seattle, WA

- Won one of only 18 spots in NASA's CubeSat Launch Initiatives. NASA launch schedule - ELaNa 43 (<https://www.nasa.gov/missions/small-satellite-missions/nasas-elana-43-prepares-for-firefly-aerospace-launch/>)
- Simulated satellite ground pass statistics for various orbital altitudes and inclinations, including contact durations and frequencies

Research Assistant

March 2018 - June 2019

UW Autonomous Flight System Lab, Seattle, WA

- Constructed a nonlinear 6-DOF dynamic model for the Research Civil Aircraft Model (RCAM) in MATLAB & Simulink and designed control systems to simulate flight dynamics

SKILLS

- Technical: C++, Python, MATLAB & Simulink, CAD (Siemens NX & SolidWorks), and COMSOL
- Additional: USC Department of Mathematics - Grader, UW Husky Leadership Program - School Ambassador, Starbucks in UW Housing & Food Service - Barista

OTHER

- Authorized to work for any US employer (US Citizen)