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University of California, Los Angeles (UCLA)

M.S. Aerospace Engineering GPA: 3.81 / 4.00 Graduated: **Fall 2025**

Thesis: Data-Driven Flight Dynamics Modeling for a Tailless Unmanned Aerial System (advisor: Kunihiko Taira)

B.S. Aerospace Engineering GPA: 3.98 / 4.00, *Summa Cum Laude* Graduated: **Fall 2024**

PROJECTS & EXPERIENCE

- **Graduate Student Researcher | UCLA Taira Lab** **Jan '25 – Dec '25**
  - Developed a data-driven optimization framework to accurately model the flight dynamics of the Dihedral-90 (D90) tailless UAS/UAV in collaboration with Prof. David Williams and PhD candidate Sai Simon at the Illinois Institute of Technology.
  - Applied Markov Chain Monte Carlo (MCMC) sampling through the Delayed Rejection Adaptive Metropolis (DRAM) algorithm to learn a set of stability derivatives that model significant dynamics.
  - Explored the Metropolis-Hastings and Metropolis with Sampled Error Variance algorithms as alternative optimization approaches.
  - Formed accurate flight dynamics models and identified dominant dynamics during takeoff and descent with Dutch roll flight segments.
  - Performed five-fold cross-validation to mitigate overfitting.
  - Performed Uncertainty Quantification (UQ) by constructing credible and prediction intervals on the final models to assess model accuracy.
  - Analyzed parameter distributions to assess model and parameter sensitivity, and confidence in results.
  - Explored the Morris screening method and Sobol indices as local and global parameter sensitivity metrics.
  - Processed and performed all analysis on MATLAB, using Simulink to model the control systems on board D90 and to simulate flight dynamics.
  - Ran 1000+ optimizations remotely on UCLA's Hoffman2 Cluster through the Linux command line.
  - Developed a user-friendly MATLAB Graphic User Interface (GUI) to quickly and easily train and test sparse regression models from experimental flight data.
  - The GUI allows the user to visually highlight significant dynamics from flight data and include various flight dynamics variables in the optimizations by comparing trends.
  - The GUI trains models using the Sparse Identification of Nonlinear Dynamics (SINDy) algorithm, which performs least squares regression with an additional penalty on the size of parameters.
  - Incorporated the option to run five-fold cross-validation on regression models to mitigate overfitting.
  - Saved, compared, and analyzed models as sparsity was promoted and parameters were removed.
  - Used the resulting models to seed the aforementioned MCMC optimizations.
  - Thoroughly described this research and the results in my Master's Thesis, seen **here**.
- **Undergraduate Research Assistant | UCLA Taira Lab** **Jun '23 – Jan '25**
  - Researched and explored various optimization methods (e.g., Least Squares Regression, Sparse Identification of Nonlinear Dynamics, Least Absolute Shrinkage and Selection Operator) for modeling flight dynamics.

- Trained various models using each optimization method and tested them by comparing attitude and force simulation results with flight data from the D90 Tailless UAS.
- Performed all analysis on MATLAB, using Simulink to model the control systems on board D90 and to simulate flight dynamics.
- Laid the foundation for my graduate research by familiarizing myself with processing flight data and with optimization methods.
- Created and 3D-printed turbulent flow structures over straight and swept wings from computational fluid dynamics (CFD) simulation data.
- Wrote MATLAB scripts to triangulate a surface from CFD flow data, project color onto the surface indicating flow velocity, and export 3D-printable .stl, colored .obj, and .fbx files.
- Visualized the CFD simulation data and 3D-printable files using ParaView and Blender applications, and removed any numerical discontinuities in the flow.
- Printed multiple prototype models, exploring the strength and complexity of the structures.
- Negotiated and received quotes from a multitude of outside vendors, eventually outsourcing to a professional resin printing company.
- Final 3D prints exceeded expectations, were given as gifts to lab donors, and are used to explain complex fluid mechanics topics.
- Also visited John. F. Kennedy High School in Granada Hills, CA, during an outreach event to help teach high school students about fluid mechanics.
- Designed and 3D-printed interactive gadgets and flow structures to make fluid mechanics engaging and more digestible for students.

- **Incompressible Lid-Drive Cavity Flow Solver with an Immersed Boundary Condition** **Mar '25 – Jun '25**
  - Developed an incompressible lid-driven cavity flow solver using MATLAB and applied an immersed boundary condition.
  - Explored the accuracy and stability properties of different finite-differencing and time-stepping methods (e.g., Explicit Euler, Runge-Kutta, Adams-Bashforth).
  - Discretized the incompressible Navier-Stokes equations into discrete divergence, gradient, Laplacian, and nonlinear advection operators.
  - Verified the code through spatial and temporal error convergence checks.
  - Validated results by comparing u- and v-velocity profiles, vorticity contours, and streamlines at $Re = 400$ and $Re = 1000$ with results from a seminal incompressible flow solver paper.
  - Implemented an immersed boundary condition using the direct forcing method to analyze flows around 2D structures. Demonstrated with a cylinder.
  - Verified the immersed boundary method solver by performing a spatial error convergence check.
  - Detailed this process in a report, seen **here**.

- **The *Silent Night Surveillant* Aircraft Design Project** **Jan '25 – Mar '25**
  - Developed a full-scale aircraft on a team of three students, for long-endurance surveillance missions.
  - Designed the *Silent Night Surveillant* to launch from Santa's offshore *Christmas Carrier*, fly to the UCLA campus, identify and monitor a student of interest for 24 hours, and return to the ship for data processing and transmission back to the North Pole.
  - Explored and compared different payloads and aircraft components to successfully carry out the mission.
  - Sized the aircraft based on estimated total mass and mission specification (e.g., endurance, climb rate, stall speed, etc.) using fundamental flight dynamic equations.
  - Seeded a Monte Carlo optimization approach with the preliminary sizing to refine the aircraft design.
  - Accepted/rejected aircraft based on endurance, maximum climb angle, static margin, maximum velocity, and more.
  - Iteratively adjusted seeding based on accepted aircraft configurations and reran Monte Carlo optimizations to achieve an optimized aircraft design.

- Led the design and implementation of the guidance, navigation, and control (GNC) system, exploring different strategies (e.g., waypoint guidance, proportional navigation).
- Implemented logic to loiter around UCLA until the student was found, then circle the student for the mission duration.
- Used MATLAB's Simulink to model the control systems on board the aircraft and run simulations.
- Outlined this process in a report, seen **here**.

- **The *Mayfly* Spacecraft Design Project** **Mar '24 – Jun '24**
  - Served as the lead launch vehicle and propulsion system engineer on a team of ten students in the design of a full-scale spacecraft to perform a sample retrieval mission.
  - Engineered the *Mayfly* spacecraft, designed to intercept and retrieve a sample from the 311P/PANSTARRS comet before returning back to Earth.
  - Worked with the lead mission trajectory engineer and the systems engineer to ensure the spacecraft design adhered to the mission timeline.
  - Collaborated closely with the power systems and thermal systems engineers to ensure sufficient power and adequate heat dissipation on board the spacecraft.
  - Conducted trade studies between chemical and Solar Electric Propulsion (SEP) systems to determine the optimal propulsion system.
  - Researched and evaluated multiple SEP systems using an iterative design approach to assess impacts on power consumption, spacecraft size and mass, and flight time.
  - Assessed the Technology Readiness Level (TRL) of different SEP systems to reduce mission risks.
  - Selected the high-I_{sp} variant of the NEXT 9a ion thruster ($I_{sp} = 4125$s) for its high efficiency, allowing for minimized propellant mass and maximized payload size.
  - Reduced the thruster input power to 3kW to decrease the solar array size while still adhering to the mission timeline.
  - Incorporated redundancy into the propulsion system design in case of mid-flight failures.
  - Described this process in a report, seen **here**.

- **Autonomous Micro Air Vehicle Design Project** **Mar '24 – Jun '24**
  - Designed and assembled an autonomous Micro Air Vehicle (MAV) on a team of six students, capable of identifying the quickest path through a randomized set of waypoints.
  - Lead engineer for the electrical subsystems on the drone, ensuring adequate power distribution and proper communication between components.
  - Conducted research on electronic subsystems (e.g., LiDAR, flight computer hardware, motors, etc.) and chose components to meet mission requirements.
  - Constructed the thrust profile of the motors, allowing for a current draw and power consumption estimates for the entire trajectory. Results were compared with the battery capacity to ensure adequate energy availability.
  - Tested a variety of different frame materials through experiments and computational simulations.
  - Soldered all components together, aligning the center of mass with the Inertial Measurement Unit (IMU).
  - 3D modeled, printed, and tested various drone leg configurations for component placement and stability.
  - Compared nearest neighbor, brute force, and k-opt waypoint sequencing methods to determine the optimal trajectory.
  - Detailed this process in a report, seen **here**.

- **Independent RC Quadcopter Design Project** **Jun '23 – Aug '23**
  - Designed, 3D-printed, and assembled an RC quadcopter from scratch.
  - Sized drone according to 3D printer bed limitations and budget.
  - Conducted copious amounts of research prior to designing and selecting each component of the drone.
  - Rigorously selected motors and propellers in conjunction with a battery, after settling on a flight controller.
  - Modeled the drone frame in SolidWorks and continuously 3D-printed prototypes, adjust the design with each iteration.
  - Soldered all components together, added heat inserts to my 3D-printed frame, and assembled the drone.

- Learned how to configure the flight controller and adjust the drone for different flying styles.
- Continuing to redesign and experiment with new components on the drone to achieve smoothest flight.
- Studying to take HAM Amateur Radio License exam so I can attach a VTX chip and camera to the drone.

- **RC Airplane Design Project** **Jan '23 – Mar '23**
  - Led a team of four students in designing, testing, and assembling a remote-controlled airplane.
  - Improved communication and organizational skills, allowing my team to overcome a multitude of challenges.
  - Consulted team members and set a goal of achieving the fastest plane award in the end competition.
  - Constructed an Figure of Merit (FOM) chart to weigh the pros and cons of different component designs.
  - Rigorously selected the airfoils for our wing and stabilizers based on lift and drag coefficients and the overall goals for the aircraft.
  - Modeled entire plane in SolidWorks and 3D-printed engine mounts, stabilizer mounts, and landing gear mounts.
  - Cut fuselage, wing, and stabilizers out of foam to reduce weight, inlaying a wooden spar to the wing.
  - Iterated on component designed to achieve best performance.
  - Placed in class a competition and won the award for the fastest and most maneuverable airplane.

- **Design/Build/Fly Manufacturing Team Member** **Jan '22 – Jun '22**
  - Joined the Manufacturing team and contributed to the design and assembly of a remote-controlled airplane placed in the AIAA Design/Build/Fly Competition.
  - Helped manufacture and assemble the vertical and horizontal stabilizers of our plane.
  - Learned how to run and analyze CFD simulations on different airfoils and wing designs using COMSOL.
  - Manufactured and tested the vertical and horizontal stabilizers of the airplane.
  - Placed 15th among 81 competing universities. At the time, this was the highest ever ranking in UCLA history.

- **Model Rocket Design Project** **Sept '22 – Dec '22**
  - Formed a team of students to design, assemble, test, and launch two model rockets.
  - Modeled preliminary designs using the application OpenRocket and analyzed how different component designs affect apogee and speed.
  - Conducted research on rocket design and communicated my understanding to my teammates.
  - Held group meetings to discuss goals, divide up the work, and share research and ideas.
  - Modeled individual components in SolidWorks and created an assembly design.
  - Operated a laser cutter and 3D printer to manufacture components, and created a fiberglass layup body tube.
  - Learned from failures after iteratively testing and redesigning components.
  - Rockets exceeded expectations, with the second rocket achieving a ~ 3200 ft apogee.

- **Saddleback Robotics *Osiris* Mars Rover Team** **Jan '22 – Jun '22**
  - Joined the Chassis and Electrical teams and helped assemble a remote-controlled rover.
  - Designed and 3D modeled inner components and electrical housing boxes within the rover's chassis.
  - Soldered and assembled different circuitry within the rover.
  - Helped in the repeated testing and redesign of the rover prior to competition.
  - Entered the international University Rover Competition.

- **Misc. Projects / Work** **Jan '22 – Current**
  - Wrote a neural network in MATLAB that used the MNIST database to learn and identify hand written digits.
  - Developed my personal website from scratch using HTML, CSS, and JavaScript.

- Have written multiple programs in C++ to calculate expenses, calculate income, play games, and more, sometimes utilizing Linux command line.
- Became a C++ class tutor after being recruited by my former professor. Held 3-hour drop-in office hour sessions to help students think through and correctly complete problems.
- Learned how to program an Arduino UNO and used it to display different light patterns.

CONFERENCE PRESENTATIONS

- **SoCal Fluids XVIII**: *Development of a Flight Dynamics Model for D90* – April 19, 2025 | University of Southern California

EXTRACURRICULAR ACTIVITIES & AWARDS

- **John F. Kennedy High School Outreach Event** – Explored fluid mechanics with high school students. **Apr '25**
- **Tau Sigma Academic Honor Society** – Member of academic honor society. **May '23 – Current**
- **Phi Theta Kappa Academic Honor Society** – Member of academic honor society. **Apr '20 – Current**
- **Saddleback College Tutor** – Computer science class tutor (C++), physics, chemistry, and math tutor. **Aug '19 – May '22**
- **Mentor Collective Trained Student Mentor** – Mentored STEM college students, helped identify interests. **Jan '22 – Current**