Jiaze Cai

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EDUCATION

University of California, Berkeley Aug 2023 - May 2024
Master of Engineering | Major in Mechanical Engineering (Concentration: Control of Robotic and Autonomous Systems)
GPA: 3.96/4.0 Berkeley, California

- **Core Coursework:**
  Introduction to Robotics (A), Control and Dynamics of Unmanned Aerial Vehicles (A), Experiential Advanced Control Design (A)

Texas A&M University Aug 2019 - May 2023
Bachelor of Science | Major in Aerospace Engineering (Engineering Honors Program), Minor in Electrical Engineering
GPA: 3.85/4.0, Minor GPA 4.0/4.0 College Station, Texas

- **Core Coursework:**
  AERO: Airfoil and Wing Design (A), Helicopter (A), Aerospace Structural Design (A)
  ECE: Digital System Design (A), Electronic Circuits (A), Signal and System (A)
  Dynamics & Control: Flight Dynamics (A), Active Controls for Aerospace Vehicles (A)

Honors: 1st place in 2022 SAE AERO Design (Regular Class), Security Award in 2021 TAMUMake, Best Hardware Hack Sponsored by Digi-key in 2021 TAMUhack, 1st place in eSMART 2019 competition

RESEARCH INTEREST

Innovative UAV Design and Prototyping, Dynamics & Control of UAVs, Reinforcement Learning on Flapping-wing UAVs, Aerial Robotics

PUBLICATION

Cai, J., Sangli V, Kim M, Sreenath K. (2024). Learning-based trajectory tracking for bird-inspired flapping-wing robots. arXiv preprint. 2024;2411.15130. https://arxiv.org/abs/2411.15130

Cai, J., Denton H, Benedict M, Kang H. (2024). Development of a tube-launched tail-sitter unmanned aerial vehicle. International Journal of Micro Air Vehicles. 2024;16. https://doi.org/10.1177/17568293241254045

Cai, J. Denton H. & Benedict M. (2023). Development of an Air-launched Tail-Sitter Unmanned Aerial Vehicle. VFS 79th Annual Forum, West Palm Beach, Florida

Cai, J. (2022). A Fully Mechanical Realization of PID Controller. Highlights in Science, Engineering and Technology, 9, 319–328. https://doi.org/10.54097/hset.v9i.1861

RESEARCH EXPERIENCE

Development and Learning-based Control on Flapping-wing robot | HYBRID ROBOTICS Lab Sept 2023 – Present
Capstone Project, supervised by Prof. Koushil. Sreenath Berkeley, California

- Designed a high-degree-of-freedom (high-DoF), bird-scale flapping-wing robot and developed its simulation environments to facilitate learning-based control.
- Designed and implemented a learning-based control framework for agile trajectory tracking and flight dynamics.
- Currently deploying the control policy on a physical flapping-wing robot for experimental validation.

Tube-Launched VTOL Foldable Tail-Sitter UAV | TAMU Advanced Vertical Flight Lab March 2022 – June 2023
Undergraduate Research Assistant, supervised by Prof. Moble Benedict College Station, Texas

- Led a project on designing, manufacturing, and flight testing on an Air-Launched Foldable Tail-Sitter that can hover, VTOL, and cruise like a fixed-wing airplane
- Fully Responsible for all aspect of the project (mechanics, electronics, and flight controller programming)
- Implemented cascade PID (proportional-integral-derivative) controller on ELKA (Embedded Lightweight Kinematic Autopilot) board for hovering and vertical flight
- Conducted aerodynamic design and longitudinal stability analysis with STAR CCM+ and XFLR5

Scaled Next-Gen VTOL UAS Prototype Design | TAMU Advanced Vertical Flight Lab Jan 2023 – May 2023
Capstone Project, supervised by Prof. Moble Benedict

- Led a 20-people team in design, fabrication, and flight tests of a 4-lb subscale double-swashplate-based wing-foldable VTOL Tail-Sitter

- Led the flight dynamics modeling sub-team and implemented control logics with ELKA (Embedded Lightweight Kinematic Autopilot)
- Successfully demonstrated indoor hovering with mid-flight wing deployment

Full-scale Next-Gen VTOL UAS Conceptual Design | TAMU Advanced Vertical Flight Lab Sept 2022 – Dec 2022
Capstone Project, supervised by Prof. Moble Benedict
- Participated in the theorical design and realization of a next-generation long-endurance VTOL unmanned aircraft
- Led the flight dynamics modeling sub-team, developed the control laws, and successfully demonstrated transition flights (fixed-wing mode to hovering mode, or vice versa) in dynamic simulation via Simulink
- Derived the equations of motion for the vehicle and developed a 2D nonlinear longitudinal dynamic simulation program to demonstrate the capability of transition flights based on CFD (Computational Fluid Dynamics) data

COMPETITIONS AND PROJECTS

Stabilator Structural Optimization| AERO 405 Feb 2023 - May 2023
- Designed and optimized a Piper Cherokee Stabilator with trim tab through ABAQUS
- Created a Python script to generate parameterized geometry of a stabilator in ABAQUS
- Implemented a Genetic Algorithm in ABAQUS to optimize the design to minimize weight while satisfying constraints on structure failure, deflection, twist angle, and buckling through FEA (Finite Element Analysis).

TAMU SAE AERO Design | SAE AERO Design Competition, Regular Class May 2021 - May 2022
- Participated in the design, manufacturing, and flight tests of a wooden aircraft capable of storing 27 soccer balls for flights
- Proposed and Incorporated the Pixhawk flight controller to obtain flight test data for design analysis and optimization
- Designed winglet and fairing for prototype design with CFD (Computational Fluid Dynamics) analysis and a subscale wind-tunnel model

Design and Dynamic Analysis of DHC-6 (a twin-engine turboprop aircraft) | AERO 321 Feb 2022 - May 2022
- Determined optimal fuselage size and tail incidence from first-principle calculations (drags and moments estimation)
- Determined control and stability derivatives for the aircraft with a linearized airplane dynamic model
- Performed modal analysis on the longitudinal phugoid mode and short-period mode of the aircraft in MATLAB

eSMART Competition Feb 2020 – Jun 2020
- Designed and built a remote-controlled boat in actual sea-water conditions with maximum speed
- Analyzed the static stability of the boat by calculating the metacentric height of the boat
- Computed the drag (Guldhammer & Harvald method) and trust (K_T-J and K_q-J Charts for Wageningen B-Series Propeller) of our design boat in Python, which was then integrated into a simulator that provides the estimated instantaneous acceleration, velocity, and distance of the boat
- Validated resistance calculation with two-phase CFD (Computer Fluid Dynamics) simulation and physical experiments

FRC Robots | FRC (FISRT Robotics Competition) & CRC (China Robotics Competition) Sept 2017 - May 2019
- Intensively participated the design and deployment of more than five different competition robots for various tasks, including collecting and shooting balls, transporting boxes, climbing stairs, etc., with SolidWorks modeling and intensive benchwork
- Worked on the structural design and implementation of different mechanisms (lifting, clamping, etc.) of robots
- Performed wiring, pneumatic system implementation, actuator selections, and aluminum profile processing

SKILLS

- **Software:** Control and Dynamic Simulation: Simulink, MuJoCo; Structure Design: SolidWorks, ABAQUS; Aerodynamic Design: Star CCM+, XFLR5; Programming: Python, C++, C, MATLAB, LabView, Java
- **Benchwork:** CNC machine, 3D printing, cutting machine, bench drill, etc.
- **Electronics:** I^2C protocol, PWM (Pulse-width modulation), Arduino, Raspberry Pi, MPU9250 IMU (inertial measurement unit), FPGA (ZYBO-z7 board), and Verilog programming