

Mahdi Shahrajabian

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A passionate advanced control researcher working toward enabling aerial vehicles and robotic systems to operate in an assured autonomous manner and interact safely and intelligently with each other and humans.

Research Interests

- Assured Autonomous Systems
- Safe Learning-Based Control
- Model Predictive Control
- Data-Driven Modeling and Control
- Resilient Flight Control
- Control of Multi-Agent Systems

Education

Master of Science in Aerospace Engineering (Dynamics and Control) <i>Sharif University of Technology (SUT)</i> CGPA: 19.32/20.0 (4-point scale CGPA: 4.0/4.0)	Tehran, Iran 2022–2024
Bachelor of Science in Aerospace Engineering (Dynamics and Control) <i>Amirkabir University of Technology - Tehran Polytechnic (AUT)</i> CGPA: 18.11/20.0 (4-point scale CGPA: 3.86/4.0 and last six semester GPA: 4.0/4.0)	Tehran, Iran 2017–2022
Bachelor of Science in Electrical Engineering (Control Systems) <i>Amirkabir University of Technology - Tehran Polytechnic (AUT)</i> CGPA: 17.76/20.0 (4-point scale CGPA: 3.64/4.0)	Tehran, Iran 2017–2022

Work & Research Experiences

Graduate Research Assistant <i>Aerial Robotics Lab, Department of Aerospace Engineering, SUT</i> Supervisor: Prof. Fariborz Saghafi	Tehran, Iran Jan 2024 – Present
Master's Thesis: Fault-Tolerant Adaptive Intelligent Control of an Autonomous Multi-rotor eVTOL Air Taxi <ul style="list-style-type: none">• Modeling and simulation of an octodecarotor eVTOL air taxi• Adaptive neural control system design for trajectory tracking of an autonomous octodecarotor air taxi in the presence of uncertainties, disturbances and actuator faults• Development of a dynamic control allocation algorithm for the new configuration to handle motor failures considering actuator saturation and fault estimation error	
Research Assistant <i>Innovation Center, Department of Aerospace Engineering, AUT</i> Supervisor: Prof. Seyed Majid Esmailifar	Tehran, Iran Jun 2023 – Dec 2023
Shafagh: A Solar-Powered High Altitude Long Endurance UAV for Sustainable Communication Relay and Enhanced 5G Internet Connectivity Applications <ul style="list-style-type: none">• Conducted a study of control systems and actuators employed in similar solar UAVs• Designed and developed the Flight Control System (FCS) for Shafagh, with a focus on minimizing power consumption and rejecting wind disturbances	
Undergraduate Research Assistant <i>Hardware-in-the-Loop Lab, Department of Aerospace Engineering, AUT</i> Supervisor: Prof. Seyed Majid Esmailifar	Tehran, Iran May 2021 – Sep 2022
Bachelor's Thesis: Design and Implementation of Autopilot for Automatic Takeoff and Landing of a Quadrotor using the Model-Based Design Approach <ul style="list-style-type: none">• Modeling of quadrotor dynamics, Brushless DC motors and wind effects• Implemented flight management and waypoint following algorithms• Designed and implemented multi-loop cascaded PID control law for the quadrotor• Implemented custom automatic flight control algorithms on the Pixhawk using Simulink• Performed Software-in-the-Loop (SIL) simulation, Hardware-in-the-Loop (HIL) simulation and flight tests for verification of custom-designed autopilot using Simulink and the Pixhawk	

Embedded Software Engineer (Part-time)

Avionics Office, Parvaz Afraz Hava Sanat Ltd.

Tehran, Iran

Oct 2021 – Sep 2022

Contributed as a junior Embedded Software Engineer in an air taxi development co.

- Conducted a comprehensive survey of basic standards for the design, development, and manufacturing of aircraft Flight Control Computer (FCC)
- Participated in flight control software design and development for a lift + cruise eVTOL aircraft according to DO-178C and Model-Based Design (MBD) approach (DO-331)
- Implemented C code on the FCC hardware with TI C2000 microcontroller
- Setting up embedded systems communication protocols
- Created an intuitive GUI for eVTOL aircraft simulation using MATLAB app designer

Engineering Intern

Avionics Office, Parvaz Afraz Hava Sanat Ltd.

Tehran, Iran

Jul 2021 – Sep 2021

- Gained expertise in utilizing Pixhawk autopilot and PX4 firmware
- Acquired proficiency in working with QGroundControl
- Conducted an in-depth study and analysis of quadrotor control methods and algorithms
- Compared and evaluated various control methods employed in control system of a lift + cruise eVTOL aircraft.

Publications

1. **Shahrajabian, M.**, Saghafi, F. (2025). Fault-tolerant control of an autonomous multirotor eVTOL air taxi using adaptive control allocation and online composite learning (in progress)
2. **Shahrajabian, M.**, Saghafi, F., Emami, S. A. (2025). Resilient trajectory tracking of an autonomous multirotor eVTOL air taxi based on adaptive neural model predictive control (in progress)

Teaching Experiences

Graduate Teaching Assistant

Optimal Control (Prof. S. H. Pourtakdoust), Department of Aerospace Engineering, SUT

Tehran, Iran

Fall 2024

Head Teaching Assistant

Modern Control (Prof. H. Atrianfar), Department of Electrical Engineering, AUT

Tehran, Iran

Fall 2024, Fall 2023

Graduate Teaching Assistant

Dynamics (Prof. F. Saghafi), Department of Aerospace Engineering, SUT

Tehran, Iran

Fall 2024, Fall 2023

Instructor

Advanced MATLAB and Simulink Course, Scientific Association of Mechanical Engineering, AUT

Tehran, Iran

Summer 2024

Lab Instructor

Linear Control Systems Lab, Department of Electrical Engineering, AUT

Tehran, Iran

Spring 2024

Graduate Teaching Assistant

Automatic Control (Prof. S. A. Emami), Department of Aerospace Engineering, SUT

Tehran, Iran

Spring 2024

Instructor

Introduction to MATLAB Course, Scientific Association of Mechanical Engineering, AUT

Tehran, Iran

Spring 2024

Instructor

Advanced MATLAB and Simulink Course, Scientific Association of Aerospace Engineering, AUT

Tehran, Iran

Summer 2023

Graduate Teaching Assistant

Automatic Control (Prof. S. M. Esmailifar), Department of Aerospace Engineering, AUT

Tehran, Iran

Spring 2023

Graduate Teaching Assistant

Modern Control (Prof. I. Sharifi), Department of Electrical Engineering, AUT

Tehran, Iran

Fall 2022

Instructor

Calculus and Differential Equations Exam Preparation Courses (offered 8 times),
Scientific Association of Aerospace Engineering, AUT

Tehran, Iran

Oct 2018 – May 2022

Honors & Awards

- Ranked 1st among all peer master's students in the Aerospace Engineering Department at SUT (Sep 2024)
- Winner of the Shahid Vezvaei Award from Iran's National Elite Foundation (Jan 2023)

- Received a merit-based direct admission offer for the Master of Aerospace Engineering at SUT (Feb 2022)
- Ranked 3rd among all peer bachelor's students in the Aerospace Engineering Department at AUT (Nov 2020)
- Recognized as an outstanding student (exceptional talent) and granted the opportunity to pursue Electrical Engineering as a second major during my Bachelor of Science at AUT (Sep 2019)
- Ranked within the top 1.3% among more than 148000 participants in the 2017 Iranian University Entrance Exam issued by the National Organization for Educational Testing (Aug 2017)

Selected Academic Projects

System Identification Jan 2024 – Jun 2024

Frequency response analysis for equivalent linear state-space model identification of a jet airliner

Supervisor: Prof. Afshin Banazadeh

Nonlinear Control Jan 2024 – Jun 2024

Nonlinear Fault-tolerant control of a quadrotor subject to disturbances using an OS-ELM-based actuator loss of effectiveness fault estimator

Supervisor: Prof. Seyyed Ali Emami

Navigation and Guidance Jan 2023 – Jun 2023

Paper Regeneration: Disturbance observer-based adaptive neural guidance and control of an aircraft using composite learning

Supervisor: Prof. Hadi Nobahari

Optimal Control 1 Jan 2023 – Jun 2023

Optimal attitude control of a tri-axial air-bearing satellite simulator platform

Supervisor: Prof. Seid H. Pourtakdoust

Advanced Automatic Control Sep 2022 – Jan 2023

Paper Regeneration: Feedback Linearization with Zero Dynamics Stabilization for Quadrotor Control

Supervisor: Prof. Afshin Banazadeh

Digital Control Systems Jan 2022 – Jun 2022

Implementation of discrete-time PID controller on Raspberry Pi for motion control of a wheeled mobile robot

Supervisor: Prof. Heidar Ali Talebi

Modern Control Dec 2021 – Jan 2022

Modern control approach for stability analysis, state feedback control with integrative action and observer design for a quadrotor (Teamwork-Leader)

Supervisor: Prof. Hajar Atrianfar

Aircraft Design Mar 2021 – Jun 2021

Conceptual design of the 116-seat regional jet aircraft (Teamwork-Leader)

Supervisor: Prof. Mohammad Ali Vaziri Zanjani

Flight Dynamics 2 Mar 2021 – Jun 2021

6DOF flight simulation of the Boeing 757-200 using XFLR5, AVL and Simulink

Supervisor: Prof. Hamed Mohammadkarimi

Instrumentation Mar 2021 – Jun 2021

Efficient Smart Home Lighting: Energy-efficient brightness adjustment based on ambient light and movement detection (Teamwork-Leader)

Supervisor: Prof. Iman Sharifi

Computational Intelligence Nov 2020 – Dec 2020

- Fuzzy Logic Control of a three-link gymnastic robot (Teamwork-Leader)
- Adaptive cruise control of an autonomous vehicle based on self-tuning fuzzy PID control
- System identification of robot manipulator using neural networks

Supervisor: Prof. Farzaneh Abdollahi

Languages

- **Persian:** Mother Tongue
- **English:** Fluent

Exam: IELTS test will be taken on Dec, 2024.

Skills

- **Programming:** MATLAB (Script, Simulink, Stateflow, Simscape), C, C++, Python (TensorFlow, Keras, PyTorch, Gym), familiar with VHDL
- **Engineering Softwares:** Solidworks, Ansys Fluent, XFLR5, AVL, OpenVSP, QGroundControl, PX4 firmware, Gazebo, CIPHER, Keil uVision, STM32 CubeMX, Code Composer Studio, Proteus, Arduino
- **General:** Windows, Ubuntu, Microsoft Office Collection, \LaTeX

Voluntary Experience

Contributing Author

Aug 2023 – Present

Book: Emami, S. A., Castaldi, P., Narimani, M., Ezabadi, M., *Neural Network-based Control Systems with Application to Flight Control: From Classical Neural Control to Reinforcement Learning*. Springer. (in preparation)

Responsibilities: Designing multiple examples, writing the solutions, conducting the corresponding simulations, analyzing the results, and drawing conclusions

Student Mentor

Mar 2023 – Sep 2023

Amirreza Esmaeeli and Alireza Esmaeeli, Undergraduates, Aerospace Engineering, AUT

Topic: Design and Implementation of Leader-Follower Formation Control of two Quadrotors Based on Image Processing using Raspberry Pi and Pixhawk Autopilot

Notable Courses

• Related Courses in M.Sc.

- ◇ Advanced Automatic Control (1st rank)
- ◇ Nonlinear Control (1st rank)
- ◇ Intelligent Control (Learning-based) (3rd rank)
- ◇ Optimal Control 1 (Deterministic) (1st rank)
- ◇ Optimal Control 2 (Stochastic Optimal Estimation and Control) (1st rank)
- ◇ Deep Reinforcement Learning (TBD)
- ◇ System Identification (1st rank)
- ◇ Navigation and Guidance (1st rank)
- ◇ Advanced Flight Dynamics and Control (1st rank)
- ◇ Modeling of Aerospace Dynamic Systems
- ◇ Flight Simulation (1st rank)
- ◇ Advanced Mathematics

• Related Courses in B.Sc.

- ◇ Linear Control Systems + Lab (1st rank)
- ◇ Applied Linear Algebra (1st rank)
- ◇ Computational Intelligence + Lab (2nd rank)
- ◇ Digital Control Systems + Lab
- ◇ Modern Control (2nd rank)
- ◇ Industrial Control + Lab
- ◇ Mechatronics
- ◇ Avionics + Workshop
- ◇ Flight Dynamics + Lab (1st rank)
- ◇ Aircraft Design (1st rank)
- ◇ Satellite Systems (1st rank)
- ◇ Computational Fluid Dynamics (1st rank)

• Coursera

- ◇ Machine Learning (Certificate)
- ◇ Robotics: Aerial Robotics (Audited)
- ◇ Robotics: Estimation and Learning (Audited)
- ◇ Robotics: Perception (Audited)

• Others

- ◇ Artificial Intelligence and Deep Learning (Certificate)
- ◇ Model Predictive Control (Audited)
- ◇ ETHZ Computational Control (Online videos)

References

Fariborz Saghafi

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Department of Aerospace Engineering
Sharif University of Technology
Tehran, Iran
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Seyed Majid Esmailifar

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