

# Mahdi Shahrajabian

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*A passionate advanced control researcher working toward enabling systems, especially aerial vehicles, to autonomously operate and interact safely and intelligently with each other and with humans.*

## Research Interests

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

## Education

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

## Work & Research Experiences

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<b>Graduate Research Assistant</b> <i>Aerial Robotics Lab, Department of Aerospace Engineering, SUT</i> Supervisor: Prof. Fariborz Saghafi	<b>Tehran, Iran</b> Jan 2024 – Present
Master's Thesis: Intelligent Adaptive Fault-tolerant Control of an Autonomous Multi-rotor eVTOL Air Taxi <ul style="list-style-type: none"><li>• Modeling and simulation of an octodecarotor eVTOL air taxi</li><li>• Adaptive neural control system design for trajectory tracking of an autonomous octodecarotor air taxi in the presence of uncertainties, disturbances and actuator faults</li><li>• Development of a dynamic control allocation algorithm for the new configuration to handle motor failures considering actuator saturation and fault estimation error</li></ul>	
<b>Research Assistant</b> <i>Innovation Center, Department of Aerospace Engineering, AUT</i> Supervisor: Prof. Seyed Majid Esmailifar	<b>Tehran, Iran</b> 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"><li>• Conducted a study of control systems and actuators employed in similar solar UAVs</li><li>• Designed and developed the Flight Control System (FCS) for Shafagh, with a focus on minimizing power consumption and rejecting wind disturbances</li></ul>	
<b>Undergraduate Research Assistant</b> <i>Hardware-in-the-Loop Lab, Department of Aerospace Engineering, AUT</i> Supervisor: Prof. Seyed Majid Esmailifar	<b>Tehran, Iran</b> 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"><li>• Modeling of quadrotor dynamics, Brushless DC motors and wind effects</li><li>• Implemented flight management and waypoint following algorithms</li><li>• Designed and implemented multi-loop cascaded PID control law for the quadrotor</li><li>• Implemented custom automatic flight control algorithms on the Pixhawk using Simulink</li><li>• 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</li></ul>	

## 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

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- Ranked 1<sup>st</sup> among all peer master students majoring in Dynamics and Control at SUT (Oct 2023)
- Winner of the Shahid Vezvaei Award (selected elite student scholarship) from Iran's National Elite Foundation (Jan 2023)
- Granted merit-based direct admission offer in Master of Aerospace Engineering from SUT (Feb 2022)
- Ranked 3<sup>rd</sup> among all peer bachelor students of Aerospace Engineering 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

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<b>System Identification</b>	Jan 2024 – Jun 2024
<i>Frequency response analysis for equivalent linear state-space model identification of a jet airliner</i>	
Supervisor: Prof. Afshin Banazadeh	
<b>Nonlinear Control</b>	Jan 2024 – Jun 2024
<i>Nonlinear Fault-tolerant control of a quadrotor subject to disturbances using an OS-ELM-based actuator loss of effectiveness fault estimator</i>	
Supervisor: Prof. Seyyed Ali Emami	
<b>Navigation and Guidance</b>	Jan 2023 – Jun 2023
<i>Paper Regeneration: Disturbance observer-based adaptive neural guidance and control of an aircraft using composite learning</i>	
Supervisor: Prof. Hadi Nobahari	
<b>Optimal Control 1</b>	Jan 2023 – Jun 2023
<i>Optimal attitude control of a tri-axial air-bearing satellite simulator platform</i>	
Supervisor: Prof. Seid H. Pourtakdoust	
<b>Advanced Automatic Control</b>	Sep 2022 – Jan 2023
<i>Paper Regeneration: Feedback Linearization with Zero Dynamics Stabilization for Quadrotor Control</i>	
Supervisor: Prof. Afshin Banazadeh	
<b>Digital Control Systems</b>	Jan 2022 – Jun 2022
<i>Implementation of discrete-time PID controller on Raspberry Pi for motion control of a wheeled mobile robot</i>	
Supervisor: Prof. Heidar Ali Talebi	
<b>Modern Control</b>	Dec 2021 – Jan 2022
<i>Modern control approach for stability analysis, state feedback control with integrative action and observer design for a quadrotor (Teamwork-Leader)</i>	
Supervisor: Prof. Hajar Atrianfar	
<b>Aircraft Design</b>	Mar 2021 – Jun 2021
<i>Conceptual design of the 116-seat regional jet aircraft (Teamwork-Leader)</i>	
Supervisor: Prof. Mohammad Ali Vaziri Zanjani	
<b>Flight Dynamics 2</b>	Mar 2021 – Jun 2021
<i>6DOF flight simulation of the Boeing 757-200 using XFLR5, AVL and Simulink</i>	
Supervisor: Prof. Hamed Mohammadkarimi	
<b>Instrumentation</b>	Mar 2021 – Jun 2021
<i>Efficient Smart Home Lighting: Energy-efficient brightness adjustment based on ambient light and movement detection (Teamwork-Leader)</i>	
Supervisor: Prof. Iman Sharifi	
<b>Computational Intelligence</b>	Nov 2020 – Dec 2020
<i>Fuzzy Logic Control of a three-link gymnastic robot (Teamwork-Leader)</i>	
<i>Adaptive cruise control of an autonomous vehicle based on self-tuning fuzzy PID control</i>	
<i>System identification of robot manipulator using neural networks</i>	
Supervisor: Prof. Farzaneh Abdollahi	

## Languages

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

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

## Skills

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- **Programming:** MATLAB (Script, Simulink, Stateflow, Simscape), C, C++, Python, 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,  $\text{\LaTeX}$

## Voluntary Experience

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### 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

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### • Related Courses in M.Sc.

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

### • Related Courses in B.Sc.

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

### • Coursera

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

### • Others

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

## References

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### **Fariborz Saghafi**

Associate Professor  
Department of Aerospace Engineering  
Sharif University of Technology  
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Department of Aerospace Engineering  
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### **Farzaneh Abdollahi**

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