

# 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

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

## 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–Present
<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: Fault-Tolerant Adaptive Intelligent 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>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>• Designed and implemented flight management, waypoint following and control algorithms 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>	
<b>Embedded Software Engineer (Part-time)</b> <i>Avionics Office, ARC Aerosystems Ltd.</i>	<b>Tehran, Iran</b> Oct 2021 – Sep 2022
Contributed as a junior Embedded Software Engineer in an air taxi development co. <ul style="list-style-type: none"><li>• Conducted a comprehensive survey of basic standards for the design, development, and manufacturing of aircraft Flight Control Computer (FCC)</li><li>• 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)</li><li>• Implemented C code on the FCC hardware with TI C2000 microcontroller</li><li>• Setting up embedded systems communication protocols</li><li>• Created an intuitive GUI for eVTOL aircraft simulation using MATLAB app designer</li></ul>	

## Engineering Intern

Avionics Office, ARC Aerosystems 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 composite learning in the presence of uncertainties (in progress)
2. **Shahrajabian, M.**, Otroushi, H., Emami, S. A. (2025). End-to-end deep reinforcement learning for minimum-time aerial manipulation in cluttered environments (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 Summer 2024

Tehran, Iran

### 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 Summer 2023

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 1<sup>st</sup> 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 3<sup>rd</sup> 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

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

Jan 2024 – Jun 2024

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

### Intelligent Control

Jan 2023 – Jun 2023

*Resilient trajectory tracking of a quadrotor based on adaptive neural model predictive control*

Supervisor: Prof. Seyyed Ali Emami

### Optimal Control Theory

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
- Control system design for a two-robot soccer game in Webots

Supervisor: Prof. Heidar Ali Talebi

### 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 and Control

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

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

Exam: IELTS test will be taken on Apr, 2025.

## Skills

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

## 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

## Notable Courses

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### • Related Courses in M.Sc.

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

### • Related Courses in B.Sc.

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

### • Coursera

- ◇ Robotics Specialization (Audited)
- ◇ Machine Learning (Certificate)
- ◇ Unsupervised Learning, Recommenders, Reinforcement Learning (Certificate)

### • Others

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

## References

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### Fariborz Saghafi

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Department of Aerospace Engineering  
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### Farzaneh Abdollahi

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