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

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

Education

Master of Science in Aerospace Engineering (Dynamics and Control) **Tehran, Iran**
Sharif University of Technology (SUT) *2022–2024*
CGPA: 19.32/20.0 (4-point scale CGPA: 4.0/4.0)

Bachelor of Science in Aerospace Engineering (Dynamics and Control) **Tehran, Iran**
Amirkabir University of Technology - Tehran Polytechnic (AUT) *2017–2022*
CGPA: 18.11/20.0 (4-point scale CGPA: 3.86/4.0 and last six semester GPA: 4.0/4.0)

Bachelor of Science in Electrical Engineering (Control Systems) **Tehran, Iran**
Amirkabir University of Technology - Tehran Polytechnic (AUT) *2017–2022*
CGPA: 17.76/20.0 (4-point scale CGPA: 3.64/4.0)

Work & Research Experiences

Graduate Research Assistant **Tehran, Iran**
Aerial Robotics Lab, Department of Aerospace Engineering, SUT *Jan 2024 – Present*
Supervisor: Prof. Fariborz Saghafi

Master's Thesis: Fault-Tolerant Adaptive Intelligent Control of an Autonomous Multi-rotor eVTOL Air Taxi

- 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

Undergraduate Research Assistant **Tehran, Iran**
Hardware-in-the-Loop Lab, Department of Aerospace Engineering, AUT *May 2021 – Sep 2022*
Supervisor: Prof. Seyed Majid Esmailifar

Bachelor's Thesis: Design and Implementation of Autopilot for Automatic Takeoff and Landing of a Quadrotor using the Model-Based Design Approach

- Modeling of quadrotor dynamics, Brushless DC motors and wind effects
- Designed and implemented flight management, waypoint following and control algorithms 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) **Tehran, Iran**
Avionics Office, ARC Aerosystems Ltd. *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 **Tehran, Iran**
Avionics Office, ARC Aerosystems Ltd. *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 **Tehran, Iran**
Optimal Control (Prof. S. H. Pourtakdoust), Department of Aerospace Engineering, SUT *Fall 2024*

Head Teaching Assistant **Tehran, Iran**
Modern Control (Prof. H. Atrianfar), Department of Electrical Engineering, AUT *Fall 2024, Fall 2023*

Graduate Teaching Assistant **Tehran, Iran**
Dynamics (Prof. F. Saghafi), Department of Aerospace Engineering, SUT *Fall 2024, Fall 2023*

Instructor **Tehran, Iran**
Advanced MATLAB and Simulink Course, Scientific Association of Mechanical Engineering, AUT *Summer 2024*

Lab Instructor **Tehran, Iran**
Linear Control Systems Lab, Department of Electrical Engineering, AUT *Spring 2024*

Graduate Teaching Assistant **Tehran, Iran**
Automatic Control (Prof. S. A. Emami), Department of Aerospace Engineering, SUT *Spring 2024*

Instructor **Tehran, Iran**
Introduction to MATLAB Course, Scientific Association of Mechanical Engineering, AUT *Spring 2024*

Instructor **Tehran, Iran**
Advanced MATLAB and Simulink Course, Scientific Association of Aerospace Engineering, AUT *Summer 2023*

Graduate Teaching Assistant **Tehran, Iran**
Automatic Control (Prof. S. M. Esmailifar), Department of Aerospace Engineering, AUT *Spring 2023*

Graduate Teaching Assistant **Tehran, Iran**
Modern Control (Prof. I. Sharifi), Department of Electrical Engineering, AUT *Fall 2022*

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

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

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

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

Skills

- **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, CIFER, 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 (3rd rank)
  - ◇ Optimal Control 1 (1st rank)
  - ◇ Optimal Control 2 (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**
  - ◇ 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

Fariborz Saghafi
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