Mahdi Shahrajabian

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

Research Interests

- Reliable Intelligent Autonomous Systems
- 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) **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: Intelligent Adaptive Fault-tolerant 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

Research Assistant **Tehran, Iran**
Innovation Center, Department of Aerospace Engineering, AUT *Jun 2023 – Dec 2023*
Supervisor: Prof. Seyed Majid Esmailifar

Shafagh: A Solar-Powered High Altitude Long Endurance UAV for Sustainable Communication Relay and Enhanced 5G Internet Connectivity Applications

- 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 **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
- 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) **Tehran, Iran**
Avionics Office, Parvaz Afraz Hava Sanat 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, Parvaz Afraz Hava Sanat 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., Emami, S. A. (2025). Resilient trajectory tracking of a quadrotor based on adaptive neural model predictive control (in progress)

Teaching Experiences

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*

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

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

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*

Skills

- **Programming:** MATLAB (Script, Simulink, Stateflow, Simscape), C, C++, Python, 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

Honors & Awards

- Ranked 1st 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 3rd 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

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.

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 I (Deterministic) (1st rank)
  - ◇ Optimal Control II (Stochastic Optimal Estimation and Control) (1st rank)
  - ◇ System Identification (1st rank)
  - ◇ Navigation and Guidance (1st rank)
  - ◇ Advanced Flight Dynamics (1st rank)
  - ◇ Modeling of Aerospace Dynamic Systems
  - ◇ Flight Simulation (1st rank)
- **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

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