Anirudh Chhabra, Ph.D. Candidate (Graduation: Summer 2025)

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Google Scholar: https://scholar.google.com/citations?user=ZQJKM1QAAAAJ&hl=en

EDUCATION

[E1]	**University of Cincinnati**, Cincinnati OH, USA	**Aug. 2020 - present**

Ph.D. Aerospace Engineering; GPA: 3.83/4
Advisor: Dr Donghoon Kim
Dissertation: *Design and Development of a Spacecraft Simulator for Hardware-In-the-Loop (HIL) Simulation of In-space Servicing, Assembly, and Manufacturing (ISAM) Missions.*

[E2]	**University of Cincinnati**, Cincinnati OH, USA	**Aug. 2019 - Aug. 2020**

M.S. Aerospace Engineering; GPA: N/A
Note: Transferred to Ph.D. program.

[E3]	**Panjab University**, Chandigarh, India	**Aug. 2014 - May. 2018**

B.Eng. Electronics and Communication Engineering; CGPA: 6.39/10
Thesis: *Handwritten Character Recognition using Artificial Neural Networks*

SKILLS SUMMARY

Hardware:	Robotic Manipulators (Quanser, KUKA, Mitsubishi PA10, Interbotix), UAVs (Quanser, Crazyflie), Hexapods, Force/Torque Sensors (ATI, ATO), Control Moment Gyroscopes (CMGs), Reaction Wheels (RWs), Motor Control (DC, BLDC), CAN Bus, Spacecraft Attitude Control, 3D Printing (FDM, SLA)
Software:	MATLAB/Simulink, ROS, Gazebo, LabVIEW, SolidWorks, Git/GitHub, Docker, LaTeX, Overleaf
Programming Languages:	Python, C/C++, Julia, JavaScript, HTML/CSS
Platforms:	Linux (Advanced), Windows, macOS, Arduino, Raspberry Pi, STM32 (Nucleo/Discovery)

WORK EXPERIENCE

[W1]	**Research Assistant**, Intelligent Autonomous Systems Research Laboratory (IASRL)	**Apr. 2025 - present**

Department of Aerospace Engineering, University of Cincinnati, Cincinnati OH, USA
Working on an Air Force Office of Scientific Research-funded project "Understanding and Addressing the Dynamic Coupling Between Robotic Arms and Base Spacecraft to Enable Challenging In-space Operations". In this project, my role is to design, construct, and operate a configurable robotic arm mechanism with variable static parameters (such as link mass, length, and inertia) on an air-bearing spacecraft simulator to assist in studying the dynamic coupling effect in space manipulator systems (SMS). Also, working on lizard-inspired robotics by implementing computer vision on high-speed camera recordings of the righting reflex in lizards.

[W2]	**Instructor**, Intelligent Robotics (AEEM 6117)	**Jan 2025 - May 2025**

Department of Aerospace Engineering, University of Cincinnati, Cincinnati OH, USA
Teaching the graduate-level course Intelligent Robotics to 48 graduate students from multiple course backgrounds. The course contents included: fundamental theory and algorithms of robot dynamics and control, intelligent control of robotic systems using Reinforcement Learning and Genetic Fuzzy Systems. Students will complete a final project on topics such as multi-robot intelligent control, decentralized control, and space-servicing robot systems.

[W3]	**Research Assistant**, Intelligent Autonomous Systems Research Laboratory (IASRL)	**Aug. 2020 - present**

Department of Aerospace Engineering, University of Cincinnati, Cincinnati OH, USA

- Designed and developed a redundant 12-DoF spacecraft simulator to represent 6-DoF spacecraft motion. Performed simulation studies to verify and validate the platform model. The proposed simulator offers the advantage of a large workspace and high accuracy by combining the advantages of both serial and parallel manipulators. Designed the Fuzzy Logic-aided Inverse Kinematics (FLIK) control technique for redundant robotic systems. Currently working on the validation of the FLIK control technique on the developed hardware-in-the-loop spacecraft simulator using ROS.

- Collaborated with other researchers to develop novel collision avoidance models for unmanned multi-agent systems, Sequential and Piecewise Adaptive Kalman Filters for application to UWB-based positioning systems, spacecraft simulator systems based on RWs and CMGs, and advanced motion control algorithms.
- Have worked on multiple funded projects from government agencies such as the Air Force Office of Scientific Research (AFOSR) and National Science Foundation (NSF) and private startups including Gimbal Innovations LLC and Applied Gyro LLC. These roles involved working on prototype development of novel technologies (subject to NDA, no further details available).

[W4] **Instructor**, Intelligent Robotics (AEEM 6117)   **May 2024 - Aug. 2024**
Department of Aerospace Engineering, University of Cincinnati, Cincinnati OH, USA
Taught the graduate-level course Intelligent Robotics to MEng (Online) students. The course contents included: fundamental theory and algorithms of robot dynamics and control, intelligent control of robotic systems using Reinforcement Learning, and Genetic Fuzzy Systems. Students completed a final project regarding multi-robot intelligent control. Received highly positive feedback (4.58 on 5-Point Likert Scale) and a few students ended up joining research groups in this area getting project inspirations from the course. One graduate student joined our research group to produce novel approaches for controlling robotic arms in space using Reinforcement Learning techniques. *As a result of positive feedback, I was requested to teach this course again in Spring 2025.*

[W5] **Teaching Assistant**, Modeling and Simulation of Dynamical Systems (AEEM 3022)   **Jan 2024 - May 2024**
Department of Aerospace Engineering, University of Cincinnati, Cincinnati OH, USA
Delivering lectures on using MATLAB/Simulink for modeling and simulation of dynamical systems, organizing doubt sessions for students, preparing the assignments/examinations, and performing grading duties.

[W6] **Teaching Assistant**, Dynamics (AEEM 2032)   **May 2022 - Aug. 2022**
Department of Aerospace Engineering, University of Cincinnati, Cincinnati OH, USA
Organized doubt sessions for students, helped prepare the examinations, performed grading duties and independently delivered lectures.

[W7] **Teaching Assistant**, Space Flight Dynamics (AEEM 5062)   **Aug. 2021 - Dec. 2021**
Department of Aerospace Engineering, University of Cincinnati, Cincinnati OH, USA
Organized doubt sessions for students, helped prepare the examinations, and performed grading duties.

[W8] **Graduate Research Assistant**, NSF Research Experiences for Teachers   **Jun. 2021 - Jul. 2021**
Department of Aerospace Engineering, University of Cincinnati, Cincinnati OH, USA
Provided an exhaustive research experience to K-12 teachers by advising them on the development of positioning systems using UWB sensors. The project was overseen by Dr. Donghoon Kim and Dr. Rajnikant Sharma.

[W9] **Research and Engineering Intern**   **Sep. 2018 - Jan. 2019**
Sensebird Solutions Pvt. Ltd., Noida, Uttar Pradesh, India
Contributed as an author to the development of "Technical Report on UAS Airspace Management" submitted to the Ministry of Civil Aviation, Government of India.

[W10] **I.T. Intern**   **Jun. 2017**
National Collateral Management Services Limited, Gurgaon, Haryana, India
Worked towards the development of web/mobile applications and administration of RHEL-based servers.

OTHER PROFESSIONAL EXPERIENCE

[O1] **Student Mentoring**   **2020-present**
Have mentored 12 undergrad students and 3 grad students towards their senior design and capstone projects (funded and non-funded) over the last 4 years. Helped some students secure the Undergraduate Research Fellowship award or the Undergraduate Co-op Research Fellowship from UC. Some of these projects were also funded through the NASA OSGC grant. I also guided the students in publishing posters and giving symposium presentations.

[O2] **Peer-Reviewer, Nature Scientific Reports**   **2024**
Peer-reviewed two journal papers published in the Scientific Reports journal by Nature in 2024.

[O3] **Invited Talk**   **2024**
A seminar for high school students about active space-based research in the department. This was organized by the UC Clermont Upward Bound Team.

[O4] **Peer-Reviewer, Springer Journal of Supercomputing**   **2023**
Peer-reviewed one journal paper published in the Springer Journal of Supercomputing in 2023.

[O5] **Peer-Reviewer, Robotica** 2023
Peer-reviewed multiple journal papers published in the Robotica journal in 2023.

[O6] **Guest Lecture** 2023
Lecture given on the topic "Applications of Modeling and Simulation Techniques" for the course AEEM 3022: Modeling and Estimation of Dynamical Systems in the Department of Aerospace Engineering at the University of Cincinnati.

[O7] **Sub-Reviewer, North American Fuzzy Information Processing Society (NAFIPS)** 2022
Invited as a sub-reviewer for 3 papers submitted to the NAFIPS conference held in 2022.

[O8] **Guest Lecture** 2021
Lecture given on the topic "Spacecraft Attitude Determination and Control with Disturbances" for the course AEEM 6036: Spacecraft Dynamics in the Department of Aerospace Engineering at the University of Cincinnati.

[O9] **Session Chair** 2021
Served as the Session Chair for 'Session 28: Robotics, Autonomy, and AI' at the 2021 AAS/AIAA Astrodynamics Specialist Conference.

[O10] **Invited Talk** 2021
A seminar for incoming graduate students about active research in the department at an event organized by the Graduate Student Association (GSA), University of Cincinnati.

Volunteer Experience

[V1] **Director of Programs** **Aug. 2024 - present**
TedX UCincinnati, University of Cincinnati

[V2] **President** **Sep. 2022 - Feb. 2023**
Indian Student Association, University of Cincinnati

[V3] **Vice President** **Sep. 2021 - Sep. 2022**
Indian Student Association, University of Cincinnati

[V4] **Member, Attitude Dynamics and Control System Team for CubeSats** **Aug. 2021 - Aug. 2022**
UC CubeCats, University of Cincinnati

Awards

[A1] **Graduate Student Engineer of the Month, March 2023**
College of Engineering and Applied Science (CEAS), University of Cincinnati

[A2] **GSG Research Fellowship Award 2022**
Graduate Student Government (GSG), University of Cincinnati

[A3] **SRIDE Fellowship for Exploration 2021-2022**
Armstrong Institute for Space, Technology, and Research (ASTRO) – Formerly Space Research Institute for Discovery and Exploration (SRIDE), University of Cincinnati

[A4] **IRiS Graduate Research Fellow 2021-2022**
Institute for Research in Sensing (IRiS), University of Cincinnati – In partnership with the Environmental Protection Agency (EPA)

Publications

Journals

[J1] **A. Chhabra** and D. Kim, "Hardware-in-the-loop Simulation for In-Space Servicing: Design, Implementation, and Validation," *IEEE Aerospace and Electronic Systems Magazine*, Mar. 2025. (Under Review)

[J2] **A. Chhabra** and D. Kim, "Ground Robotic Platform for Simulation of On-Orbit Servicing Missions," *AIAA Journal of Aerospace Information Systems*, Vol. 19, No. 7, pp. 480-493, Jul. 2022.

[J3] **A. Chhabra**, J.R. Venepally and D. Kim, "Measurement Noise Covariance-Adapting Kalman Filters for Varying Sensor Noise Situations," *MDPI Sensors*, 21(24):8304, Dec. 2021.

[J4] D. Choi, **A. Chhabra**, D. Kim, "Intelligent Collision Avoidance Approach Using Fuzzy Potential Fields," *Robotica*, 40(6), pp. 1919-1938, Oct. 2021.

Conferences/Book Chapters/Symposiums

[C1] **A. Chhabra**, G. Das, D. Quevedo, D. Choi, and D. Kim, "Development of a Reconfigurable Space Manipulator Testbed for Dynamic Coupling Analysis," *IEEE National Aerospace & Electronics Conference (NAECON)*, Dayton, OH, Jul. 28-31, 2025.

[C2] **A. Chhabra** and D. Kim, "Hardware-in-the-loop Simulation for In-Space Servicing: Design, Implementation, and Validation," *National Security Research Symposium*, Cincinnati, OH, May 1, 2025. (**First Prize in Poster Competition, Space Category**)

[C3] **A. Chhabra**, A. Borger, and D. Kim, " A Modular Robotic Testbed for In-Space Mission Simulation," *50th Dayton-Cincinnati Aerospace Sciences Symposium*, Dayton, OH, Mar. 4, 2025.

[C4] **A. Chhabra**, A. Borger, and D. Kim, "Advancing Simulation for In-Space Missions with a 12 Degrees-of-Freedom Robotic Testbed," *2025 AAS/AIAA Space Flight Mechanics Meeting*, Kaua'i, HI, Jan. 19-23, 2025.

[C5] K. Wen, **A. Chhabra**, and D. Kim, "Application of Reinforcement Learning in High-Degree-of-Freedom Robotic Arms for Space Operations," *John Glenn Memorial Symposium*, Cleveland, OH, Jul. 15-17, 2024.

[C6] S. Kraine, **A. Chhabra**, and D. Kim, "Simulating Martian Environments for Testing of Localization Algorithms," *49th Dayton-Cincinnati Aerospace Sciences Symposium*, Dayton, OH, Mar. 5, 2024.

[C7] K. Wen, **A. Chhabra**, and D. Kim, "Application of Reinforcement Learning in High-Degree-of-Freedom Robotic Arms in Space," *49th Dayton-Cincinnati Aerospace Sciences Symposium*, Dayton, OH, Mar. 5, 2024.

[C8] **A. Chhabra** and D. Kim, "Intelligent Control for Robotic Spacecraft Simulator with Kinematic Redundancy," *49th Dayton-Cincinnati Aerospace Sciences Symposium*, Dayton, OH, Mar. 5, 2024. (**Best Presentation Award**)

[C9] D. Choi, **A. Chhabra**, and D. Kim, "Fuzzy Inference System-applied Spacecraft Control for Final Approach of Rendezvous Process," *2023 23rd International Conference on Control, Automation and Systems (ICCAS)*, Yeosu, Republic of Korea, Oct. 17-20, 2023.

[C10] **A. Chhabra** and D. Kim, "Development of a 12 Degrees-of-Freedom Robotic Testbed for Experimental Analysis of In-Space Missions," *2023 AAS/AIAA Astrodynamics Specialist Conference*, Big Sky, MT, Aug. 13-17 2023.

[C11] **A. Chhabra**, S. Karthikeyan, D. Choi, and D. Kim, "Fuzzy Logic-aided Inverse Kinematics Control for Redundant Manipulators," *North American Fuzzy Information Processing Society*, Cincinnati, OH, May 31- Jun. 2, 2023. (**Outstanding Student Paper Award**)

[C12] S. K. Sampathkumar, **A. Chhabra**, D. Choi, and D. Kim, "Optimization of Artificial Potential Field using Genetic Algorithm for Human-aware Navigation of Autonomous Mobile Robots," *North American Fuzzy Information Processing Society*, Cincinnati, OH, May 31- Jun. 2, 2023. (**Best Student Paper Award**)

[C13] **A. Chhabra** and D. Kim, "Design and Development of a Hardware-In-the-Loop (HIL) Spacecraft Simulator," *48th Dayton-Cincinnati Aerospace Sciences*, Dayton, OH, Feb. 28, 2023.

[C14] S. Karthikeyan, **A. Chhabra**, D. Choi, and D. Kim, "Interpretable AI-based control for tumbling satellite capture," *48th Dayton-Cincinnati Aerospace Sciences*, Dayton, OH, Feb. 28, 2023.

[C15] S. Karthikeyan, **A. Chhabra**, D. Choi, and D. Kim, "Fuzzy-Aided Closed-Loop Inverse Kinematics Control for Capturing a Tumbling Satellite," *33rd AAS/AIAA Space Flight Mechanics Meeting*, Austin, Texas, Jan. 15-19, 2023.

[C16] D. Choi, **A. Chhabra** and D. Kim, "Collision Avoidance of Unmanned Aerial Vehicles Using Fuzzy Inference System-Aided Enhanced Potential Field," *AIAA SciTech Forum*, San Diego, CA, Jan. 3-7 2022.

[C17] D. Choi, **A. Chhabra**, and D. Kim, "Genetic Algorithm-Aided Fuzzy Controller for Spacecraft Attitude Maneuver with Uncertainties," *AIAA ASCEND*, Las Vegas, USA, Nov. 15-17, 2021.

[C18] **A. Chhabra**, D. Choi, and D. Kim, "Decentralized Collision Avoidance via Fuzzy Potential Field," *IEEE National Aerospace and Electronics Conference (NAECON)*, Dayton, OH, Aug. 16-19 2021. (Virtual)

[C19] **A. Chhabra** and D. Kim, "A Unique Ground Simulator for On-Orbit Service Mission Emulation," *2021 AAS/AIAA Astrodynamics Specialist Conference*, Big Sky, MT, Aug. 9-11 2021. (Virtual)

[C20] **A. Chhabra** and D. Kim, "A Unique Robotic Platform for On-orbit Servicing Simulations," *46th Dayton-Cincinnati Aerospace Sciences Symposium*, Dayton, OH, Mar. 2, 2021. (Virtual)

[C21] J. Venepally, **A. Chhabra**, and D. Kim, "Modified Kalman Filter Algorithms for Varying Sensor Noise Situations," *46th Dayton-Cincinnati Aerospace Sciences Symposium*, Dayton, OH, Mar. 2, 2021. **(Best Presentation Award)**

[C22] **A. Chhabra**, D. Patel, X. Li, L. Pickering, J. Viana, and K. Cohen, "Understanding the Effects of Human Factors on the Spread of COVID-19 using a Neural Network," *2020 7th International Conference on Soft Computing and Machine Intelligence*, Sweden, Stockholm, Nov. 14-15, 2020. (Virtual)

[C23] L. Pickering, J. Viana, X. Li, **A. Chhabra**, D. Patel, and K. Cohen, "Identifying Factors in COVID - 19 AI Case Predictions," *2020 7th International Conference on Soft Computing and Machine Intelligence*, Sweden, Stockholm, Nov. 14-15, 2020. (Virtual)

[C24] **A. Chhabra**, D. Kim, K. Cohen, "Enhanced Cascaded Genetic Fuzzy System for Counterfeit Banknote Authentication", *North American Fuzzy Information Processing Society*, Seattle, WA, Aug. 20-22, 2020. (Virtual)

[C25] **A. Chhabra**, D. Choi, D. Kim, K. Cohen, "An Explainable AI-based Collision Avoidance Model for UAVs," *Dayton-Cincinnati Aerospace Sciences Symposium*, Dayton, OH, Mar. 3, 2020.