

# MOHAMED KHALID M JAFFAR

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## SUMMARY

**Robotics and autonomy** researcher with a decade of experience across diverse platforms, including ground, aerial, and legged robots, UAVs, and rockets. Expertise in motion planning, control, optimization, and learning-based methods for **safety-critical autonomous systems**, translating theory into real-world deployments. Focused on advancing reliable, intelligent autonomy through rigorous research and system-level integration.

## EDUCATION

<b>University of Maryland, College Park, USA</b> <i>Doctor of Philosophy (PhD) in Aerospace Engineering</i>	<b>Expected May 2026</b> <b>GPA: 3.62/4</b>
<b>Indian Institute of Technology Madras, India</b> <i>Dual Degree (B.Tech &amp; M.Tech) in Aerospace Engineering</i> <i>Minor in Robotics</i>	<b>2013 – 2018</b> <i>Class Rank 1</i> <b>GPA: 9.06/10</b>

## SKILLS AND EXPERTISE

- **Core Expertise:** Robot Autonomy, Motion Planning and Control, Optimization, Applied Mathematics, State Estimation, Machine Learning (ML), and Vision-Language Models (VLMs)
- **Programming Languages:** C++, Python, Object-Oriented MATLAB, C
- **Tools and Software:** ROS, Simulink, YALMIP, CasADi, CVXPY, gurobipy, PyTorch, SolidWorks

## AWARDS AND HONORS

- Ann G. Wylie **Dissertation Fellowship** for pursuing *semester-long* academic research (Fall 2024)
- **Dean's Fellowship** from the University of Maryland, College Park (2019)
- **Gold Medalist for best overall academic record** in Dual Degree Aerospace Engineering (2018)
- **NTU-India Connect Scholarship** from NTU, Singapore; *1 among 20 students from India* (2016)

## RELEVANT EXPERIENCE

<b>Research Scientist Intern</b>   Mitsubishi Electric Research Labs (MERL) <i>Project: Adaptive spatio-temporal monitoring using constrained mobile robots</i>	<b>2025–present</b>
<ul style="list-style-type: none"><li>• Developed a heterogeneous multi-agent environmental monitoring system using <b>12+</b> aerial and ground vehicles that coordinate under kinematic, collision-avoidance, and battery constraints</li><li>• Implemented data-driven adaptation via Gaussian process-based uncertainty quantification and centralized multi-agent route planning using integer programming</li></ul>	
<b>Graduate Research Assistant</b>   Motion and Teaming Lab, University of Maryland <i>PhD Thesis: Safe feedback motion re-planning of mobile robots in dynamic spaces</i>	<b>2018–25</b>
<ul style="list-style-type: none"><li>• Designed and implemented real-time kinodynamic replanning algorithms that provide formal safety guarantees for mobile robots in dynamic environments, achieving replanning speeds of <b>50+ Hz</b></li><li>• Released <code>computeSOSFunnel</code>s, a MATLAB toolbox for invariant reachable set synthesis across 4 robot platforms</li><li>• Developed fault-tolerant control strategies for multirotor aerial vehicles with <b>up to 3</b> complete rotor failures</li></ul>	
<b>Summer Scholar</b>   U.S. Army Research Lab & GAMMA Lab, University of Maryland <i>Project: Long-range navigation of legged robots in outdoor terrain</i>	<b>Summer 2024</b>
<ul style="list-style-type: none"><li>• Ran field experiments of quadruped autonomous navigation in unmapped forests with trees, tall grass, and mud</li><li>• Implemented robot gait adaptation for uneven terrain traversal using multimodal sensor fusion of vision-based perception (VLMs) and proprioceptive feedback from inertial sensors</li></ul>	

**Master's Research** | RAFT Lab & Robotics Lab, IIT Madras

2017–18

*Thesis: Maneuver control of quadrotors in indoor spaces*

- Developed onboard model-based control for aggressive maneuvers of quadrotors in tight indoor spaces
- Synthesized and compared the performance of 4 different nonlinear controllers: backstepping, PI-PID, SMC
- Conducted **70+ hours** of hardware tests for system identification and evaluation of the multiple control strategies

**Autonomy Lead** | Team Noctua, DeTect Technologies | Tech startup

2015–17

*Product: Aerial robot operations for infrastructure inspection in oil and gas industrial plants*

- Founding-stage member of a seed-funded startup, leading technology development and operations; company currently valued at **\$138M (Series B)**
- Developed localization and control algorithms for aerial robots to autonomously inspect pipelines and chimneys in petrochemical plants, reducing inspection time by **80%** compared to manual methods

**Undergraduate Research Intern** | IIT Madras & Defense R&D Organisation (DRDO)

Fall 2015

*Project: Autonomous target-tracking unmanned aerial vehicle (UAV)*

- Mathematically modeled a multirotor UAV system in MATLAB; implemented guidance and control strategies for a VTOL hexacopter to generate and track reference trajectories with **0.2 m accuracy**

## APPLIED PROJECT EXPERIENCE

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**Systems Lead** | Airbrake subteam, Terrapin Rocket team | Spaceport America Cup

2021–24

*Awards: Placed **2nd in category** in 2023 and **overall 1st** in 2024, out of **150 teams globally***

- Led a 6-student team across two years, developing electro-mechanical modules of deployable braking flaps
- Implemented an MPC and EKF-based control stack in C++ for real-time rocket altitude regulation, reducing apogee error from **2000 ft to 70 ft**

**Independent Research** | Innovative Projects Scheme | IC&SR, IIT Madras

Fall 2017

*Project: Autopilot flight controller board for multirotor UAVs*

- Designed and fabricated a custom embedded autopilot board for real-time flight stabilization, achieving **<10 ms** end-to-end control latency through RTOS and assembly-level programming

## SELECTED PUBLICATIONS

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### Journal and Peer-Reviewed Conference Articles

- **M.K.M Jaffar**, S. Di Cairano, A. Vinod. "Adaptive spatio-temporal monitoring using constrained mobile robots." *Conference on Decision and Control* (under review)
- **M.K.M Jaffar** and M. Otte. "Online feedback motion re-planning in dynamic spaces using invariant funnels." *International Journal of Robotics Research* (preprint)
- **M.K.M Jaffar** and M. Otte. "PiP-X: Funnel-based online feedback motion planning/replanning in dynamic environments." *Algorithmic Foundations of Robotics (2022)* [**best paper consideration**]

### Open-source Software Releases

- **M.K.M Jaffar**. "computeSOSFunnelS: A MATLAB framework for invariant funnel synthesis using sum-of-squares optimization." *v1.0.0 - GitHub (2025)*

15+ peer-reviewed publications. A complete list is available on my **Google Scholar** profile.

## PROFESSIONAL SERVICE AND LEADERSHIP

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- **Head Instructor, CAD Lab:** Taught 150+ undergraduate students core computer-aided design concepts through hands-on SolidWorks training; managed and supervised 4 teaching fellows at UMD College Park **Spring 2025**
- **Academic and Professional Chair** of Graduate Student Advisory Committee (GSAC), Aerospace Department, UMD College Park **2021–22**
- **Strategist and Mentor** for student teams in **Robotics, Electronics, and Aero Clubs** at the Centre for Innovation (CFI), IIT Madras **2016–18**