Ayaz Ahmed

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SUMMARY

- 5 years of industry experience in design, development and control laws for complex high precision hardware and software systems in a highly collaborative environment, utilizing strong technical and communication skills.
- Proficient in writing efficient codes in MATLAB, Python, C++ for high-fidelity modelling and validation with a strong foundation in various classical and modern control and analysis techniques.

EDUCATION

University of Washington, Seattle. Master of Science in Aeronautics and Astronautics (Controls), 2025(Expected)
GPA – 3.98, Courses – Network System Dynamics, Non-Linear Control Systems, Linear System Theory, Stability Control of Flight Vehicles.

Indian Institute of Space Science and Technology, India. Bachelor of Technology, Aerospace Engineering, 2018
GPA –9/10, Courses – Control Systems, Robotics, Atmospheric, Space Flight Mechanics, Linear Algebra, Multi-Disciplinary Optimization.

PROFESSIONAL EXPERIENCE

Robotics Researcher Assistant, *RAIN Lab, University of Washington* January 2024 – Present

- Modelled the dynamics of actuation and unfolding of an origami structure, using bar and hinges model, reaching **over 95% accuracy** compared to literature data.
- Realized an optimization-based setup utilizing **genetic algorithm** to design origami structures based on **inverse kinematics** to accomplish desired trajectory to **over 80% accuracy**.
- Designed control laws for the optimum deployment of the origami structure, **improving operational efficiency by 25%.**

Engineer, *Indian Space Research Organization (ISRO), India* August 2018 – August 2023

- Led a cross-functional team to develop a Mach 6-capable Dynamic Damping test setup for a wind tunnel system, delivering a vision-based state estimation package in **MATLAB** with **<0.1° resolution.**
- Designed and implemented a **robust and precise control system** to excite models in a wind tunnel test for dynamic simulation, achieving less than **0.5° error** in reference trajectory tracking.
- Collaborated on a **C++ based spacecraft orbit propagation tool** by modelling multiple perturbation sources and using adaptive time-stepping integration, achieving 30m/day error growth and **99.9% accuracy compared to NASA's GMAT**.
- Estimated aerodynamic coefficients utilizing **state estimation and sensor fusion** techniques, for a test article in free fall, instrumented with Pixhawk based IMU and GPS sensors, with over **99% accuracy** compared to wind tunnel data
- Mentored three interns on complex engineering projects, offering technical guidance, detailed feedback, and thorough reviews of their work and reports, ensuring alignment with project goals and industry standards.

PROJECTS

Simulink Flight Simulator

- Developed a flight simulator in **MATLAB/Simulink, integrated with Flight Gear** software package for realistic visualization and added the functionality to accept user inputs from an Xbox controller with controller tuning.
- Derived and Implemented **6-DoF Non-linear model** of a twin-engine aircraft, with 12 states and 5 control inputs.
- Implemented an automated trimming module capable of trimming the aircraft in less than 3 seconds and verified its robustness under one-engine-out condition.

High Fidelity Simulation of a drone delivery system with UAV Traffic Management System

- Built a full-stack, parallel simulation of a swarm of fixed-wing delivery drones in **Python**, incorporating **Unreal Engine 5.4** for real-time visualization.
- Modeled the dynamics of aircraft, weather, sensors, actuators, battery, and thermal systems and **verified in Simulink**.
- Designed and implemented a control system based on **successive loop closure** for aircraft autopilot system, attaining a less than **5% steady-state error**.
- Implemented a **sensor fusion** algorithm utilizing data from 6 different asynchronous sensors, achieving **99% accuracy.**

Quantitative analysis of autonomous waypoints following algorithms for self-driving vehicles.

- Implemented and compared the performance of Pure Pursuit (PP) and **Model Predictive Controller (MPC)** based algorithms for waypoint tracking in **CARLA** simulation using **Python APIs**.
- Developed and implemented fast waypoint generation tools using **A* algorithm** for shortest path graph search.
- PP provided an average tracking RMSE of 0.5m at low speeds but underwent oscillations at higher speeds; designed a **lookahead distance-based algorithm** to improve tracking at higher speeds.
- MPC demonstrated robust tracking and stability at all speeds with an **average tracking RMSE of 0.15m.**

SKILLS

Programming - C++, Python, Julia, MATLAB, Git, Linux; **Simulation tools** – Simulink, Unreal Engine, Microsoft Airsim, CARLA; **CAD tools** – SolidWorks, CATIA, Inventor; **Mechatronics/Robotics** – LabView, Arduino, Raspberry Pi, Pixhawk, Microcontrollers.

Modelling and simulation – Kinematics and dynamics, Actuator dynamics, Sensor dynamics, First Principal Analysis
Control system design – MPC, LQR, PID, Loop Closure, Loop Shaping, Data- driven controls, Frequency domain analysis