

# Harsh Modi

Mechanical Design, Prototyping, Autonomous Aerial Systems  
PhD Candidate, Texas A&M University

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## ENGINEERING FOCUS

- Hands-on mechanical design, rapid prototyping, electro-mechanical testing, and failure analysis for flight-critical robotic systems.

## EDUCATION

Texas A&M University, College Station, TX | PhD in Mechanical Engineering (Robotics) | GPA: 4.0/4.0 [Dec 2026]  
Thesis: Improving Robustness, Reachability and Trajectory Planning of Aerial Robots

IIT Bombay, Mumbai, India | MS in Mechanical Engineering | GPA: 9.85/10.0 [Aug 2022]  
Thesis: Design and development of multirotor aerial robotic platform

IIT Gandhinagar, Gandhinagar, India | BS in Mechanical Engineering | GPA: 9.05/10.0 [Aug 2018]

## SKILLS

|                     |   |
|---------------------|---|
| Programming         | : Python, C++, Embedded C, MATLAB/Simulink, ROS1 & ROS2, GIT  |
| Hardware & Test     | : LiDAR, Pixhawk, Mechatronics Assembly, Design for Manufacturing, Oscilloscope, Multimeter, Raspberry Pi, Arduino, serial communication (UART, I2C, CAN) |
| Simulation & Design | : Solidworks, Gazebo, Motion Planning, Control System Modeling, Reinforcement Learning  |
| Power & Electronics | : Li-Polymer batteries, ESCs, power distribution, current/voltage sensing, safety and failsafes   |

## MECHANICAL & ROBOTIC SYSTEMS EXPERIENCE

**Control and Robotics Lab, Texas A&M University / University at Buffalo** [Aug 2022 –present]

- Designed and developed a novel **(6+1) DOF Quadrotor** (MorphoCopter) that can **transform mid-flight** into a very narrow configuration (**from 450 mm to 150 mm width**) via a single servo-actuated joint, applied for a patent for the design.
- Conducted repeated mechanical and system-level tests to evaluate durability, transformation repeatability, and performance under environmental disturbances.
- During the development of the MorphoCopter, utilized tools such as CAD, designed and tested electric propulsion subsystems including BLDC motors, ESCs, propellers, and Li-polymer batteries; evaluated thrust, efficiency, thermal limits, and power draw under varying flight conditions.
- Designed and built custom motor thrust test fixtures to analyze performance of various motor-propeller combinations.
- Designed Gazebo-based simulation and hardware test workflows to validate controllers, replicate failure modes, and reduce risk prior to flight testing.
- Developed motion planning algorithms to exploit the vehicle's folding mechanism, informing mechanical design tradeoffs and operational constraints.
- Developed and implemented a new ILC+DOB framework on multiple heterogeneous quadrotor UAVs for estimating wind disturbances: Improved estimation accuracy by around **88%** compared to the standard methods.

**Intelligent Dynamical Ubiquitous Systems Lab, IIT Bombay, India**

[Dec 2020-Jun 2022]

- Implemented a robust PID based controller with failsafe algorithms using ROS for precise trajectory tracking of the aerial robotic platform (i.e. quadrotor).
- Designed and implemented algorithm to control the oscillations of an unactuated pendulum on the UAV.
- Created an algorithm to gradually store the kinetic energy in the pendulum by increasing the oscillations and hit a ball so that it passes through a target hoop; Achieved **90% repeatability**.
- Documented design decisions, test procedures, and experimental results for use by collaborators and future team members.

## School of Mechanical and Aerospace Engineering, NTU Singapore

[May 2017-Jul 2017]

- Designed a mechanism to precisely control the attitude and to enable the transition between hover mode and fixed-wing mode of the Vertical Takeoff and Landing fixed-wing UAV.
- Performed structural sizing and stress analysis (ANSYS) to meet strength and stiffness requirements under flight loads.
- Iterated designs based on analysis and testing feedback to simplify mechanisms and improve reliability.
- Manufactured the final mechanism leveraging additive manufacturing and assembled the bicopter components such as Pixhawk flight controller, ESC, BLDC Motors and performed tests to evaluate the roll/pitch/yaw control.

## Trailing Edge Flap Mechanism

[Jan 2021 – Apr 2021]

- Accurately modeled the trailing edge flap mechanism (fowler flaps) of Airbus A320 in SolidWorks using the technical drawings in literature.
- Simulated and analyzed the motion for required torques in ADAMS with various motor speeds for various flap levels.
- Determined critical potential failure operating regimes and suggested improvements in the design.

## INDUSTRIAL EXPERIENCE

### Tata Motors Ltd. – Commercial Vehicle Business Unit, Pune, India

[Aug 2018-Aug 2020]

Senior Manager; “Advance Quality – Purchase & Supplier Quality”

- Led engineering qualification and production validation of **150+ automotive components** for BS VI emission rollout.
- Conducted design-for-manufacturing reviews, PPAP audits, and supplier quality verifications ensuring adherence to ISO standards.
- Coordinated with cross-functional R&D and testing teams to deliver safety-critical components under strict timelines.

## RELEVANT PATENTS & PUBLICATIONS

- Harsh Modi, Minghui Zheng, “TRANSFORMABLE MULTICOPTERS”, **US Provisional Patent** Application No 63798376, Filed on May 1, 2025.
- H. Modi, H. Su, X. Liang and M. Zheng, "MorphoCopter: Design, Modeling, and Control of a New Transformable Quad-Bi Copter," in **IEEE/ASME Transactions on Mechatronics**, doi: 10.1109/TMECH.2025.3643609H.
- Modi, Z. Chen, X. Liang and M. Zheng, "Improving Disturbance Estimation and Suppression via Learning Among Systems With Mismatched Dynamics," in **IEEE Robotics and Automation Letters**, vol. 9, no. 6, pp. 5238-5245, June 2024, doi: 10.1109/LRA.2024.3391026. Also presented at ICRA 2025, Atlanta, Georgia.
- Harsh Modi, Mohammad R Hajidavalloo, Zhaojian Li, Minghui Zheng: “Robust Iterative Learning for Collaborative Road Profile Estimation and Active Suspension Control in Connected Vehicles”; **Modeling, Estimation and Control Conference**, Chicago 2024, doi: 10.1016/j.ifacol.2024.12.040.

## EXPERIMENT VIDEOS

- Transformable Quad-Bi Copter: <https://www.youtube.com/watch?v=-Cgr8RbE3Ko> (Experiments from 2:16)
- Creating impact energy by oscillations with drone pendulum: <https://youtu.be/NHGj9HEucaE?feature=shared>
- Mitigating wind disturbance: [https://harsh-modi.com/images/ILCDOB\\_v3f.mp4](https://harsh-modi.com/images/ILCDOB_v3f.mp4) (Experiments from 2:05)

## AVAILABILITY

- **Summer 2026:** Available for full time **internship** anywhere in USA
- **January 2027:** Available for full time **job** anywhere in USA