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.

DRONE 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 (Experiments from 2:05)

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
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]
(Skills Used: Solidworks, ANSYS, QGroundControl, MATLAB)

- 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.

Designing 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.

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, M. Zheng, “MorphoCopter(4-2): Design, Modeling, and Control of a Transformable Quad-Bi Copter.” Accepted and under production at IEEE/ASME Transactions on Mechatronics. Preprint available at: arXiv:2506.07204
- H. 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.

AVAILABILITY

- Available for full-time, onsite Summer 2026 internship.