Mehul Menon

Pittsburgh, PA | mehulm@andrew.cmu.edu | linkedin.com/in/mehul-menon-9191141b3/ | sites.google.com/view/mehulmenon

Education

Carnegie Mellon University Aug 2025 — Present
M.S. in Robotics, GPA 4.00/4.00, Advisors: Prof. Changliu Liu and Prof. Jiaoyang Li *Pittsburgh, PA*
- Coursework: Human-Robot Interaction, Embodied AI Safety, Multi-Robot Planning and Coordination, Advanced Controls, Fundamentals of Computer Vision

National Institute of Technology, Durgapur Aug 2020 — Jul 2024
B.Tech. in Mechanical Engineering, GPA 8.95/10.0 *Durgapur, India*
- Coursework: Control Systems, Signal Processing, Additive Manufacturing, Soft Computing Techniques

St. Xavier's Collegiate School Apr 2013 — Jul 2020
High School Diploma (Physics, Mathematics, Chemistry, Computer Science), ISC 97% / ICSE 96% *Kolkata, India*

Skills

- **Programming**: Python, C++, C, MATLAB, LaTeX, Arduino
- **Machine Learning**: PyTorch, JAX/Flax, TensorFlow/Keras, Stable-Baselines3, NumPy, Gymnasium, Weights & Biases, Qiskit/Cirq
- **Robotics and Simulation**: ROS/ROS2, MoveIt, Gazebo, RViz, MuJoCo/MJX, Isaac Gym, PyBullet, robosuite/LIBERO, Simulink
- **Optimization and Engineering Tools**: Gurobi, pybind11, Git, SolidWorks, ABAQUS, LabVIEW
- **Methods**: Reinforcement Learning, Imitation Learning (DAgger), Graph Neural Networks, Transformers, Conformal Prediction, Task and Multi-Robot Planning, MPPI, Sliding Mode Control

Publications

* denotes equal contribution

Calibrated Clarification: A Computational Maxim of Quantity for Grounding Under-Specified Human Intent Oct 2026
Mehul Menon, Ruixuan Liu, Philip Huang, Jiaoyang Li, Changliu Liu **Presented**
- IROS 2026 Workshop on Human-Robot Dialogue

Deep Learning-Based Classification of Lubricating Oils Using Ultrasonic Waveguide Sensors July 2026
Mehul Menon, Akhil Balachandran, Krishnan Balasubramaniam **Presented**
- Machinery Failure Prevention Technology Conference (MFPT) 2026

Design, Modelling, and Experimental Validation of a Soft Continuum Wrist Section Developed for a Prosthetic Hand June 2024
Shifa Sulaiman, ***Mehul Menon***, Francesco Schetter, Fanny Ficuciello **Published**
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2024 — doi:10.1109/IROS58592.2024.10802467

Adaptive Sliding Mode Control Law Based on Super Twisting Algorithm for Trajectory Tracking of Quadrotors July 2024
Biswapratim Roy, ***Mehul Menon***, Aritro Dey, Jayati Dey **Published**
- International Journal of Automation and Control (IJAAC), Inderscience — doi:10.1504/ijaac.2025.10066500

Manuscripts Under Review

Latent Strategies for Ad-Hoc Human-Robot Teaming in Overcooked-AI Sept 2026
Adrian Krieger*, Nathan Ludlow*, ***Mehul Menon***, Juee Chandrachud **Under Review**
- Conference manuscript, under review

A Hybrid Model-based and Data-based Approach Developed for a Prosthetic Hand Wrist Sept 2024
Shifa Sulaiman, Francesco Schetter, ***Mehul Menon***, Fanny Ficuciello **Under Review**

- Journal of Intelligent and Robotic Systems, Springer — arXiv:2601.08711

Manuscripts in Preparation

Details available on request.

- **Learned guidance for physically constrained assembly** — Long-horizon assembly planning that pairs a lightweight learned proposer with a physics-exact planner.
- **Grounding under-specified intent for physical builds** — Interactive clarification that commits the intended, buildable design from a handful of simple questions.
- **Statistical safety guarantees for learned legged control** — What sampled safety guarantees are good for, and how to decide which unseen maneuvers are safe.
- **Splitting large assemblies for multi-robot builds** — Learned, physically constrained partitioning of brick models into independently buildable parts (co-first author).

Experience

Robotics Institute, Carnegie Mellon University Aug 2025 — Present
Graduate Researcher, Advisors: Prof. Changliu Liu and Prof. Jiaoyang Li *Pittsburgh, PA*

- **Built an RL-guided planner for long-horizon LEGO assembly** that pairs a learned policy with physics-exact search, solving structures that classical search cannot within an hour (PyTorch, Gurobi).
- **Achieved zero-shot transfer within object categories** at roughly an order of magnitude less compute than search.
- **Designed an interactive clarification loop for text-to-LEGO generation** that learns a compact representation of user intent, committing the intended, buildable design several times more often.
- **Co-led a physically constrained decomposition method for multi-robot LEGO assembly** (co-first author), splitting models into independently buildable parts.
- **Created a training-free, mutual-information score that predicts whether an instruction is enough for a robot policy** (with UT Austin), validated over 3,000 LIBERO episodes.
- **Implemented DAgger for a multi-robot search-and-rescue GNN policy**, adding C++ bindings for the expert planner and a search-based expert that cut makespan 15%.

MarMot Lab, National University of Singapore Jan 2024 — Present
Research Intern, Advisor: Dr. Guillaume Sartoretti *Singapore*

- **Developed RL- and CPG-based gait control for quadruped and hexapod robots**, enabling gait transitions and stable walking under leg failure and manipulation (ROS2, PyBullet).
- **Built a GPU-parallel framework for statistical safety guarantees on black-box legged RL policies** (JAX, MuJoCo MJX).
- **Cut verification cost several-fold relative to exhaustive sampling** with no false-safe verdicts.
- **Designed an LLM task interface that cannot override safety**: 0 unsafe actions in 60 closed-loop missions vs. 10 for the LLM alone (Qwen2.5-7B).
- **Showed that where a runtime safety filter acts determines whether it preserves a legged gait.**

Centre for Non-Destructive Evaluation, IIT Madras Jan 2024 — May 2025
Research Intern, Advisor: Dr. Krishnan Balasubramaniam *Chennai, India*

- **Built a Transformer defect classifier for ultrasonic scans of ceramic bearing balls** with SKF, reaching 99% accuracy and 100% on unseen scans.
- **Simulated ultrasonic wave propagation and crack-induced harmonics in ABAQUS**, and validated the models experimentally.
- **Predicted microporosity and material degradation in ceramic bearing balls** using wavelet analysis of ultrasonic signals.
- **Designed an infrared (IR) thermography setup for defect detection** using an IR camera and Altair.
- **Developed quantum-accelerated deep learning models** to detect defects in ultrasonic A-scans.

PRISMA Lab, University of Naples Federico II Oct 2023 — Mar 2024
Research Intern, Advisor: Dr. Fanny Ficuciello *Naples, Italy*

- **Modeled the soft continuum wrist of the PRISMA Hand II prosthesis** with Cosserat rod theory, and used it to compute forward kinematics.

- **Built a model-based computed-torque controller** for precise wrist trajectory tracking, tuning gains with Particle Swarm Optimization.
- **Developed a neural-network kinematic controller** for accurate wrist trajectory tracking (IROS 2024; journal version under review).

Centre for Non-Destructive Evaluation, IIT Madras May 2023 — Jul 2023
Research Intern, Advisor: Dr. Krishnan Balasubramaniam *Chennai, India*

- **Collected ultrasonic waveguide signals for 10 lubricating oils** in an IOCL-funded project on online lubricant condition monitoring.
- **Trained CNN, FFT-based neural network, and Transformer classifiers** to identify oils from raw signals, reaching 98.6% accuracy (first-author paper, MFPT 2026).

Stoch Lab, Indian Institute of Science Feb 2023 — Aug 2023
Research Intern, Advisor: Dr. Ashitava Ghosal *Bengaluru, India*

- **Designed a compliant foot mechanism for the Stoch3 quadruped** to absorb landing impacts and eliminate spurious joint torques.
- **Validated the design in MuJoCo simulation**, demonstrating improved shock absorption and torque elimination.

National Institute of Technology, Durgapur Dec 2022 — Jul 2023
Undergraduate Researcher, Advisor: Dr. Aritro Dey *Durgapur, India*

- **Proposed an adaptive sliding mode control law for quadrotors** with proven Lyapunov stability, achieving faster convergence and robust tracking under disturbances.
- **Reduced control effort, chattering, and noise** relative to conventional sliding mode control (published in IJAAC).

Orangewood Labs Apr 2022 — Jul 2022
ROS Intern *Noida, India*

- **Programmed a 6-DoF industrial robot arm with ROS, Python, and MoveIt**, building a Tkinter GUI to run dexterous motion demos for customers.
- **Researched the global industrial robotics market** (integrators, suppliers, manufacturers) and pitched to prospective clients at IndiaWood 2022.

Projects

Latent Strategies for Ad-Hoc Human-Robot Teaming in Overcooked-AI, Course project, manuscript under review
Aug 2025 — Dec 2025

- **Co-developed a human-robot teaming framework** that infers a partner's strategy from partial trajectories and plans with sampling-based control (MPPI).
- **Built behavior-cloning and PPO baselines from 480 human-human games**; the framework earned the highest reward in 4 of 6 human-replay settings.

Discriminative Barrier Learning with Task-Aware Regularization for Safe Assembly RL, Research project, CMU
Feb 2026 — May 2026

- **Replaced 92% of slow Gurobi stability checks in assembly RL with an uncertainty-aware GNN**, speeding training 6.6x at a 0.36% false-safe rate.
- **Learned a task-aware safety barrier** that flags placements doomed by later failures, cutting confident-but-wrong predictions 3.4x and reaching full success 22% faster.

Online Rolling-Horizon Multi-Robot Arm Planning with Vector-Accelerated Incremental Shortcutting, Course project (Multi-Robot Planning and Coordination) Jan 2026 — May 2026

- **Built an online multi-arm assembly planner** that starts executing before the full plan is ready, cutting time-to-first-move 5.9–22.2x across 2–4 robot arms.
- **Devised a windowed collision-check scheme** that cuts inter-robot collision queries about 64x, running all checks on a SIMD-accelerated backend (VAMP).
- **Added time-budgeted path shortcutting** that beat the offline plan's makespan by 5.9–7.6% without altering motion already being executed.
- **Benchmarked the system across planning-window sizes**, showing stable makespan and update latency under 1 s.