

# Apurva Patil

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## 🎓 EDUCATION

### The University of Texas at Austin

PhD, Mechanical Engineering (Robotics, Autonomy and Controls)

Aug 2021 - May 2025

Advisor: [Takashi Tanaka](#), [Luis Sentis](#), GPA: **4.0/4.0**

MS, Mechanical Engineering ([Robotics Portfolio Program](#))

Aug 2019 - May 2021

Advisor: [Takashi Tanaka](#), [Luis Sentis](#), GPA: **4.0/4.0**

### College of Engineering Pune, India

BTech, Mechanical Engineering; GPA: **9.39/10** (Class Rank: **2/185**)

Aug 2013 - May 2017

## 💼 PROFESSIONAL EXPERIENCE

### Tensor Auto

*Machine Learning Engineer for Motion & Behavior Planning*

San Jose, CA

Jun 2025 - Present

- Integrating **ML-based approaches** with classical (rule-based) planning algorithms
- **Leading** the development of an ML-based architecture that improves **autonomous parking** performance
- Developing a joint prediction and planning framework for interactive, human-like decision-making using **Transformer-based architectures, game theory, and imitation learning**
- Built a **model-training** framework using data augmentation based on **contrastive imitation learning** to address the challenges of **distribution shift** and **learning shortcuts**
- Optimized **graph-based planning algorithms** for autonomous parking and validated the developed features through **on-road test drives**

### Amazon Robotics

*Applied Scientist II Intern (Vulcan Stow team)*

Seattle, WA

May - Aug 2024

- Built and deployed a **real-time motion planning** algorithm for Vulcan, an 8-DOF manipulator, enabling efficient item stowing and retrieval from densely packed shelves in the Amazon fulfillment centers
- Demonstrated over **95% success rate** in finding feasible trajectories with a **15×** improvement in **planning speed** relative to the original planner
- Integrated a **trajectory re-optimization framework** capable of updating plans online within **60 ms**
- Validated performance through large-scale experiments using **Isaac Sim**

### Cruise

*Motion Planning Intern*

San Francisco, CA

Sep - Dec 2023

- Improved the safety and passenger comfort of autonomous vehicle trajectories during **remote assistance, auto parking and unparking**

### Apptronik

*Software and Controls Intern*

Austin, TX

May - Aug 2020

- Developed a **sampling-based, real-time motion planning** algorithm Hierarchical Dynamic Roadmap (HDRM) for Apptronik's robotic manipulators
- Benchmarked the algorithm on **6 DOF manipulators** with the virtual workspace developed in **Gazebo**

## ❑ RECENT PROJECTS

### *PhD Thesis: Advancing Frontiers of Path Integral Theory for Stochastic Optimal Control*

*Advisor: Prof. Takashi Tanaka and Luis Sentis, UT Austin*

May 2021 - May 2025

- Developed theoretical frameworks and algorithms to solve **risk-constrained motion planning** via **path integral** control (an approach to synthesize optimal policies **on-the-fly** using Monte-Carlo simulations)
- Developed **digital twins** (simulators) of physical systems like quadcopters using gray-box modeling

## **Master's Thesis: Safety-based Motion Planning in Uncertain Environments**

*Advisor: Prof. Takashi Tanaka and Luis Sentis, UT Austin*

*Aug 2019 - May 2021*

- Developed algorithms to estimate **end-to-end collision probabilities** of **motion plans** for autonomous agents with discrete and continuous-time dynamics, navigating in **uncertain environments**
- Incorporated the developed risk estimation framework in motion planners to generate **optimal safe trajectories** in the presence of uncertainties

## **Reinforcement Learning Based Risk-Bounded Motion Planning**

*Advisor: Prof. Peter Stone and Scott Niekum, UT Austin*

*Jan - May 2022*

- Proposed an extension of **semi-gradient SARSA** and **TD(0)** algorithms to solve **risk-bounded motion planning** and end-to-end **risk estimation** problems for autonomous vehicles in continuous-space. The proposed model allows the user to adjust the **risk-averse level** of the autonomous agent.

## **Bachelor's Thesis: Design and Development of a Humanoid Torso**

*Advisor: Prof. Shantipal Ohol, College of Engineering Pune, India*

*Aug 2016 - May 2017*

- Built a humanoid torso to **pick and place** objects by obtaining visual and audio data via **Microsoft Kinect**
- Designed **5 DOF robot arms** and **multi-finger adaptive grippers**, established a real-time control of the robot arms to attain the desired position and orientation of the end-effectors

## **+** SKILLS

**Languages:** Python, C++, **Tools and software packages:** MATLAB/Simulink, PyTorch, TensorFlow, ROS, OpenCV, NuSMV, Slugs, PRISM, LabVIEW, AutoCAD, SolidWorks, ANSYS, ParaView, MeshLab, Git, Isaac Sim

## **≡ RELEVANT PUBLICATIONS** ([FULL LIST OF PUBLICATIONS](#))

- **A. Patil**, A. Duarte, F. Bisetti, T. Tanaka, “Strong Duality and Dual Ascent Approach to Continuous-Time Chance-Constrained Stochastic Optimal Control”, *Transactions of Automatic Control, (TAC)*. [\[Paper\]](#)
- **A. Patil**, K. Morgenstein, L. Sentis, T. Tanaka, “Path Integral Methods for Synthesizing and Preventing Stealthy Attacks in Nonlinear Cyber-Physical Systems”, *submitted to TAC*. [\[Paper\]](#)
- C. Martin, **A. Patil**, W. Li, T. Tanaka, D. Chen, “Model Predictive Path Integral Control for Roll-to-Roll Manufacturing”, *IFAC-PapersOnLine*, 2025. (**Best Student Paper**) [\[Paper\]](#)
- **A. Patil**, G. Hanasusanto, T. Tanaka, “Discrete-Time LQR via Path Integral Control and Its Sample Complexity Analysis”, *IEEE Control Systems Letters (L-CSS)*, 2024. [\[Paper\]](#)
- **A. Patil**, M. Karabag, T. Tanaka, U. Topcu, “Simulator-Driven Deceptive control via Path Integral Approach”, *IEEE Conference on Decision and Control (CDC)* 2023. [\[Paper\]](#)
- **A. Patil**, T. Tanaka, “Upper and Lower Bounds for End-to-End Risks in Stochastic Robot Navigation”, *IFAC World Congress*, 2023. [\[Paper\]](#)
- **A. Patil**, A. Duarte, A. Smith, F. Bisetti, T. Tanaka, “Chance-Constrained Stochastic Optimal Control via Path Integral and FDM”, *IEEE Conference on Decision and Control (CDC)*, 2022 [\[Paper\]](#)
- **A. Patil**, M. Kulkarni, A. Aswale, “Analysis of the inverse kinematics for 5 DOF robot arm using D-H parameters”, *IEEE International Conference on Real-time Computing and Robotics*, 2017. [\[Paper\]](#)

## **🏆 AWARDS, ACHIEVEMENTS AND POSITIONS**

- **Reviewer:** TAC, CDC, ACC, ECC, IFAC WC
- **Best Student Paper Award**, Modeling, Estimation and Control Conference (MECC) 2025
- **CDC 2022 Student Travel Support Award**, IEEE Control System Society 2022
- **H. Grady Rylander Excellence in Teaching Fellowship**, UT Austin 2020
- **TCS Best Student Award**, College of Engineering Pune, India 2017
- **Best Bachelor's Project Award**, College of Engineering Pune, India 2017
- **S. N. Bose Fellowship** for a research internship in the USA (1 in 47 students across India) 2016
- **National Robocon**: Winner 2017, Runners-up 2016, Best Innovative Design 2015