


# KUSHAGRA GUPTA

(+1) (737) 420-7734 ◊ kushagrag@utexas.edu ◊ 

## EDUCATION

---

### The University of Texas at Austin

Ph.D. in Electrical and Computer Engineering

Advisors: [David Fridovich-Keil](#), [Ufuk Topcu](#), [Sandeep Chinchali](#)

*Aug 2023 - Present*

### Indian Institute of Technology, Delhi

Bachelor of Technology in Mechanical Engineering

Thesis Advisors: [Souvik Chakraborty](#), [Shaurya Shriyam](#)

*Jul 2019 - May 2023*

**GPA: 9.212/10**

**Dept. Rank: 5/89**

## RESEARCH INTERESTS

---

My primary research interests lie at the intersection of **machine learning**, **control theory**, **game theory** and **multi-agent decision making**. My goal is to make efficient, safe and adaptable robots. Consequently, I am interested in applications involving **robot learning**, **motion planning**, **dynamic games** and **embodied AI**.

## PUBLICATIONS

---

**Kushagra Gupta**, David Fridovich-Keil, “Iterative LQ Games for Occlusion Motion Planning”, *Conference on Robot Learning Workshop on Strategic Multi-Agent Interactions: Game Theory for Robot Learning and Decision Making*, 2022. [[pdf](#)]

## RESEARCH EXPERIENCE

---

### Deep Learning based Latent Time Series Methods for Robot Trajectories

*Deep Learning, Optimal Control - Undergraduate Thesis*

*Aug 2022 - April 2023*

- Used Physics-Informed Deep Learning to learn **true system dynamics** with generalised robot image data for the task of **accurate prediction** of future trajectories and control of robotic systems.
- Encoded image data sequence into a **latent** space using a variational autoencoder and the dynamics were learnt using **physics-based priors** in offline training.
- The dynamical model which is learned is coupled with an iterative linear-quadratic regulator for **efficient control**. The model has been successfully tested for controlling planar two-link manipulator for trajectory tracking problems.

### Control and Learning for Autonomous Robotics (CLeAR) Lab, UT Austin

*Motion Planning, Game Theory - Research Internship*

*April 2022 - May 2023*

- Worked under the guidance of [Prof. David Fridovich-Keil](#) to develop a novel **multi-agent** algorithm for **motion planning** in **occluded** scenarios, which uses **dynamic games** and is capable of real-time performance.
- Designed an **efficient iterative linear-quadratic method** for decision-making using a hybrid information structure utilizing Hamiltonian-Jacobi-Bellman equations and Pontryagin’s Principle to find **local approximations to Nash equilibria**.
- Achieved **8.062 ± 1.031s** computational time for our algorithm in **Julia** simulations for 3-vehicle overtaking scenario, **outperforming** time scores of previous works employing grid-based reachability analysis and zero-sum games.

## Assured Intelligent Robotics (Air) Lab, Cleveland State University

*Motion Planning, Optimal Control - Research Internship*

*June 2022 - Dec 2022*

- Working under the guidance of [Prof. Qin Lin](#) on developing techniques for accommodating **uncertainty** in dynamical models to improve performance of **model-based optimal control** methods while remaining **time-efficient**.
- Developing framework for **constrained iterative linear-quadratic regulator** (CILQR) utilizing a **generalised extended state observer** (ESO) to compensate non-linear errors and external disturbances in an MPC scheme.
- The method accounts for uncertainties caused by the difference between the nominal and linearised dynamic model.

## Intelligent Mechanical Systems Lab, Shibaura Institute of Technology, Tokyo

*Remote Teleoperation, Mobile Robots - Research Internship*

*May 2021 - July 2021*

- Remotely collaborated with [Prof. Nobuto Matsuhira](#) and conducted **teleoperation** experiments between India and Japan to study response in **remote assistive applications**.
- Identified need of autonomous variation in collision avoidance parameters for assisting human robot operators in narrow-spaced environments and achieved reduction in ping rates by removing redundant nodes.
- Developed **Pioneer 3-DX** based robot simulations in **ROS** using Navigation Stack library for lab research use.

## School of Public Policy, IIT Delhi

*Agent Based Models, Complex Adaptive Systems - Research Project*

*Aug 2021 - Dec 2021*

- Worked under [Prof. Kaveri Iychettira](#) to develop a novel learning model for social behaviour of actors which is used in specifying agent-based models.
- Designed agents to display hybrid social-individual behaviour (**replicator-reinforcement**) to learn from their own experience while also accounting for societal experiences.
- Successfully observed early stage **novel** actor behaviour in a market game setting before convergence, which was absent in baseline **Roth-Erev Model**.

## TEACHING EXPERIENCE

---

### Teaching Assistant - Control Theory Course

*Jan 2023 - May 2023*

- Working as the sole undergraduate TA in the course taken by instructor [Prof. S.V. Modak](#).
- Taking laboratory and viva sessions for 181 registered students to supplement lectures.
- Organizing demos, physical experiments and MATLAB walkthroughs for weekly sessions.

## RELEVANT COURSEWORK

---

**Robotics, Algorithms and Planning:** Machine Learning, Robotics Technology (Computer vision, Embedded Systems, Manipulator Kinematics), Control Theory, Kinematics and Dynamics of Machines, Introduction to Programming

**Mathematics:** Calculus, Linear Algebra, Differential Equations, Probability and Statistics, Numerical Analysis, Operations Research (Dynamic, Linear & Non-Linear Programming)

**Miscellaneous:** Complex Adaptive Systems, Manufacturing System Design (Queuing Theory, Inventory Modelling & Game Theory)

## ORAL PRESENTATIONS

---

- December 2022, “Iterative LQ Games for Occlusion Motion Planning”, Workshop on Strategic Multi-Agent Interactions, Conference on Robot Learning
- June 2021, “Getting Started with Robot Operating System”, Robotics Club IIT Delhi [[video](#)]

## SCHOLASTIC ACHIEVEMENTS

---

- Selected for **Department Change** to Mechanical Engineering in **IIT Delhi** for being in **Top 5 %** in year 2019-20.
- **1 out of 2** students selected to represent IIT Delhi in an exchange program at the City University of Hong Kong.
- Cleared Joint Entrance Exam (Advanced) with an All India Rank of **1267** in 2019 out of 0.16 million candidates.

## TECHNICAL SKILLS

---

**Programming Languages**

Python, Julia, Java, MATLAB

**Tools and Softwares**

ROS, Gazebo, Simulink, Solidworks

**Software Libraries**

PyTorch, TensorFlow, SciPy, Pandas, NumPy

## RELATED POSITIONS OF RESPONSIBILITY

---

**Robotics Club, IIT Delhi**

*Student Coordinator*

*Sept 2021 - Aug 2022*

- Organized a robotics workshop for 250+ freshmen, focused on making line-following robots.
- Organized introductory lectures on robotics for outreach to college freshmen.

*Core Team Member*

*Oct 2020 - Aug 2021*

- Developed game strategy for team submission to **ABU Robocon 2021** competition. Designed robot's arrow throwing mechanism in Autodesk Inventor. The team qualified the shortlist round with a perfect 100 score.