Ajinkya Jain

The University of Texas at Austin

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Interests

Machine Learning, Reinforcement Learning, Optimal Control, Motion Planning under Uncertainty, Robotic Manipulation

Education

Doctor of Philosophy, Mechanical Engineering, Advisor: Prof. Scott Niekum (2015 - 2020)
Specialization: Robotics, Dynamics Systems and Controls
The University of Texas at Austin, CGPA: **3.7/4.0**

Master of Technology, Mechanical Engineering (2014 - 2015)
Specialization: Robotics
Indian Institute of Technology Kanpur, CGPA: **9.7/10**

Bachelor of Technology, Mechanical Engineering (2010 - 2014)
Indian Institute of Technology Kanpur, CGPA: **9.0/10.0**

Research Experience

Graduate Research Assistant, Computer Science Jan'16 - present
Advised By Dr. Scott Niekum, Department of Computer Science, UT Austin
Project Title: *Belief Space Planning under Approximate Hybrid Dynamics*

- Motion Planning under uncertainty using Trajectory Optimization; extended for Hybrid Dynamics
- **Focus**: Tasks with State Dependent Dynamics; Leveraging Dynamics for Performance Enhancement
- Implemented for Contact-Rich furniture assembly task on a 6 DOF Kinova Jaco2 Arm

Graduate Research Assistant, Mechanical Engineering, IIT Kanpur Feb'14 - June'15
Advised by Dr. Bishakh Bhattacharya, Dept. of Mechanical Engineering
Thesis: *Two Design Challenges in Exoskeleton Systems: Optimal Gripper Design and Optimal Bipedal Gait Controller* [Github] [paper]

- Modeled Dynamics of Piezoelectric actuator using a novel minimalistic model
- Optimized Piezoelectric actuator driven gripper design using genetic algorithm
- Designed a Time-Varying Optimal Controller (LQR) for Bipedal locomotion of Exoskeletons

Undergraduate Research Assistant, Aerospace Engineering, TAMU May'13 - July'13
Advised by Dr. Suman Chakravorty, Dept. of Aerospace Engineering
Title: *Motion planning for MAVs using Feedback Information based RoadMaps* [GitHub]

- Implemented Motion Planning Library FIRM on robots including mobile manipulator Kuka youBot
- Interfaced robotic simulator, V-Rep, with the library in MATLAB
- Features: Robot Dynamics Models, Customizable work environment, Synchronized communication

Product Development Experience

Team Austin Villa, Robocup@Home, SSPL March'17 - July'17
Third Place Worldwide, Nagoya Japan

- Developed Manipulation pipeline for Toyota Human Support Robot
- Implemented fast tabletop perception based common household object grasping and manipulation

Boeing IIT-K Autonomous Navigation System (Abhyast) Phase-III May'12 - Jan'13
Funded by Boeing Corporation, US and Dean, R&D, IIT Kanpur

- Built navigation planner for a jumping robot capable of navigating in cluttered environment

Project: Humanoid Robot, Phase-I
Funded by Dean, Resource Planning & Generation, IIT Kanpur Sep'11 - April'12

- Designed navigation system for an omnidirectional movable robot featuring obstacle avoidance and path planning

Technical Skills

Languages: C, C++, Python, MATLAB

Softwares/Other Tools: Robot Operating System, Moveit, Drake Toolbox for Planning, Control and Analysis, AGILE Grasp, Autodesk Inventor, V-REP Simulator

Hardware: Toyota Human Support Robot, Kinova Jaco-2 6-DOF and 7-DOF Arms, Microsoft Kinect SDK, Hokuyo 3D laser Scanner, Atmel AVR, Arduino, Bluetooth Modules, IR sensors, IC Engines

Academic Projects

Learning Optimal Policy under Spatially-Varying Dynamics Aug'16-Dec'16
Reinforcement Learning: Theory and Practice, Course Project, UT Austin

- Developed learning agents executing optimal policy on domains with spatially-varying dynamics
- Stochastic dynamics modeled as POMDP; Implemented **SARSA** update rule with Eligibility traces

Stochastic Motion Planning for State-Dependent Dynamics Aug'16-Dec'16
Robot Learning from Demonstration and Interaction , Course Project, UT Austin

- Modeled state-dependent dynamics as hybrid dynamics; Motion planning under uncertainty as POMDP
- Implemented and Extended Belief-space LQR algorithm to Hybrid systems

Optimal Controller for Car Active Suspension Assembly Jan'17-May'17
Modern Control , Course Project, UT Austin

- Designed and Implemented a Reduced-order observer with an Optimal finite time tracker

A case study of Passivity-based control of 6-DOF arm Jan'16-May'16
Nonlinear Dynamics and Control , Course Project, UT Austin

- Designed and Implemented a Passivity-based feedback linearization controller for 6-DOF arm

Classification of Human Actions in Video Jan'14-Apr'14
Course Project, Computer Vision, IIT Kanpur

- Implemented multiclass SVM and SCHM for classifying Human Actions in Videos.
- Improvised SCHM by focusing on characteristic histogram bins; *Accuracy increased by 20%*

A* algorithm : A motion planning algorithm for Soccer playing Robots July'13-Nov'13
Term Paper, Robot Motion Planning, IIT Kanpur

- Analysed applicability of A* Graph search algorithm as offensive strategy for Soccer playing robots
- Simulated a 2D Soccer game on MATLAB; Studied the impact of computational complexity of path planning algorithm and team formation and passing strategy, on the chances of winning.

Relevant Courses

Robotics: Introduction to Robotics, Robot Motion Planning, Robot Manipulators: Dynamics and Control, Robot Mechanism Design

Machine Learning: Reinforcement Learning, Learning from Demonstration and Interaction, Computer Vision and Image Processing

Controls: Optimal Control, Nonlinear Dynamics & Control, Modern Control, Automation & Control

Miscellaneous: Optimization Methods in Engineering, Theory of Mechanisms and Machines, Finite Element Methods, Programming and Numerical Analysis, Introduction to Cognitive Science

Publications

A. Jain and S. Niekum, Belief Space Planning under Approximate Hybrid Dynamics, Robotics: Science and Systems (R:SS) Workshop on POMDPs in Robotics, July 2017.

R. Datta, **A. Jain** & B. Bhattacharya,"A Piezoelectric Model based Multi-Objecive Optimization of Robot Gripper Design", *Structural and Multidisciplinary Optimization, Springer 2015* [paper]

A. Jain, R. Datta & B. Bhattacharya,"Unified Minimalistic Modelling of Piezoelectric Stack Actuators for Engineering Applications", *Advances in Intelligent Systems and Computing, Springer 2014* [paper]

Awards and Achievements

- Awarded **Certificate of Merit for Academic Excellence** for the terms 2011-12 and 2012-13
- Recipient of **Robotics Scholarship** by **Boeing Corporation** for Abhyast Phase-III project
- Selected for **TAMU-IITK Student Exchange Program at Texas A&M University**, 2013