Ajinkya Jain

Website: jainajinkya.github.io
Email: ajinkya@utexas.edu
Phone: +1 512 508 9869

Research Interests

Robot Learning, Dexterous Robot Manipulation, Motion Planning Under Uncertainty, Model Learning for Planning and Control, Reinforcement Learning, Optimal Control

Education

The University of Texas at Austin
Ph.D., Mechanical Engineering (*Robotics, Dynamics Systems and Controls*) 2015–Current
Advisor: Prof. Scott Niekum

Indian Institute of Technology Kanpur
M.Tech., Mechanical Engineering (*Robotics and Automation*) 2014–2015
Advisor: Prof. Bishakh Bhattacharya

B.Tech., Mechanical Engineering 2010–2014

Research Experience

The University of Texas at Austin
Graduate Research Assistant, Computer Science 2015-Current

Robot Motion Planning Under Uncertainty and Hybrid Dynamics
- Developed a POMDP-based Motion planner that generates efficient motion plans leveraging object-object interactions to perform manipulation tasks under uncertainty with high success rates

Learning Object Kinematics Models from Observations for Manipulation Planning
- Developed a novel method for learning planning-compatible hybrid kinematics models for articulated objects from human demonstrations

Object Articulation Model Estimation From Raw Depth Images
- Developed a novel deep learning-based method to estimate articulation models for objects directly from raw depth images without knowing their articulation type a priori using screw theory

Indian Institute of Technology Kanpur
Graduate Research Assistant, Mechanical Engineering 2014-2015

Thesis: **Two Design Challenges in Exoskeleton Systems: Optimal Gripper Design and Optimal Bipedal Gait Controller**
- Developed a simple, computationally-cheap, yet effective model for piezoelectric stack actuators as a replacement of black-box models used in engineering design optimization problems
- Optimized design of a piezoelectric actuator driven gripper using the proposed model with a genetic algorithm
- Designed a time-varying optimal controller (LTV-LQR controller) for exoskeleton bipedal locomotion

Publications

A. Jain, R. Lioutikov, and S. Niekum, *ScrewNet: Category-Independent Articulation Model Estimation From Depth Images Using Screw Theory*, under submission, July 2020

A. Jain and S. Niekum, *Learning Hybrid Object Kinematics for Efficient Hierarchical Planning Under Uncertainty*, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020

A. Jain and S. Niekum, *Efficient Hierarchical Robot Motion Planning Under Uncertainty and Hybrid Dynamics*, 2nd Conference on Robot Learning (CoRL), 2018

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

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

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

Internships

Samsung AI Research Center-Robotics — New York City, NY
AI Researcher (Intern) — May'19-Aug'19

GrAB-Net: Grasping with optimal Approach Behavior

- Developed a fully autonomous training pipeline to train networks for generating object category-level optimal grasping behaviors given a single RGB-D image of the scene via imitation learning
- Achieved high success rate ($\sim 70\%$) in grasping 40 different objects belonging to two object categories

Vicarious — Fremont, CA
Roboticist (Intern) — May'18-Aug'18

Task Agnostic High Precision Assembly using Visual Servoing

- Implemented state-of-the-art visual servoing algorithms to do high precision ($\leq 2mm$) assembly tasks. Ensured fast convergence ($\leq 20\ s$) to target features with high repeatability ($\geq 90\%$ success)
- Developed python-based interfaces ensuring a task and platform-agnostic implementation

Texas A&M University — College Station, TX
Undergraduate Researcher, Aerospace Engineering, Advisor: Prof. Suman Chakravorty — May'13-Aug'13

Robot Motion Planning using Feedback Information Based RoadMaps

- Modeled dynamics of different holonomic and non-holonomic mobile robot platforms and implemented motion planning library FIRM to perform navigation under uncertainty tasks
- Interfaced robotic simulator, V-Rep, with the library with added features including customizable work environments and synchronized communication for real-time control

Technical Skills

- **Languages/Softwares:** C++, Python, MATLAB/R, PyTorch, ROS, ViSP (Visual Servoing Platform), SNOPT, MuJoCo, Gazebo, V-Rep, GraspIt!
- **Robot Platforms:** UR5 robot arms, Toyota Human Support Robot, Kinova Jaco-2 6-DOF and 7-DOF Arms

Scholarships and Awards

- Second runner-up in the RobotCup@Home SSPL league, Robocup, Nagoya, Japan — 2017
- Awarded UT AI-lab travel grant — 2017, 2018
- Awarded Certificate of Merit for Academic Excellence at IIT Kanpur — 2011-12, 2012-13
- Recipient of Robotics Scholarship by Boeing Corporation for Abhyast Phase-III project — 2012-13

Relevant Courses

- **Robotics:** Introduction to Robotics, Robot Motion Planning, Robot Manipulators: Dynamics and Control, Robot Mechanism Design, Optimization Methods
- **Machine Learning:** Reinforcement Learning, Robot Learning from Demonstration and Interaction, Computer Vision and Image Processing
- **Controls:** Optimal Control, Nonlinear Dynamics & Control, Modern Control, Automation & Control

Projects

- Analysis of Optimal Control Schemes for Car Active Suspension Assembly 2017
  Course project for Modern Control
  Designed and implemented a reduced-order observer with an optimal finite time tracker
- Analysis of Optimal Control Schemes for Car Active Suspension Assembly 2017
  Course project for Nonlinear Dynamics and Control
  Designed and Implemented a Passivity-based feedback linearization controller for 6-DOF arm
- Learning Optimal Policy under Spatially-Varying Dynamics 2016
  Course project for Reinforcement Learning: Theory and Practice
  Developed learning agents executing optimal policy on domains with spatially-varying dynamics using SARSA update rule with Eligibility traces
- Stochastic Motion Planning for State-Dependent Dynamics 2016
  Course project for Robot Learning from Demonstration and Interaction
  Modeled state-dependent dynamics as hybrid dynamics and extended belief-space LQR to hybrid systems for planning robot motion under uncertainty
- Classification of Human Actions in Video 2014
  Course project for Computer Vision: Theory and Practice
  Implemented multiclass SVM and SCHM for classifying Human Actions in Videos
- Optimal motion planning for 2D soccer playing robots 2013
  Course project for Robot Motion Planning
  Implemented A* algorithm for devising game play strategies for 2D multiplayer soccer playing robots

Teaching

- **Guest Lecturer** at UT Austin Spring 2016
  Mechatronics (ME 340), Topic: Introduction to Python
- **Teaching Assistant** at UT Austin Spring 2016
  Dynamics Systems and Controls Lab (ME 144L)
- **Teaching Assistant** at UT Austin Fall 2015
  Dynamics Systems and Controls Lab (ME 144L)
- **Teaching Assistant** at IIT Kanpur Spring 2015
  Optimization Methods in Engineering Design (ME 752)
- **Teaching Assistant** at IIT Kanpur Fall 2014
  Mechanical Engineering Lab-II (ME 471N)

Professional Service

Reviewer

Journals: Mechatronics

Conferences: IROS'20, ICRA'20, ICRA'19, ARSO'17, Humanoids'16