# Ajinkya Jain

PhD Candidate, UT Austin

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

## EDUCATION

**The University of Texas at Austin**

Ph.D., Mechanical Engineering (*Robotics, Dynamic Systems and Controls*)          2015–Current
Advisor: Prof. Scott Niekum  (Expected Graduation: Summer 2021)

**Indian Institute of Technology Kanpur**

B.Tech. - M.Tech. (Dual Degree), Mechanical Engineering (*Robotics and Automation*)          2010–2015
Advisor: Prof. Bishakh Bhattacharya

## RESEARCH EXPERIENCE

**Graduate Research Assistant**, Dept. of Computer Science, UT Austin          2015-Current

**Robot Motion Planning Under Uncertainty and Hybrid Dynamics** [Manipulation Planning]

- Developed a POMDP motion planner that leverages object interactions to generate efficient plans (via trajectory optimization; 5x faster) to perform long-horizon manipulation tasks with high accuracy ($\geq 90\%$) under uncertainty

**Learning Object Kinematics Models from Observations** [Model Learning, Manipulation Planning]

- Developed a novel method for learning planning-compatible hybrid kinematics models for articulated objects from human demonstrations (improved up to 3x in accuracy over the state-of-the-art method)

**Object Articulation Model Estimation From Raw Depth Images** [Deep Learning, Robot Perception]

- Developed a novel deep learning based method (using CNNs) to estimate articulation models for objects directly from raw depth images without knowing their articulation type a priori using screw theory (2x data efficient)

**Graduate Research Assistant**, Dept. of Mechanical Engineering, IIT Kanpur          2014-2015

Thesis: **Two Design Challenges in Exoskeleton Systems: Optimal Gripper Design and Optimal Bipedal Gait Controller** [Optimal Control, System Modeling]

- 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 NSGA-II algorithm
- Designed a time-varying optimal controller (LTV-LQR controller) for exoskeleton bipedal locomotion

## INTERNSHIPS

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

**GrAB-Net: Grasping with optimal Approach Behavior** [Deep Learning, Grasp Planning]

- Developed a fully autonomous training pipeline to train networks for generating 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

**Roboticist**, Vicarious (Union City, CA)          May'18-Aug'18

**Task Agnostic High Precision Assembly using Visual Servoing** [Perception, Motion Planning]

- 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

**Undergraduate Researcher**, Texas A&M University (College Station, TX)          May'13-Aug'13

**Robot Motion Planning using Feedback Information Based RoadMaps** [Motion Planning]

- Modeled dynamics of 5 different holonomic and non-holonomic mobile robot platforms and implemented motion planning library FIRM to perform navigation tasks under uncertainty
- Interfaced robotic simulator, V-Rep, with the library with added features including customizable work environments and synchronized communication for real-time control

## Selected Publications

**A. Jain**, R. Lioutikov, and S. Niekum, *ScrewNet: Category-Independent Articulation Model Estimation From Depth Images Using Screw Theory*, IEEE International Conference on Robotics and Automation (ICRA), 2021

**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 Dynamic*s, 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

## Technical Skills

- **Languages/Frameworks:** Python, C++, MATLAB/R, PyTorch
- **Robotics Software:** ROS, MuJoCo, Gazebo, V-Rep, PyBullet, OMPL, MoveIt!, GraspIt!, ViSP (Visual Servoing Platform), SNOPT, IPOPT, Solidworks, PCL, OpenCV
- **Robot Platforms:** Universal Robotics UR5, Toyota Human Support Robot, Kinova Jaco2 6-DOF, 7-DOF, Gen-3 arms, Rethink Robotics Sawyer, Robotiq grippers

## Selected Projects

- **RobotCup@Home SSPL league, Robocup, Nagoya, Japan**  [Manipulation Planning, Perception]  2017
  Developed manipulation pipeline for fast pick-up and placement of household objects for Toyota Human Support Robot
- **Optimal Control Schemes for Car Active Suspension Assembly**  [Controls]  2017
  Designed and implemented a reduced-order observer with an optimal finite time tracker
- **Nonlinear controller for 6-DOF robot arm**  [Controls]  2017
  Designed and Implemented a Passivity-based feedback linearization controller for 6-DOF arm
- **Learning Optimal Policy under Spatially-Varying Dynamics**  [Reinforcement Learning]  2016
  Developed an on-policy algorithm for learning optimal policies on domains with spatially-varying dynamics
- **Stochastic Motion Planning for State-Dependent Dynamics**  [Motion Planning]  2016
  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**  [Computer Vision, Machine Learning]  2014
  Implemented multiclass SVM and SCHM for classifying Human Actions in Videos
- **Gameplay Strategies for 2D soccer playing robots**  [Motion Planning]  2013
  Implemented A* algorithm for devising game play strategies for 2D multiplayer soccer playing robots

## Awards

- Second Runner-up Worldwide (Team Austin Villa), RobotCup@Home SSPL league, Nagoya, Japan  2017
- UT AI-lab travel grant  2017, 2018
- Certificate of Merit for Academic Excellence at IIT Kanpur  2011-12, 2012-13
- Robotics Scholarship, Boeing Corporation  2012-13

## Teaching

- **Guest Lecturer** at UT Austin  Spring 2016
  *Mechatronics (ME 340), Topic: Introduction to Python*
- **Teaching Assistant** at UT Austin  2015-16
  *Dynamics Systems and Controls Lab (ME 144L)*
- **Teaching Assistant** at IIT Kanpur  2014-15
  - Optimization Methods in Engineering Design (ME 752)
  - Mechanical Engineering Lab-II (ME 471N)