

# JACOB JOHN JOHNSON

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## EDUCATION

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**University of California San Diego, USA**

M.S. and Ph.D. in Electrical & Computer Engineering,

*Oct '17 - expected Sept '23*

**GPA: 3.73/4**

**Indian Institute of Technology-Guwahati, India**

B.Tech. in Electronics & Communication, Minor in Computer Science

*Aug '13 - Apr '17*

**CPI: 8.81/10**

## PROJECTS

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**Learning-based planners,**

*Feb '18 - Present*

### **Vector-Quantized Motion Planning Transformers**

- Developed transformer-based planning algorithms to accelerate sampling-based planners for manipulation robots.
- Reduced planning times up to 6× for single and bi-manual manipulators compared to previous planners, while generalizing to out-of-distribution environments.
- Integrated planner with Moveit library for testing the planner on the Fetch Robot system.

### **Motion Planning Transformers**

- Developed transformer-based planning algorithm to accelerate sampling-based planners for 2D and non-holonomic robots.
- Reduced planning times up to 12× compared to previous planners while generalizing to larger environments.
- Set up the planner as a ROS2 plugin for Nav2, and tested the complete stack using an F1/10th car.

### **Dynamic Motion Planning Networks**

- Extended Motion Planning Networks for non-holonomic robots improving planning accuracy by 34% and increasing average speed by 60%.
- Mentored graduate and undergraduate students with developing, integrating, and testing motion planners on different robotic platforms.

**Camera-to-robot pose estimation,**

*Sep '22 - Present*

- Architected a containerized solution to set up Franka Panda Arm, Azure Kinect Sensor, and Deep learning system over a ROS network.
- Integrated learning-based markerless Camera-to-Robot pose estimation Network to the system for localizing the manipulator.

**Planning Under Uncertainty,**

*Aug '20 - May '21*

- Captured measurement uncertainty in state estimation techniques using a Gaussian Process (GP) model to verify chance constraints for motion planning.
- Provided theoretical proof for methods validity and convergence.

## WORK EXPERIENCE

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**Robotics Software Engineer Intern, Fox Robotics Inc**

*July - Sept '22*

- Designed and implemented a custom environment for simulating narrow-corridor environments, which was used for data collection and testing motion planning models.
- Devised novel transformer-based planning for non-holonomic robots, reducing planning times by 30%.
- Integrated custom learning-based planner to proprietary navigation stack using Bazel build tools and pytorch C++ API.

- Mentored co-intern in designing and implementing sampling-based planners for automating forklifts.

**Software Trainee, BrainCorp**

*Aug '19*

- Integrated SST planner with proprietary navigation stack with test-driven coding and automated build process using Travis-CI.

## TECHNICAL STRENGTHS

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## RECENT PUBLICATIONS

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Learning Sampling Dictionaries for Efficient and Generalizable Robot Motion Planning with Transformers, J. J. Johnson, A. H. Qureshi, and M. C. Yip, *Under Review*, 2023.

Motion Planning Transformers: A Motion Planning Framework for Mobile Robots, J. J. Johnson, U. S. Kalra, A. Bhatia, L. Li, A. H. Qureshi, and M. C. Yip, arXiv preprint arXiv:2106.02791, 2022.

Chance-Constrained Motion Planning using Modeled Distance-to-Collision Functions, J. J. Johnson and M. C. Yip, CASE, 2021.

Dynamically Constrained Motion Planning Networks for Non-Holonomic Robots, J. J. Johnson, L. Li, F. Liu, A. H. Qureshi and M. C. Yip, IROS, 2020.

Composing ensembles of policies with deep reinforcement learning, Qureshi, A.H., Johnson, J.J., Qin, Y., Boots, B. and Yip, M.C. in International Conference on Learning Representations (ICLR), 2020.

## TEACHING EXPERIENCE

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**Robot Manipulation and Control, UCSD**

*Apr - June '23*

- Developed exercises for manipulation kinematics, dynamics, control, and planning using Python libraries such as roboticstoolbox, sympy, and pybullet.

**Robot Reinforcement Learning, UCSD**

*Oct - Dec '19, '20*

- Developed exercises for training control policy using policy gradients, actor-critic networks, and deep deterministic policy gradients using Python libraries such as pytorch and pybullet.

**Computation Data Analysis and Product Development, UCSD**

*Apr - June '20, '21*

- Tested homework for solving real-world problems using probability theory and statistics using Python libraries such as networkx, sympy, and scipy.
- Assisted students with developing dashboards and hosting them on AWS-EC2 instances.

## HONORS

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- UCSD best ECE Tutor 2020 for ECE276C: Robot Reinforcement Learning.

## VOLUNTEER

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**Treasurer-RoboGrads, UCSD**

*Aug '20 - Aug '22*

- Conducted multi-day ROS workshops for graduate and undergraduate students.
- Organized research talks to facilitate networking opportunities between robotics graduate students.
- Managed the financial assets of the organization.