Mohak Bhardwaj

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Education

2018– **Georgia Institute of Technology, College of Computing**, *Atlanta*,
Ph.D. Robotics, *Advisor: Dr. Byron Boots*.

2015–2016 **Carnegie Mellon University, School of Computer Science**, *Pittsburgh*,
Master of Science In Robotic Systems Development, *QPA:3.83/4.0*.
Relevant Coursework: Planning, Execution and Learning; Mobile Robots; Computer Vision; Robot Autonomy; Dynamic Optimization; Statistical Techniques in Robotics; Manipulation Algorithms

2011–2015 **Indian Institute of Technology (BHU), Varanasi**, *India*,
B.Tech in Mechanical Engineering.

Journal and Conference Publications

Choudhury S., **Bhardwaj M.**, Arora S., Kapoor A., Ranade G., Scherer S., Dey D., "Data-driven Planning via Imitation Learning", International Journal of Robotics Research(IJRR), 2017(Submitted) **Pre-print**: goo.gl/6ABoZf

Bhardwaj, M., Choudhury S., Scherer S., "Learning Heuristic Search via Imitation", Conference on Robotic Learning 2017 **Proceedings**: goo.gl/cPo2yQ

Mithun, P., Anurag, V. V., **Bhardwaj, M.**, Shah, S. V., "Real-Time Dynamic Singularity Avoidance while Visual Servoing of a Dual-Arm Space Robot", Advances in Robotics 2015 **Proceedings**: goo.gl/j1uVLg

Work Experience

Dec 2017-July 2018 **Near Earth Autonomy**, *Robotics Engineer*.
Adaptive motion planning under uncertainty for real-world UAVs..

Mar 2017-Dec 2017 **Air Lab, CMU**, *Extern*, Advisor: Dr. Sebastian Scherer.
Research on reinforcement and imitation learning applied to search based planning; Planning under uncertainty.

Feb 2016-Dec 2016 **Air Lab, CMU**, *Research Associate*, Advisor: Dr. Sebastian Scherer.
Research on motion planning for UAV emergency landing.

May 2016-Aug 2016 **Qualcomm R&D**, *Intern, Autonomous Driving*, Manager:Sebastian Mounier.
S.L.A.M and multi-sensor calibration for autonomous cars.

May 2014-Aug 2014 **Robotics Research Institute, IIIT-Hyderabad**, *Intern*, Advisor: Dr. Suril V Shah.
Research on optimal control algorithms for space manipulators.

Research Work

Dec 2016-July 2017 **Learning Heuristic Search via Imitation**, *Carnegie Mellon University*.
Proposed a formulation of graph search as sequential decision making and developed a novel algorithmic framework for learning heuristic policies using imitation learning. Trained neural network policies to explicitly minimize search effort by selecting next vertex to expand.

Mar 2017- **Risk-Aware Stochastic Motion Planning for UAV Contingency Response**, *Carnegie Mellon University*.
Developing a robust motion planning architecture for UAVs that optimizes for closed loop performance under dynamics uncertainty to respond to a suite of emergency conditions (vehicle damage, loss of power etc.)

May 2014-Jul 2014 **Visual Servoing with Singularity Avoidance for Dual-Arm Space Robot**, *IIIT-Hyderabad*.
Developed IK based optimal control algorithms for visual servoing of space manipulators with real-time singularity avoidance in a coupled arm-base dynamic system.

Project Work

Aug 2015-May 2016 **Motion Planning and Online Learning for Autonomous Driving** , *Master's Capstone Project*.
Developed real-time state lattice based motion planner for autonomous cars with differential constraints using ROS-C++.
Devised an online reinforcement learning method for dynamically allocating parking spots to autonomous cars using a multi-armed bandit formulation.

May 2016-Aug 2016 **Multi-sensor calibration using S.L.A.M for Autonomous Cars**, *Qualcomm R&D*.
Created a full-vehicle calibration room and developed software for multi-camera intrinsic calibration using factor graph SLAM and lidar to camera registration.

Sep 2016-Jan 2017 **End-to-End Reinforcement Learning with Deep Deterministic Policy Gradients**.
Applied off-policy learning for manipulation to grasp and pick up objects in simulation using OpenRAVE.

July 2016-Sep 2017 **Deep Reinforcement Learning using Actor-Critic Policy Gradient**, *Code:goo.gl/lzGQjW*.
Experimented with deep RL algorithms for continuous control using an actor-critic setting with monte-carlo policy evaluation and Generalized Advantage Estimation.**Webpage**: goo.gl/CcdPo3

Aug 2014-May 2015 **Stable Walking of a Quadrupedal Robot**, *B.Tech Final Year Project*.
Led a four member team to design, simulate and implement statically stable crawl gait on a quadrupedal robot with 3DOF legs.

Open-Source Code

Search as Imitation Learning: Tensorflow pipeline for learning heuristic policies for search based motion planning. Link: goo.gl/YXkQAC

Python Motion Planning: Easy-to-use motion planning library geared towards planning and ML research Link: goo.gl/88shhJ

Deep RL with OpenAI Gym: Modular pipeline for developing and testing RL agents with OpenAI gym environments. Link: goo.gl/8tkFC4

Motion Planning Datasets: Benchmarks for comparing planning algorithms. Link:goo.gl/H6FqfV

Achievements and Honors

2011 Secured a rank in 0.6 % out of 480,000 students from all over India in the IIT Joint Entrance Examination

2015 Received Institute Color Award from IIT,Varanasi for outstanding extra-curricular achievements.

Technical Skills

Languages C++,Python
Software ROS,TensorFlow, OMPL
Hardware Nvidia Jetson,Beaglebone,Raspberry Pi