

Abhay Singh Bhadoriya

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EDUCATION

Ph.D., Mechanical Engineering	Texas A&M University, College Station, TX	Aug 2024
<i>Thesis:</i> Assisted Path Planning for Heterogenous Agents with Structural and Motion Constraints		
<i>Key Courses:</i> Analysis of Algorithms, Data Structures, Combinatorial & Heuristic Optimization, Survey of Optimization, Mathematical Modelling, Robotic Manipulators, Design of Non-Linear Control Systems		
B. Technology, Chemical Engineering	Indian Institute of Technology, Bombay, India	Aug 2017

RESEARCH PROJECTS

Assisted Path Planning in an Impeded Environment	May 2020-Dec 2023
<i>Funding:</i> Air Force Research Laboratory, US	
<ul style="list-style-type: none">Developed a novel Multi-Agent Path Planning algorithm with asynchronous robot motion for complex applications, including warehouse operations or rescue missions, where an assisting agent can help the primary agent to complete a given task in a deterministic environment; Monte-Carlo Tree Search (MCTS) based anytime algorithm was also proposed to find a near-optimal solution with limited computation time.For the stochastic environment, designed an efficient real-time algorithm for the primary agent by combining the k-shortest path planning algorithm and D*Lite algorithm; also solved a Rural Postman Problem with Time Window constraints for the assisting agent path.	
Object Detection and Tracking for Autonomous Vehicles	Sept 2019-Aug 2020
<i>Funding:</i> SAFE-D, US Department of Transportation	
<ul style="list-style-type: none">Implemented a novel real-time tracking system for autonomous vehicles using Modified Multiple Hypothesis Tracking (MHT) and YOLOv3 for object detection during challenging weather conditions (night-time, direct sun glare, fog) improving over baseline model by 52%.Synthesized a sensor fusion algorithm to combine the data from radar and 5 thermal cameras to achieve a robust 180° field of view.	
A Hierarchical Network for Trajectory Proposals	Jul 2018-Feb 2019
<ul style="list-style-type: none">Formulated a generalized two-stage Convolutional Neural Network architecture to mimic humans' ability to map the perceived surroundings to multiple trajectories for an autonomous vehicle; evaluated the framework on several platforms including KITTI dataset and indoor robots.Showcased the results on an in-house drive-by-wire car with LiDAR for mapping and Real-Time Kinematic-GPS and IMU for localization.	

WORK EXPERIENCE

Postdoctoral Researcher , Los Alamos National Laboratory, Los Alamos, NM	Oct 2024-Present
<ul style="list-style-type: none">Pioneered a novel Multiple Traveling Salesman Problem (MTSP) with fairness constraints by modeling it as a Mixed-Integer Second Order Cone program, a computationally efficient alternative to min-max MTSP; developed a custom branch-and-cut algorithm for optimal solution.Devised a framework to analyze the trade-off between efficiency vs safety in autonomous platoons during emergency braking maneuvers with uncertain breaking capacity; Designed and trained a Temporal Normalizing Flow Neural Network to estimate the collision probability.	
Autonomy Stack Developer , Fox Robotics, Austin, TX	May 2024-Aug 2024
<ul style="list-style-type: none">Optimized operational efficiency by dissecting intervention data from 50+ autonomous forklifts, engineering a high-frequency local planner to actively avoid static and dynamic obstacles, and improving throughput by 24% while maintaining safety standards.Deployed a local planner using the Model Predictive Path Integral (MPPI) algorithm, integrating it seamlessly with the Autonomy Stack.	
Electronics and Powertrain Engineer , Vazirani Automotive, Mumbai, India	Jul 2017-May 2018
<ul style="list-style-type: none">Designed and developed a 600 kW battery pack in-house for the Vazirani Shul electric hypercar including a custom battery management system (BMS) to reduce the production cost by 40%; Conducted comprehensive research to optimize the weight-energy-power ratio.Integrated a 3kW cooling system with power-dense lithium-ion battery, including two-phase immersion cooling and phase change material.	

SKILLS & CERTIFICATIONS

<ul style="list-style-type: none">Programming: C++, Python (PyTorch, TensorFlow, Pandas, NumPy, SciPy), Kotlin, Julia, R, SQL, MATLAB, LatexTools: Git, Docker, CUDA, Robot Operating System (ROS), CPLEX, GurobiSkills: Combinatorial and Stochastic Optimization, Graph Theory, Operations Research, Reinforcement Learning, Model Predictive Control, Nonlinear Programming, Probability and Statistics Theory, State EstimationCertifications: Machine Learning, Deep Learning Specialization, Object-Oriented Data Structures in C++
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PUBLICATIONS & AWARDS

<ul style="list-style-type: none">Abhay Singh Bhadoriya, et al. "Optimal Path Planning for a Convoy-Support Vehicle Pair Through a Repairable Network." IEEE Transactions on Automation Science and Engineering (2023).Abhay Singh Bhadoriya, Vamsi Vegamoor, and Sivakumar Rathinam. "Vehicle Detection and Tracking Using Thermal Cameras in Adverse Visibility Conditions." Sensors 22.12 (2022): 4567.Reviewer: Journal of Intelligent and Robotic Systems, Transactions on Intelligent Transportation Systems, Journal of Aerospace Information Systems, International Conference on Robotics and Automation, IEEE International Conference on Automation Science and Engineering.Research Fellowship: Emil Buehler Aerodynamic Analog Fellowship and Summer Research Fellowship.Institute Roll of Honor: Awarded for Innovative Design in IIT Bombay Racing.
