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Technical Skills

- **Languages:** C++17, C++14, C++11 , C, Python
- **C++ libraries:** Eigen, Boost, Taskflow, Fast DDS, nlohmann-json, GoogleTest, TinyXML-2, GRAMPC, TOPP-RA, MoveIt!, OpenCV, PCL, LibTorch, Bullet, FCL, OMPL, OctoMap
- **Python libraries:** NumPy, SciPy, Pandas, OpenCV, scikit-learn, matplotlib, SymPy, PyTorch, Gym, CasADi, OSQP, PyBullet, OpenCV
- **Software:** ROS, ROS2, Gazebo, MATLAB/Simulink, SolidWorks, EagleCad, RoboDK, AirSim, ArduPilot SITL
- **Platforms:** Linux, Windows, QNX RTOS

Work Experience

Robotics Software Engineer - Flexiv Robotics, Santa Clara, U.S.A. — Sep 2021 - Present

- Designed and implemented a variant of Dynamic Roadmaps, for real time motion planning under uncertainty, of a dual arm setup with 100% success rate for the given voxel resolution, and O(n) time complexity for collision detection
- Implemented a real time path-following model predictive controller (MPC) using GRAMPC, CasADi, OSQP for continuous re-planning with Dynamic Roadmaps, which computes trajectory in less than 200us, thereby improving the computation time by 80%
- Single-handedly developed and released a motion planning app consisting of optimization based motion planning algorithms like TrajOpt using OSQP, IFOPT, sampling based algorithms like RRT, RRT*, Descartes, and continuous collision detection algorithm using Bullet Physics thereby reducing the deployment time from weeks to hours
- Utilized multi-threading techniques to parallelize the execution of multiple RRT threads, enabling the robotic system to explore multiple paths simultaneously and find optimal trajectories
- Demonstrated expertise in motion planning algorithm design using C++ and mathematical modeling, with a proven track record of delivering optimized solutions
- Established communication using Fast-DDS zero copy between robot control app, motion planning app and ROS
- Developed a deep understanding of CI/CD methodologies, including experience with tools such as Jenkins, Bitbucket CI/CD, and Docker containerization technology, to facilitate the development of efficient and robust software pipelines for the motion planning app
- Utilized Agile Scrum techniques to prioritize development tasks and maintain high levels of software quality

Motion Planning Intern - Mathworks, Hyderabad, India — May 2018 - July 2018

- Developed MATLAB module for path planning of autonomous robotic arm of high-DOF like KUKAs LBR iiwa
- Executed obstacle avoidance using GilbertJohnsonKeerthi (GJK) distance algorithm in parallel to RRT-star

Robotics Intern - Systemantics, Bengaluru, India — Dec 2017 - Jan 2018

- Improved the trajectory computation time for a pick and place operation of a 6 DOF robotic manipulator by 50%
- Designed a gripper for a teach-and-repeat type application of the robot as per client requirement

Education

- **University of California, San Diego** (Currently on F-1 STEM OPT) — **GPA 3.84/4.0**
  M.S. in Intelligent Systems, Robotics and Control — 2019-2021
  Department of Electrical and Computer Engineering
- **Indian Institute of Technology (IIT) Kharagpur** — **CGPA 9.36/10.0**
  B.Tech. (Hons), Department of Mechanical Engineering — 2015-2019

Research Experience

Motion Planning Networks (MPNet) using Fastron — San Diego, U.S.A.

Guide: Prof. Michael Yip — June 2020–April 2021

- Combined a learning-based neural planner with a differentiable learning-based proxy collision detection algorithm
- Used LibTorch (PyTorch in C++) for optimization with joint limit, collision score and path length as objectives
- Reduced the computation time by 50% and improved the success rate from 85% to 99%

Semantic SLAM — San Diego, U.S.A.

Guide: Prof. Henrik Christensen — Sep 2020–Dec 2020

- Used YOLOv3 for object detection and semantic labelling and PoseCNN for pose estimation of the detected object
- Designed and implemented a novel approach to map creation that combined geometric and semantic information using particle filter algorithms, resulting in highly accurate and semantically meaningful maps

Motion planning of autonomous UAVs — Kharagpur, India

Guide: Prof. Cheruvu Siva Kumar — July 2018–April 2019

- Designed and implemented a novel multi-objective optimized path for UAV using Open Motion Planning Library (OMPL) and Flexible Collision Library (FCL), resulting in significant improvements in UAV path planning efficiency
- Developed autonomous 3D occupancy (Octomap) and collision avoidance and tested on Ardupilot SITL Gazebo
- Used stereoscopic camera instead of lidar reducing the cost by 90%, where point cloud was created using OpenCV

RoboSoccer — Kharagpur, India

Guide: Prof. Jayanta Mukhopadhyay — Feb 2016–April 2018

- Built a team of autonomous soccer playing robots in Python & C++ and participated in 21st RoboCup, Japan (2017)
- Performed a comparative study on the variations of RRT, worked on path simplifier and velocity profiling of the path
- Developed a multi-threaded 3-tier Skills-Tactics-Plays architecture for controlling omni-directional robots using ROS

Autonomous stair-climbing Robot — Kharagpur, India

Self-initiated project — Nov 2016–April 2017

- Developed computer vision based target following for navigation using Kanade-Lucas tracking of Shi Tomasi corners
- Applied EEG signal based control, voice control using CMUSphinx along with a touch interface using Raspberry Pi
- Recipient of the Gold medal in the intra-collegiate hardware exhibition 2017 at IIT Kharagpur.

Relevant Courses

University of California San Diego

- Planning & Learning in Robotics
- Sensing & Estimation in Robotics
- Random Processes
- Statistical Learning
- Bio-inspired robotics
- Nonlinear Systems
- Linear Algebra
- Introduction to Robotics
- ML: Learning Algorithms