CONG FU

http://congfu.github.io/
Los Angeles, California, 90066
congfu@umich.edu (734)680-3842

EDUCATION

University of Michigan, Ann Arbor, United States **Graduated 2018**

- MS in Mechanical Engineering (robotics and control) GPA: 3.92/4.0
- Coursework: Robotics System Lab, Robotics Kinematics and Dynamics, Self-Driving Car, C++, Linear System, Digital Control, Powertrain Control
- Online Course: Motion Planning, Visual SLAM, Mobile Robot, Computer Vision, Machine Learning, Deep Learning, Reinforcement Learning, Convex Optimization

Harbin Institute of Technology (HIT), Harbin, China **Graduated 2016**

- B.Eng. in Mechanical Design, Manufacturing & Automation GPA: 3.88/4.0
- Class Rank: Among top 6 out of 299 students, 1 out of 299 in the second and third year at HIT
- Coursework: Calculus, Linear Algebra, Numerical Methods, Probability and Statistics, Complex Function

WORK EXPERIENCE

Robotics Engineer, DMAI, Los Angeles **Jun 2018 – Mar 2020**

- Responsible for building mobile robot prototype including mechanical design, soldering, wiring, assembly, programming and system integration with ROS
- Performed robot perception and autonomous navigation systems development with camera and lidar for object detection, human tracking, and SLAM
- Developed and maintained a ROS node on micro-controller board for motor control, sensor interface and data processing
- Developed software components to interface with ROS navigation stack such as odometry and base PID controller
- Built simulator with Gazebo to test and compare different planners such as Deep Q-Learning based navigation
- Designed and implemented finite state machine to model behavior of robot for state transition in certain tasks
- Analyzed and evaluated the prototypes and robotic system at system level as well as component level
- Conducted social aware navigation research and tested several social scenarios in simulator

PROJECT EXPERIENCES

Digital Device Image Retrieval Contest (PyTorch) **Jul - Aug 2020**

- Developed accurate image retrieval for shopping by picture taking. Training data has 3096 categories, with almost 70 thousands images in total.
- Finetuned SE-ResNeXt on training dataset as backbone to extract feature and use GEM to aggregate local feature map
- Performed PCA and L2 normalization on global feature vector to get final representation for original images
- Indexed top 10 images similar to query digital device image from gallery database containing 40 thousands images
- Got 0.70 score in the metric of 50% top1 accuracy plus 50% mAP of top10 results

Advanced Lane Detection (Udacity, C++) **Oct - Nov 2019**

- Utilized OpenCV to develop a robust pipeline for highway lane detection and identification
- Transformed original image to bird eye view and use HSL and Lab color space transformation to perform lane detection
- Applied sliding window on the binary image to extract pixels of the lane and used second order polynomial to fit the lane

RGB-D SLAM Experiment (C++) **Jul - Aug 2019**

- Developed front-end visual odometry including feature extraction and matching, key frame selection, point cloud registration and stitching and pose estimation with OpenCV and PCL
- Constructed pose gragh and loop closure detection for back-end pose optimization with bundle adjustment

Motion planning for mobile robot (C++) **Apr - Jun 2019**

- Created global and local planner plugins in ROS navigation stack to perform mobile robot autonomous navigation
- Developed modified A* algorithm to find global path for the differential-drive mobile robot on a 2D grid map
- Implemented Dynamic Window Approach as a local planner to generate velocity command for mobile robot

Motion planning for UAV (MATLAB) **Apr - Jun 2019**

- Generated collision free trajectory for the quadrotor to follow and minimize energy consumption during flight
- Implemented minimum snap trajectory generation algorithm taking the waypoints from front-end A* search
- Implemented corridor-based smooth trajectory generation algorithm using bezier curve optimization

Automated Vehicle Reference Trajectory Tracking (MATLAB & SIMULINK) **Jan - Mar 2018**

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- Developed LQG controller in MATLAB for auto lane changing task and got highest score on the course
- Developed Kalman optimal estimator to estimate lateral velocity and yaw angle changing rate of the vehicle
- *Designed LQR and feedforward steering controller to track a predefined trajectory based on error dynamics model*

Robotics Estimation and Learning (MATLAB) **Jan - Feb 2018**

- Estimated a Gaussian model for ball color and developing a ball detect function based on the color model
- Implemented a linear Kalman filter for ball position tracking and velocity estimation in 2D space
- Implemented the Occupancy Grid Mapping algorithm for a 2D floor map using range measurement and known poses
- Implemented a particle filter for robot localization from LIDAR measurement in 2D space

Perception and control tasks of self-driving car simulation **Dec 2017**

- Implemented model predictive control and LQR control to track reference route based on predefined control input
- Implemented YOLO algorithm to perform vehicle recognition and localization using PyTorch framework
- Implemented feature-based algorithm to perform lane detection task on a recorded video using OpenCV library

Event-Driven Simulation of Fast Food Restaurant (C++) **Oct - Nov 2017**

- This project was an implementation of a server simulation at a fast food restaurant.
- Developed event driven method to simulate the restaurant with events such as customer arrival, waiting and being served
- Logged basic statistics such as customer numbers, customer waiting percentage and the longest waiting line, etc

Interactive Image Modification Program (C++) **Sep - Oct 2017**

- Used object-oriented design to develop an PPM image modification program with command line user interaction
- Designed interactive menu on command line for users to read in , annotate, write out images and show error checking result
- Allow user to: 1). draw user specified rectangle 2). annotate image with any shape pattern provided 3). insert another PPM image at a specified location within the original image

Real-time Motion Control of Two-wheeled Balancing Robot using Cascaded PID Controller (C++) **Feb – Mar 2017**

- Developed cascaded PID and feedforward controller to control balancing, position, and heading of a two-wheeled robot
- De-noised IMU data with low pass filter and fused odometry and gyro data with Kalman filter
- Interfaced with OptiTrack motion capture system to accomplish square path tracking task

6 DOF Robotics RGBD Vision Arm (Python) **Jan – Feb 2017**

- Completed a four-bar linkage gripper design prototype with SolidWorks, 3D printed out and assembled prototype
- Completed forward and inverse kinematics calculation and implementation using python
- Completed affine calibration to align pixel frame with world frame and colored-block coordinate detection using OpenCV

TESTS

- GRE: 323 (V: 153, 59%; Q: 170, 98%; AWA: 3, 15%) **Sep 2015**
- TOEFL: 97/120 (L: 27/30, S: 22/30, R: 26/30, W: 22/30) **Oct 2015**

AWARDS & HONORS

- SMC Corporation Scholarship **2015**
- National Academic Scholarship, National Level **2014**
- Honorable Excellent Student Award, University Level **2013 & 2014**

SKILLS

- Programming Language: C++, C, C#, Python, Java, Javascript, HTML/CSS
- System&Tool: Linux, MATLAB/Simulink, OpenCV, SolidWorks, AutoCAD, ADAMS
- Framework: ROS, PyTorch, Tensorflow
- Languages: English(fluent) and Chinese(native)