# Dingding Zheng

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## Education

**University of Pennsylvania** — Philadelphia, USA
*Master of Science in Engineering, Robotics* — *Aug. 2018 – May 2020*

**Donghua University** — Shanghai, CHINA
*Bachelor of Science in Engineering, Electrical Engineering* — *Sep. 2014 – June 2018*

## Research Interests

Micro Aerial Vehicles, Multi-agent Systems, Human Robot Teaming, Visual-SLAM, Optimal Control

## Research Experience

**Distributed and Collaborative Intelligent Systems and Technology** — July 2020 – Present
*University of Pennsylvania, Kumar lab* — *Supervisor: Prof.Vijay Kumar*

- Implemented behavior cloning and task allocation algorithms for multi-robot system using Graph Neural Network
- Helped improve the ROS, Unity-based testing environment for heterogeneous system

**Reconfiguration of Multi-modular Robots (SMOREs)** — Aug 2019 – July 2020
*University of Pennsylvania, Modlab* — *Supervisor: Prof.Mark Yim*

- Research on 3D reconfiguration efficiency of modular robots.
- Initialized multi-camera detection system using "Vicon" and "Apriltag".
- Implemented a MPC controller using ROS tuw package to do multi-robot path-planing and tracking.
- Explored new ways to justify the similarity between different robot configurations (topology).

**Human Robot Interaction & Safety Guarantee for Multi-agent System** — Aug 2019 – Oct 2019
*University of Pennsylvania, PRECISE lab* — *Supervisor: Prof.Osbert Bastani*

- Added car dynamics model into OpenAI multi-agent particle environment.
- Implemented MPC controller to simulate the human decision making and trained robotcar using MADDPG algorithm.
- Implemented "Human Social Force Model" to simulate the human decision making and MPC controller to control robot car.

## Projects

**Quadrotor Planning and Control** | *Python, ROS, CrazyFlies 2.0, EuRoc, Vicon* — Feb 2020 – May 2020

- Designed a geometric non-linear PID controller to let the quadrotor reaches its desired goal without collision.
- Down-sampled the path derived from A* to get waypoints and implemented "MinimumJerk" algorithm to get optimal trajectory.
- Implemented "Complementary Filter" and RANSAC to get accurate estimated states.
- Implemented "Error-state Kalman Filter" to estimate the pose of quadrotor given by data from IMU and onboard stereo pair.
- Reconstructed a 3D environment model given data from EuRoc dataset.

**Autonomous Racing** | *ROS, C++, Python, F1tenth racing car* — Feb 2020 – May 2020

- Designed and implemented algorithms to let the "F1tenth" racing car finish loops as soon as possible. Ranked 1st among all racing teams.
- Implemented "Point-to-Line Iterative Closest Point (PLICP)" to estimate the pose of racing car given by data from IMU, Lidar and VESC.
- Generated a 2D map of Upenn Levine 2nd floor using "Google Cartographer".
- Implemented "RRT*" algorithm and created local occupancy map to let the car avoidobstacles more efficiently.
- Implemented "Minimum Curvature" and "Covariance Matrix Adaptation Evolution Strat-egy (CMA-ES)" algorithm to get optimal racing trajectory.
- Implemented "Obstacle-Dependent Gaussian Potential Field" algorithm to do obstacle avoidance.

**RGBD SLAM** | *ROS, Python, THOR-OP humanoid robot* Apr 2020 – May 2020

- Integrated the IMU orientation and odometry information from a walking humanoid with a 2D laser range scanner in order to build a 2D occupancy grid map of the walls and obstacles in the environment.
- Integrated additional camera and depth imagery from a Kinect One sensor to build a textured map.

**Deep Learning for Computer Vision** | *Pytorch, OpenAI gym* Aug 2019 – Dec 2019

- Generated adversarial images using deep neural network.
- Implemented "YOLO v1" to do extremely fast real time multi object detection.
- Implemented "Mask-RCNN", which combines object detection and semantic segementation.
- Implemented a family of generative models including: "Variational Autoencoder (VAE)"and "Generative Adversarial Network (GAN)".
- Controlled OpenAI racing-car v0 using "Clipped Proximal Policy Optimization (Clipped PPO)" algorithm. Ranked: (5/26)th in the final race.

**Orienation Tracking based Panorama Stitching** | *Python* Apr 2019 – May 2019

- Implemented a kalman filter to track three dimensional orientation.
- Given IMU sensor readings from gyroscopes and accelerometers, estimated the underlying 3D orientation by learning the appropriate model parameters from ground truth data given by a Vicon motion capture system.
- Generated real-time panoramic images from camera images using the 3D orientation filter.

**6-DoF Pose Estimation** | *Pytorch* Apr 2020 – May 2019

- Trained a heatmap-based neural network which estimates the location of the keypoints in that image.
- Synthesized the heatmaps by identifying the location of each keypoint on the 2D image and placing a 2D Gaussian centered on this location on the corresponding heatmap.
- Used the coordinates of detected keypoints to estimate the 6-DoF pose of the object.

**Barrel Detection using Color Segmentation based on GMMs** | *Python* Mar 2019 – Apr 2019

- Trained a GMM-based model to detect barrels in images and found the relative world coordinates of the barrel.
- Implemented algorithms to learn the color model, segment the target color and finally localize the target object.
- Hand-labeled the training sets and then built a color classifier and a red barrel detector.

**UPenn Engineering Logo Projection** | *Matlab* Mar 2019 – Apr 2019

- Estimated the homography that maps the video images onto the logo points.
- Warped the sampled points according to the homography.
- Used the correspondence between sampled points and homography to project the "Penn Engineering" logo to the goal in a football match.

**Scale Invariant Detection** | *Matlab* Mar 2019 – Apr 2019

- Approximated a Laplacian of Gaussian filter (LoG) by a Difference of Gaussians (DoG).
- Used LoG filter for blob detection, such as: sunflower, birds, balloons, etc.

## Awards

**Excellent Academic Performance (Top 10%)** | *Donghua University* 2016 - 2017

**Mathematics Modeling Contest (Rank: 7/102))** | *Donghua University* 2016

**Mathematics Contest for Calculus (Rank: 3/351))** | *Donghua University* 2015

**Outstanding Undergraduate Student (Top 3%))** | *Donghua University* 2015

## Technical Skills

**Languages**: Python, C/C++, Matlab, HTML/CSS
**Deep Learning Frameworks**: Pytorch, Tensorflow, Keras
**Developer Tools**: Git, Docker, VS Code, Visual Studio, PyCharm
**Libraries**: Cvxopt, pandas, NumPy, OpenCV, scipy, pygame, Matplotlib