# Jianxiong Cai

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## EDUCATION

**University of Pennsylvania**, Philadelphia, PA, U.S *09/2019- 05/2021 (expected)*

- Candidate for M.S.E (Master of Science in Engineering) in Robotics

**ShanghaiTech University**, Shanghai, China *09/2015- 07/2019*

- Bachelor of Engineering in Computer Science
- GPA: **3.70**/4.0 (Overall)
- Focus Areas: Simultaneous Localization and Mapping (SLAM); Robotics; Computer Vision
- Research experience: ShanghaiTech MARS Lab (*Mobile Autonomous Robotic System*) with Prof. *Sören Schwertfeger*

## INTERESTS

- Semantic SLAM; Autonomous Mobile Robot; Mobile Manipulator; Robotics; Computer Vision

## SELECTED PROJECT EXPERIENCE

### Planar Object Detection with Geometric Image Rectification for CNN *03/2019-09/2019*

Research Project, ShanghaiTech MARS Lab (*Mobile Autonomous Robotic System*) *Advisor: Prof. Sören Schwertfeger*

- Proposed and implemented object detection with CNN detector using geometric image rectification explicitly.
- Rectified side-view images to canonical view in advance to help the CNN object detector.
- Trained the neural network for hazmat sign detection (with canonical-view images) with YOLOv3-tiny.
- Effectively eased the training stage for CNN object detector, compared with end-to-end solution.
  - Reduced the size of CNN detector network needed, as prospective distortion has been resolved in advance.
  - Reduced training time and training set size.
- Produced higher mAP and more accurate bounding boxes.
- Collected the first public-available RGB-D hazmat sign detection dataset for mobile rescue robots (*to be released).*
- Collaborated with another student to investigate the performance with hazmat sign detection (*as example objects).*
- Wrote an academic paper (probably as co-first author).
- *The work may be submitted to ICRA 2020 (unsubmitted and unpublished yet).*

### AGV (Autonomous Ground Vehicle) Research of Mobile Manipulator and Integration

*MARS Lab (Mobile Autonomous Robotic System), ShanghaiTech University & ABB Robotics (China) Joint Project*
*Supervisor: Prof. Sören Schwertfeger* *09/2017-05/2018*

- Built an autonomous mobile manipulator prototype with an ABB dual-arm manipulator (fixed industrial robot).
- Collaborated with a team with heterogeneous background (electronic engineer, mechanical engineer) to investigate the robot capability of performing complicated task like navigating to press buttons, taking elevators.
- Used generalized AMCL to perform self-localization based on vision for final prototyped solution.
- Tried bag of words for self-localization based on vision
- Constructed an approach for integrating map building, navigation and TCP communication into a complete system with SLAM, vision and manipulator technique.
- Successfully implemented a demo for the mobile manipulator to autonomously navigate and press buttons.
- Cool video at *https://robotics.shanghaitech.edu.cn/node/204*

## RELATED PROJECT EXPERIENCE

**Sign Detection and Robot System Integration (RoboCup)** *08/2018-05/2019*

RoboCup German Open 2019 Rescue Robot League (May 3-5, 2019) *(Intro: https://robocupgermanopen.de/en/major/rescue)*

*ShanghaiTech University MARS Lab (Mobile Autonomous Robotic System), Supervisor: Prof. Sören Schwertfeger*

- Participated in RoboCup 2019 German Opening (Rescue Robot League) as team member of MARS-RESCUE.
- Used SIFT feature extraction and descriptors for fast sign detection.
- Developed visualization utility which allows remote operator to view detection results real-time.
- Implemented various system integration utilities e.g. visualizer, robot emergence stop, detection result saver, etc.
- Total score ranked 5th out of 9 teams participated in the preliminary round, given that our robot is much smaller than other participators. *(Tasks become more challenging for us.)*

**Open Source Solution for Reconstructing Sparse Pointcloud** *03/2018-08/2018*

Student Developer, GSOC (Google Summer of Code) 2018 with Jderobot Organization

*Difficulties: Sparsity of input pointcloud (GSOC Program Intro: https://summerofcode.withgoogle.com)*

- Designed reconstruction pipeline including Loop closure with pose-graph optimization, Global localization.
  - Identified possible planes and candidate points with RANSAC plane estimation.
  - Used Region Growing to estimate finite plane and remove outliners away from other valid points.
- Proposed and implemented the whole project within the 3 months. *(official coding period started from May 2018)*
- Implemented prototype demo for final evaluation. *(All weekly progresses are logged at https://jderobot.org/Club-jianxiong)*

**Aspect Ratio Sensitive Network Improvement with Prior Knowledge for CNN-Based Object Detection**

Course Project, ShanghaiTech University *02/2018-05/2018*

*Group Members: Jianxiong Cai (team leader), Anqi Pang, Peijia Xu, Lei Jin, Ruijian Li*

*Advisor: Prof. Shenghua Gao*

- Proposed an approach to include object aspect ratio as a prior knowledge to CNN object detection network.
- Modified Fast-RCNN to generate proposal with 3 RPN sub-network. (classified by different target shapes)
- Improved the performance (AP) of certain classes for up to 3.9%.
- Constructed the detection method in tools of Pytorch, PASCAL VOC Dataset, COCO Dataset with knowledge of Computer Vision, Object Detection, Convolutional Neutral Network, Deep learning.

## TEACHING ASSISTANT EXPERIENCE

- Computer Architecture *Spring 2018*
- Introduction to Computer Science *Fall 2017*
- Introduction to Information Science and Technology *Spring 2017*

## SKILLS & INTERESTS

**Professional Skills**

- C++, Python 3, MATLAB
- ROS (Robot Operating System)
- Pytorch, Keras
- Linux (Ubuntu)
- LaTex

**Languages**

- English (fluent)
- Chinese (native speaker)

**Interests**

- Fencing
- Music Drama

## STANDARD TEST

- GRE: 325 (V: 156 (73%) Q: 169 (96%) AW: 3.5 (41%))