

Zhang Handuo

Date of Birth: 28/05/1988

Nationality: Chinese

INFORMATION

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EDUCATION

NANYANG TECHNOLOGICAL UNIVERSITY (NTU)

PH.D IN ELECTRICAL & ELECTRONIC ENGINEERING

2016-2021 | Singapore

Cum. GPA: 4.67/5.00

NORTHEASTERN UNIVERSITY

M.SC IN PATTERN RECOGNITION & INTELLIGENT SYSTEM

2011 - 2013 | Shenyang, China

College of Information Science & Engineering

Major GPA: 3.94 / 4.0

BACHELOR'S DEGREE IN AUTOMATION

2007 - 2011 | Shenyang, China

College of Information Science & Engineering

SKILLS

PROGRAMMING

C & C++ • Python • SQL

TECHNOLOGY

ROS • Pytorch • TensorFlow • FastAPI

AWARDS

2013 National Graduate Scholarship

2012 2 times of school 1st-class scholarship.

2011 **1st Prize** for 8th National Graduate Mathematical Contest in Modeling.

2010 **Meritorious Winner** (First Prize) for 2010 American Mathematical Contest in Modeling.

WORKING EXPERIENCES

MIND POINTEYE PTE LTD

AI SCIENTIST

April 2021 - Present | Singapore

- I am the tech leader of a team of 7 AI and data engineers on the development and deployment of video and IoT analysis.
- Lead development of "Multi-embedding query for person MOT-ReID System", which uses the innovative idea of pose-guided feature alignment to improve accuracy.
- Development of human action recognition and intrusion detection, with the combination of spatio-temporal and skeleton-based models. The algorithm has been deployed in applications like construction site surveillance and facility management.
- Construct an object detection pipeline with quantization-aware mixed precision training on top of YOLO family and DETR. The pipeline also supports semi-automatic labelling and curriculum learning.
- Development of model quantization and acceleration on edge devices of all video analysis related algorithms in both C++ and Python. The target edge computing chips include Rocketchip RK3588 NPU and Sophgo TPU.
- Development of long-term time-series forecasting and classification for stock return forecasting.
- Development of time-series data from IoT sensors for anomaly detection, remaining useful life estimation and predictive maintenance.

NTU EEE ROBOTICS I LAB

PROJECT OFFICER

Sep 2015 - Jan 2016 | Singapore

- Team leader of three post-graduate students in the collaboration project "Using Stereo vision System on a Fast Moving Unmanned Ground Vehicle" with ST Engineering.
- My work focus was visual SLAM and navigation based on stereo camera.
- I designed the hardware and software architecture.
- I was in charge of the calibration and sensor fusion of stereo cameras and GNS sensor.

SHENYANG INSTITUTE OF AUTOMATION CHINESE ACADEMY OF SCIENCES

ASSISTANT RESEARCHER

Aug 2013 - Sep 2015 | Shenyang, China

- I was in charge of robot communication and localization system development for earthquake rescue use.

PUBLICATIONS

PhD Thesis: Visual metric and semantic localization for UGV, 2022.

- (1) GMC: Grid Based Motion Clustering in Dynamic Environment
Handuo Zhang, K Hasith, Han Wang, Intelligent System Confernece (IntelliSys), 2019.
- (2) LaCNet: Real-time End-to-End Arbitrary-shaped Lane and Curb Detection with Instance Segmentation Network
Hui Zhou, Han Wang, **Handuo Zhang** and K Hasith, ICARCV 2020.
- (3) Multiple Object Tracking With Attention to Appearance, Structure, Motion and Size
K Hasith, Han Wang, **Handuo Zhang**, IEEE Access, 2019.
- (4) Real Time Multiple Object Tracking using Deep Features and Localization Information
K Hasith, **Handuo Zhang**, Han Wang, ICCA, 2019.
- (5) A consistent and long-term mapping approach for navigation
Handuo Zhang, K Hasith, Han Wang, International Journal of Research in Advent Technology (IJRAT), 2019.
- (6) Heading Reference-Assisted Pose Estimation for Ground Vehicles
Han Wang, Rui Jiang, **Handuo Zhang**, SS Ge. IEEE Transactions on Automation Science and Engineering (T-ASE), 2018.
- (7) A hybrid feature parametrization for improving stereo-SLAM consistency
Handuo Zhang, K Hasith, Han Wang, International Conference on Control and Automation (ICCA), 2017.
- (8) Ultra-wideband aided fast localization and mapping system
Chen Wang, **Handuo Zhang**, TM Nguyen, L Xie, International Conference on Intelligent Robots and Systems (IROS), 2017.
- (9) Stereo vision based negative obstacle detection
K Hasith, **Handuo Zhang**, Han Wang, ICCA, 2017.
- (10) Object co-segmentation via weakly supervised data fusion
Shiping Wang, **Handuo Zhang**, Han Wang. Computer Vision and Image Understanding (CVIU), 2017.

PROJECTS

1. STEREO VISION SYSTEM ON UGV

COOPERATION WITH ST ENGINEERING

2016 –2018 | Singapore

See project page: ugv_stereo.gitlab.io for more details.

The project aims to develop and implement a high speed stereo vision system and apply it onto unmanned ground vehicles (UGV).

We deploy obstacle detection & tracking system (for objects 50 meters away), road feature detection (including lanes and curbs), and visual SLAM into a unified system to make UGV run at 60 km/h speed.

- SLAM under heavy traffic has translation RMSE 0.043% and rotation 0.41°.
- Object tracking method (MASS): TPR is 0.947, MOTA 0.915, ranking 4th in KITTI tracking benchmark in 2019. (Right now ranked in 68th position due to the boom of deep learning based MOT methods).
- Object distance, bearing and size estimation mean error 1.58m, 1.25° and 0.45m in about 30 meters.
- Lane & Curb detection TPR 98%.

In terms of SLAM, we have four contributions:

1. **Utilize a hybrid feature parametrization technique.**
In outdoor scenes, we select remote features for rotation only estimation and alternately optimize rotation and translation to better handle fast rotation case.
Moreover, we choose the features with the most contributions considering spatial and temporal factors to improve feature association accuracy.
2. **Add an option to fuse IMU or AHRS (attitude and heading reference system) sensors to reduce drift of pure visual SLAM.**
We introduce a new auxiliary vertex of heading reference and construct a new graph optimization framework to make localization more accurate.
3. **Able to discover dynamic objects by using a grid-based motion clustering approach to filter out moving objects under dynamic traffic environments,** based on the assumption of motion coherence of unified distributed features.
4. **Able to save and load previous visited pose graph map** with key frames and sparse 3D point clouds and conduct 6D optimization to make current localization more robust and accurate. The saving and loading of a 10 km trip map takes only 5 seconds by optimizing the serialisation process.

In terms of robocentric mapping, we create a compact object-level map representation by differentiating temporary movable objects and static landmarks and obstacles.

By using object detection and motion hypothesis technology, we are able to extract movable objects and estimate their size, orientation and velocity individually to further abstract them into semantic cube models.

For static obstacles, we associate them with the estimated sparse feature points to help generate a 3D obstacle map which also contains localization information.

2. SAFETY PRODUCTION AND HIDDEN HAZARD WARNING

COMPUTER VISION BASED PROCEDURE MONITORING

2022 –2023 | Xuzhou, China

The project combines computer vision techniques with artificial intelligence (AI) algorithms to analyse and monitor human activities and procedures. The intelligent system can automatically recognise and understand the actions performed by workers in real-time, given standard operation procedure.

These actions can range from simple tasks to complex procedures, such as assembling parts, loading and unloading hazardous chemicals, or following safety protocols.

