

PENGYU CHU

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EDUCATION

Michigan State University

Ph.D. in Electrical and Computer Engineering

Aug. 2018 – Dec. 2023

Lansing, MI

Michigan State University

M.Sc. in Computer Science and Engineering

Dec. 2019 – Dec. 2020

Lansing, MI

Sichuan University

B.S. in Computer Science and Technology

Sep. 2012 – Jun. 2016

Chengdu, China

RESEARCH INTERESTS

Pengyu's research interest focuses on adaptive perception for robotics. His doctoral research is dedicated to designing robust deep learning-based approaches to resolve around **image segmentation** and **vision-based localization** in orchard-grown fruit harvesting, with a particular emphasis on addressing real-world challenges in agricultural automation. He has developed effective deep learning solutions for various applications, including fruit harvesting, food inspection, road anomalies surveillance, etc. Pengyu's strength also resides in **visual reasoning** and **reinforcement learning** applied in human computer interaction.

RELEVANT COURSEWORK

- Pattern Recognition
- Theory of Prob & Stat
- NLP
- Parallel Computing
- Deep Learning
- Computer Vision
- Data Mining
- Design of Algorithms

RESEARCH EXPERIENCE

Orchard Segmentation | @ MSU

2023 - now

- Developed and delivered **panoptic segmentation** models to enhance the capabilities of harvesting robots, enabling more precise and efficient harvesting operations.
- Designed and built **skeleton-aided segmentation** models for enhancing the accuracy dispersion segmentation tasks, tailored specifically to address the challenges of branch segmentation.
- Developed an efficient image annotation tool called **PicA** (powered by SEM) to optimize the data preparation process by reducing human effort.

Apple Detection & Localization | @ MSU

2020 - 2022

- Designed and built effective apple detection models using a suppression head and improved the accuracy of apple detection.
- Designed and built occlusion-aware detection models to address the challenges posed by clustered apples.
- Developed and delivered a laser-based 3D fruit localization pipeline with a designed laser extraction algorithm.

Traffic Anomalies Detection | @ MSU

2018 - 2019

- Developed real-time vehicle detection and tracking models for highway surveillance systems.
- Developed and delivered a comprehensive traffic anomaly detection pipeline, ensuring timely intervention in critical situations.

AWARDS

ASABE: Rain Bird Engineering Concept of the Year Award

2023

Outstanding Bachelor's Thesis in Sichuan University

2016

2nd Prize Scholarship in Sichuan University

2015

1st Prize in The Eighth National Challenge Cup Mathematical Contest in Modeling

2015

PUBLICATIONS

- [1] **Chu, P.**, Li, Z., Zhang, K., Chen, D., Lammers, K., and Lu, R. (2023). O2RNet: Occluder-occludee relational network for robust apple detection in clustered orchard environments. Smart Agricultural Technology, 5, pp.100284. **(SAT)**
- [2] Zhang, K., Lammers, K., **Chu, P.**, Dickinson, N., Li, Z. and Lu, R. (2022). Algorithm Design and Integration for a Robotic Apple Harvesting System. IEEE/RSJ International Conference on Intelligent Robots and Systems, Kyoto, Japan, 2022, pp. 9217-9224. **(IROS)**
- [3] Lu, R., Dickinson, N., Lammers, K., Zhang, K., **Chu, P.**, and Li, Z. (2022). Design and evaluation of end effectors for a vacuum-based robotic apple harvester. Journal of the ASABE, 0. **(ASABE)**
- [4] **Chu, P.**, Li, Z., Lammers, K., Lu, R. and Liu, X. (2021). Deep learning-based apple detection using a suppression mask R-CNN. Pattern Recognition Letters, 147, pp.206-211.**(PRLetters)**
- [5] Zhang, K., Lammers, K., **Chu, P.**, Li, Z. and Lu, R. (2021). System design and control of an apple harvesting robot. Mechatronics, 79, p.102644.

UNDER REVIEW

- [1] **Chu, P.**, Li, Z., and Lu, R. (2023). Skeleton-lead Dispersion Segmentation for Branch Prediction in Orchards.
- [2] **Chu, P.**, Li, Z., Zhang, K., Lammers, K., and Lu, R. (2023). High-Precision Fruit Localization Using Active Laser-Camera Scanning: Robust Laser Line Extraction for 2D-3D Transformation.
- [3] Zhang, K., **Chu, P.**, Li, Z., Lammers, K., and Lu, R. (2023). Active Laser-Camera Scanning for High-Precision Fruit Localization in Robotic Harvesting: System Design and Calibration.

PATENT

Renfu Lu, Zhaojian Li, Kyle Lammers, Kaixiang Zhang and Pengyu Chu. FRUIT PERCEPTION SYSTEM FOR ROBOTIC HARVESTING. US Patent App (18/463,516), 2023.

SERVICES

Talks:

- **ASABE 2023:** Apple Localization Using an Active Laser-Camera Scanner (ALACS) for Robotic Harvesting of Apples.
- **ASABE 2021:** Detection of Apples in Orchard Using Deep Neural Networks with Single and Multiple Cameras.

Reviewer:

- IEEE Robotics and Automation Letters
- International Journal of Intelligent Robotics and Applications
- Evolving Systems.
- Cogent Food & Agriculture