Fan WU

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Summary

- **Research Interests**: My research centers on the integration of **robotics**, **environmental sensing**, and **artificial intelligence** to enable intelligent, low-cost monitoring and intervention systems for biological and ecological environments. I develop **vision-based perception pipelines**, **3D reconstruction methods**, and **data-driven models**, and integrate them with **robotic platforms** for understanding and interacting with complex physical scenes.

  These techniques, originally developed for automated mushroom cultivation and harvesting, naturally extend to **field-scale monitoring problems** such as **wildlife activity analysis**, **habitat utilization**, and **resource impact assessment**. My goal is to build **scalable sensing and robotic systems** that support sustainable agriculture and environmental management through advanced perception, modeling, and physical interaction.

- **Highlight**: 5 years of programming experience; Proficient in data analysis using R and Python; A combination of science and engineering with a solid foundation in mathematics and science.

- **Relevant course**: Computer Vision(A), Mathematical Analysis(A), Big Data Analysis(A), Probability and Mathematical Statistics(A), Advanced Robotics(A), Theoretical Mechanics(A), Bio-environmental Engineering(A), Electrotechnics & Electronics(A), Mechanics of Materials(A)

Education

- **Zhejiang University** — Hangzhou, China
  Bachelor's of Engineering - ***Agricultural Engineering*** — *Sep. 2019 - Jun. 2024*
  Bachelor's of Science - ***Statistics***
  Overall GPA: 3.61/4.0, Major GPA: 3.70/4.0

- **North Carolina State University** — Raleigh, United States
  M.S. in Biological Engineering — *Since Aug. 2024*
  Overall GPA: 3.90/4.0

Published Paper

- **A review of robotic and automated systems in meat processing**:
  Yining Lyu[1*], **Fan Wu**[1*], Qingyu Wang, Guanyu Liu, Yingqi Zhang, Huanyu Jiang, Mingchuan Zhou[*]
  Frontiers in Robotics and AI, 5, 1578318, 2025 (*Equal contribution)
- **A Synthetic Vision System for Accurate 3D Mushroom Pose Estimation Using Multi-View RGB-D Fusion**:
  Fan Wu, Wenqiao Yuan[*]
  2025 ASABE Annual International Meeting, 2025
- **Improved two-stage deep learning algorithm and lightweight YOLOv5n for classifying cottonseed damage**:
  Weilong He[1*], **Fan Wu**[1*], Lori Unruh Snyder, Jean Cheng, Lirong Xiang[*]
  Computers and Electronics in Agriculture, 232, 110042, 2025 (*Equal contribution)
- **Development of A Bionic Hexapod Robot with Adaptive Gait and Clearance for Enhanced Agricultural Field Scouting**: Zhenghua Zhang, Weilong He, **Fan Wu**, Lina Maria Quesada-Ocampo, Lirong Xiang[*]
  Frontiers in Robotics and AI, 11, 1426269, 2024
- **Development of A Bionic Hexapod Robot with Adaptive Gait and Clearance for Enhanced Agricultural Field Scouting**: Zhenghua Zhang, Weilong He, **Fan Wu**, Lina Maria Quesada-Ocampo, Lirong Xiang[*]
  2024 ASABE Annual International Meeting, 2400650, 2024
- **Geometric based apple suction strategy for robotic packaging**:
  Zhong Wang, Qingyu Wang, Mingzhao Lou, **Fan Wu**, Mingchuan Zhou[*], Yibing Ying
  International Journal of Agricultural and Biological Engineering, 17(3), 12–20, 2024
- **Eggshell biometrics for individual egg identification based on convolutional neural networks**:
  Zhonghao Chen, Pengguang He, Yefan He, **Fan Wu**, Xiuqin Rao, Jinming Pan, Hongjian Lin[*]
  Poultry Science, 102(4), 102540, 2023

Paper in Progress

- **Towards Accurate Mushroom Pose Estimation: Integrating Synthetic Data Scaling and Multi-View Attention Fusion**: Fan Wu, Zhenghua Zhang, Wenqiao Yuan[*]
  In Submission to ***Computers and Electronics in Agriculture***
- **Monocular infrared imaging for high-throughput time-series phenotyping and instance-level growth modeling of mushrooms**: Fan Wu, Zhenghua Zhang, Wenqiao Yuan[*]
  In Submission to ***Smart Agriculture Technology***
- **MIR3D: Monocular Infrared Geometry Estimation for Autonomous Robotic Mushroom Harvesting in Dark Environments**: Fan Wu, Zhenghua Zhang, Wenqiao Yuan[*]
  In Submission to ***Robotics and Automation Letters***
- **Navigating Cluttered Vine Crop Fields with an Adjustable Clearance Hexapod Robot and Energy-Aware Path Planning**: Zhenghua Zhang, Pengyao Xiel, Fan Wu, Weilong He, Shengdao Du, Lirong Xiang[*]
  In Submission to ***Journal of Field Robotics***

Research Experience

- **North Carolina State University** — Raleigh, USA
  *Graduate Research Assistant, Supervised by **Prof. Wenqiao Yuan*** — *Since Aug. 2024*

  Mushroom Growth Monitoring and 3D Perception [Ongoing Work]

  - Built a mushroom growth monitoring system in dark, high-humidity environments using time-lapse active infrared imaging (10-minute interval).
  - Developed an IR-based 3D vision pipeline for mushroom reconstruction, including depth estimation, spatial measurement, and growth-stage inference.
  - Developed and evaluated efficient, non-destructive mushroom harvesting strategies based on a UR5e robotic arm.

  Deer Management in Field Environments [Ongoing Work]

  - Investigate methods to stitch large-scale all day field infrared images, accurately detect deer in complex backgrounds, and further estimate deer pose to determine crop-damaging behaviors for risk assessment.
  - Develop flexible and movable camera mounting systems to track active deer in the field, and use depth-aware vision algorithms to localize and reconstruct deer trajectories for motion analysis and feedback.

- **North Carolina State University** — Raleigh, USA
  *Visiting Undergraduate Researcher, Supervised by **Prof. Lirong Xiang*** — *Aug. 2023 - Dec. 2023*
  Research Topics: Image processing, Cottonseed damage classification, Hexapod robot development
  Categorized various cottonseed defect types and curated a specialized dataset with Dr. Lori Unruh Snyder. Developed a lightweight YOLOv5 detector and a Vision Transformer–based two-stage classification model to improve defect recognition accuracy. Additionally assisted in developing and testing a hexapod robot by implementing a U-Net–based vision network capable of detecting weeds, cucumbers, and obstacles in highly occluded agricultural environments.

- **Zhejiang University** — Hangzhou, China
  *Supervised by **Prof. Hongjian Lin*** — *Jun. 2022 - Jun. 2023*
  Research Topics: Image Processing, CNNs
  Proposed a method based on traditional machine vision to perform individual recognition of blunt-end egg images. The approach utilizes the SIFT algorithm to perform angle correction on the images, followed by binary encoding using 2D-Gabor filters. The Hamming distance between the two image encodings is then used to determine whether the images belong to the same egg.

Skills

- **Programming**: Python, R, LaTeX, C++, MATLAB
- **Frameworks**: TensorFlow, NumPy, PyTorch, OpenCV, Anaconda
- **Software**: SolidWorks, CAD, Altium Designer

Honors and Awards

- **Evans Fellowship** — Sep. 2024
- **BEFS College's Top 10 Graduation Projects for 2023 Undergraduates** — Jun. 2023
- **Outstanding Graduate of Zhejiang University** — May. 2023
- **Outstanding Student of Zhejiang University** — Oct. 2022
- **Kangerda Scholarship** — Oct. 2022
- **Best Overall in the Standard Division of the 2021 ASABE Robotics Competition** — Jul. 2021
- **Outstanding Leader of Zhejiang University Student Association** — May. 2021
- **Third Prize of Zhejiang College Students Physics Innovation Competition** — Dec. 2020
- **Special Prize of 2020 China Agricultural Robot Competition** — Oct. 2020