Xinyao (Cynthia) Zhang

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Research Interests

- **Advanced Manufacturing:** Human-Cyber-Physical Systems, Human-Robot Interaction Systems.
- **AI-Enabled Computation:** Simulation & Optimization, Big Data Analytics, Sustainable Design.
- **Robotics:** Manipulation & Control, Multi-physics Sensing, Embodied AI.

Education

- **University of Florida** — Gainesville, FL
  Doctor of Philosophy, Environmental Engineering — *Jan 2021 - May 2025*
  Advisor: Dr. Sara Behdad
  Master of Engineering, Electrical and Computer Engineering
- **University of Michigan** — Ann Arbor, MI
  Master of Engineering, Civil Engineering — *Aug 2019 - Dec 2020*
- **Chang'an University** — Xi'an, China
  Bachelor of Engineering, Civil Engineering — *Sep 2015 - May 2019*

Publications

Journal Articles

[6] **Zhang, X.**, Behdad, S. Reinforcement Learning-Driven for Maintenance Forecasting and Optimization, in progress.

[5] **Zhang, X.**, Liu, C., Liang, X., Zheng, M., Behdad, S. E-waste Net: A Hierarchical Image Database for End-to-end Learning, in progress.

[4] **Zhang, X.**, Tian, S., Liang, X., Zheng, M., Behdad, S. 2024. Multi-task Learning for Intention and Trajectory Prediction in Human-Robot Collaborative Disassembly Tasks. *Journal of Computing and Information Science in Engineering*, Accepted October 2024.

[3] **Zhang, X.**, Tian, S., Liang, X., Zheng, M., Behdad, S. 2024. Early Prediction of Human Intention for Human–Robot Collaboration Using Transformer Network. *Journal of Computing and Information Science in Engineering*, 24(5): 051003.

[2] **Zhang, X.**, Yi, D., Behdad, S., Saxena, S. 2023. Unsupervised Human Activity Recognition Learning for Disassembly Tasks. *IEEE Transactions on Industrial Informatics*, vol. 20, no. 1, pp. 785-794.

[1] **Zhang, X.**, Eltouny, K., Liang, X., Behdad, S. 2022. Automatic Screw Detection and Tool Recommendation System for Robotic Disassembly. *Journal of Manufacturing Science and Engineering*, 145(3): 031008.

Conference Articles

[4] **Zhang, X.**, Tian, S., Liang, X., Zheng, M., Behdad, S. 2024. Multi-task Learning for Intention and Trajectory Prediction in Human-Robot Collaborative Disassembly Tasks. *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC)*, IDETC2024-143753.

[3] **Zhang, X.**, Tian, S., Liang, X., Zheng, M., Behdad, S. 2023. Early Prediction of Human Intention for Human-robot Collaboration Using Transformer Network. *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC)*, IDETC2023-116492.

[2] **Zhang, X.**, Eltouny, K., Liang, X., Behdad, S. 2022. Automatic Screw Detection and Tool Recommendation System for Robotic Disassembly. *International Manufacturing Science and Engineering Conference (MSEC)*, MSEC2022-85403.

[1] Hu, Z., **Zhang, X.**, Liao, H., Liang, X., Zheng, M., Behdad, S. 2021. Deep Learning and Machine Learning Techniques to Classify Electrical and Electronic Equipment. *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC)*, IDETC2021-71403.

SCHOLARSHIPS & AWARDS

- First Year Faculty Teaching Academy Badge, University of Florida *2023*
- Don Maurer Memorial Scholarship Award, University of Florida *2023*
- David Cooper Scholarship, Florida Section of the Air and Waste Management Association *2023*
- Outstanding Merit from College of Engineering, University of Florida *2023*
- Witters Competition Engineering Award, University of Florida *2021*
- Research Program Scholarship Award, North Carolina State University *2020*
- First Prize Scholarship of College of Engineering, Chang'an University *2018*

RESEARCH EXPERIENCE

- **Safety and Smart Human-Robot Collaboration** University of Florida
  Research Scientist, led 3 projects *NSF, FW-HTF-RL*
  - **Multi-task Learning for Human Behavior Prediction**: Designed an autoencoder-based multi-task learning model to simultaneously predict human intention and trajectory, demonstrating the model's efficiency in parallel task predictions.
  - **Seq2seq Learning for Human Intention Prediction**: Established an early prediction framework combining a hidden Markov model for motion state segmentation with a Transformer model for real-time intention classification, achieving safety prediction without complete motion data.
  - **Unsupervised Learning for Human Activity Recognition**: Developed an unsupervised learning model combining a variational autoencoder with a hidden Markov model to learn disassembly activities, facilitating robotic perception of human actions without labeled data.
- **Digital Manufacturing** University of Florida
  Research Scientist, 1 project in-progress *NSF, DESC*

- **Digital Twin-based Sequence Planning**: Proposed a bidirectional framework connecting cyber and physical spaces to enable robotic disassembly sequence planning under uncertain product conditions.

- **Automated Electronic-Waste Remanufacturing** University of Florida
  Research Scientist, led 2 projects *NSF, FW-HTF-RL*
  - **Large-scale Hierarchical E-waste Dataset**: Created a comprehensive dataset of e-waste images captured during disassembly processes; organized the dataset hierarchically and labeled it to support diverse computer vision tasks to enhance robotic vision capabilities in e-waste management and recycling.
  - **E-waste Object Detection and Tool Recommendation**: Optimized a YOLOv4 algorithm for precise detection of screws in e-waste products and integrated an EfficientNetv2 model to recommend appropriate screwdrivers, advancing automated screw disassembly processes.

- **Product Life-Cycle Analysis** University of Florida
  Research Scientist, collaborated with industry 2 projects *NSF, DESC*
  - **Bayesian Learning for Repair Dataset Modeling**: Built a Bayesian model to identify vehicle maintenance patterns, utilizing probabilistic theory to improve the reliability of predicting repair needs and usage disparities.
  - **Medical-device Maintenance Data Mining**: Utilized variational autoencoders, LSTM networks, and K-means clustering to analyze device operation data at both holistic and individual levels, driving life-cycle management and maintenance strategies.

GRANTS EXPERIENCE

- **Technical Writer**, "Developing an Infrastructure for Remote Experimentation and Training using Robotic Control and Virtual Reality", submitted to NSF CCRI program, 2023.
  - **Precision-Enhanced SLAM**: Proposed a precision-driven simultaneous localization and mapping (SLAM) technique designed for computer chip federated testing, emphasizing delicate object detection.
  - **Remotely Plan and Control Robotic Arm**: Created a probabilistic roadmap planner to ensure safe robot navigation while minimizing operation time; developed a deep reinforcement learning controller for gentle grasping and manipulation to avoid damage.
- **Technical Writer**, "Integrating Artificial Intelligence into Product Assessment for Enhancing E-waste Management Practices", submitted to NSF DESC program, 2022.
  - **Semi-Supervised E-waste Detection and Segmentation**: Designed an object detection method to handle the challenge of overlapping tear-down images; proposed a multi-scale feature fusion approach to enhance e-waste boundary segmentation accuracy.
  - **Product Clustering and Repair Recommendation**: Suggested a hierarchical image clustering technique to categorize products by brand and integrated a user-based recommendation system to provide repair information feedback to manufacturers.

TEACHING EXPERIENCE

- **ENV6932: ML & AI for Engineering Applications** University of Florida
  Guest Lecturer *Fall 2024, 2023, 2022*
  - **Foundational ML Concepts**: Delivered lectures on essential ML concepts, covering various ML models, performance metrics, data structures, and practical applications in engineering.
  - **Hands-on Python Coding**: Guided students through interactive Jupyter notebooks, providing hands-on coding exercises and facilitating real-world problem-solving scenarios.
- **CEE 435: Building Information Modeling** University of Michigan
  Teaching Assistant *Fall 2020*
  - **Assisted with Grading**: Evaluated student projects on Revit software and provided detailed feedback on Canvas.
  - **Hold Office Hours**: Addressed student inquiries related to course material and provided guidance on completing assignments.

INVITED TALKS & PRESENTATIONS

- **X. Zhang et al.,** (2024) Multi-task learning for human behavior prediction in human-robot collaborative disassembly tasks, *IDETC*, Washington, DC, August 27.
- **X. Zhang et al.,** (2023) Early prediction of human intention for human-robot collaboration using transformer network, *IDETC*, Boston, MA, August 22.
- **X. Zhang et al.,** (2022) Automated screw detection system for robotic disassembly, *MSEC*, Purdue University, June 28.
- **X. Zhang et al.,** (2022) Automated screw detection system for robotic disassembly, *The Future of Human-Robot Cooperation in Remanufacturing Workshop*, Virtual, August 11.
- **X. Zhang,** (2022) Unlocking the Potential of Medical Devices Repair Data Using Sequential Neural Network Methods, *Production and Operations Management Society Conference*, Virtual, April 22.
- **X. Zhang et al.,** (2021) Deep learning and machine learning techniques to classify electrical and electronic equipment, *IDETC*, Virtual, August 18.

SERVICES

- **Reviewer:**
  - Journal of Mechanical Design
  - International Conference on Machine Learning (ICML) Workshop
  - International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC)
- **Professional Societies:**
  - American Society of Mechanical Engineers (ASME): Computers and Information in Engineering Committee, Design for Manufacturing and Life Cycle Committee
  - Institute of Electrical and Electronics Engineers (IEEE)

- Society of Women Engineers (SWE)

- **Volunteer:**
  - K-12 education outreach
  - Graduate recruitment webinars
  - Commencement marshals
  - Industry career fair

MENTORING EXPERIENCE

- Undergraduate student in environmental engineering, 2023 - present. Supervised the development of a review paper on e-waste treatment methods.
- PhD student in computer science, 2024. Guided machine learning project at ML4H symposium.
- Graduate student in civil engineering, 2020. Coordinated research on virtual reality topic.

PROFESSIONAL SKILLS

- **AI and Machine Learning:**
  - Programming: Python, TensorFlow, PyTorch, LaTex, GitHub, MATLAB
  - Simulation: Unity, Revit, AutoCAD
  - Robotics: ROS

- **Interpersonal Skills:**
  - Communication
  - Technical Writing
  - Leadership and Collaboration