Yao DU 杜尧

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Research Summary: I am a Ph.D. candidate at HKUST working on multimodal foundation models, focusing on physically grounded perception, numerical understanding, and quantitative reasoning in vision-language and MLLM systems. My research develops principled learning objectives and evaluation frameworks to improve how models perceive, represent, and reason about physical quantities and numerical distributions in real-world environments.

Education

PhD, The Hong Kong University of Science and Technology
Major: Electronic and Computer Engineering 2022.09 – 2026.12
Advisor: Prof. Xiaomeng Li Expected

MPhil, The Hong Kong Polytechnic University
Major: Structural Health Monitoring 2019.09 – 2022.06
Advisor: Prof. Yong Xia

BEng, Northwestern Polytechnical University
GPA: 91.88/100 Rank: 1/53 2015.09 – 2019.06

Research Directions

Quantitative Perception, Multimodal Reasoning, and AI for Physical Systems

- ***Multimodal Quantitative Reasoning***: Improving numerical understanding and physical quantity perception in vision-language and multimodal foundation models.
- ***Medical and Scientific AI***: Developing data-efficient and reliable models for medical imaging and scientific applications, guided by domain knowledge and inductive biases.
- ***AI for Physical Systems***: Integrating AI models with real-world sensing systems for sensing data analysis, anomaly detection, and deployment in infrastructure monitoring.

Publications

Quantitative Reasoning and Evaluation for Multimodal Foundation Models
Numerically grounded perception, quantitative reasoning, and distribution awareness in VLM/MLLMs.

1. **Teach CLIP to Develop a Number Sense for Ordinal Regression.**
   Yao Du, Qiang Zhai, Weihang Dai, Xiaomeng Li. **ECCV 2024 (First author)**
   Proposes a unified framework that maps numbers to linguistic concepts, combining coarse-to-fine regression with distance-aware cross-modal contrastive learning to improve ordinal reasoning in VLMs.
2. **Injecting Distributional Awareness into MLLMs via Reinforcement Learning for Deep Imbalanced Regression.**
   Yao Du, Shanshan Song, Xiaomeng Li. **Under Review 2026 (First author)**
   Identifies the limitations of supervised fine-tuning for numerical regression, and introduces GRPO with batch-aware supervision for deep imbalanced regression together with a newly constructed DIR benchmark.
3. **Semi-Supervised Contrastive Learning for Deep Regression with Ordinal Rankings from Spectral Seriation.**
   Weihang Dai, **Yao Du**, et al. **NeurIPS 2023 (Second author)**
   Studies semi-supervised deep regression by leveraging cross-sample relationships and noisy unlabeled outputs to extract informative supervision signals.

Medical Image Analysis: Echocardiography and Computational Pathology
Parameter-efficient fine-tuning and multimodal representation learning for medical imaging.

1. **CardiacCLIP: Video-based CLIP Adaptation for LVEF Prediction in a Few-shot Manner.**
   Yao Du, Jiarong Guo, Xiaomeng Li. **MICCAI 2025 (First author)**
   Extends CLIP-based ordinal regression to echocardiography, with a focus on multi-scale representation learning and frame-level relationship modeling.
2. **Beyond H&E: Unlocking Pathological Insights with Polarization Imaging.**
   Yao Du, et al. **BIBM 2025 (First author)**
   Constructs a paired HE and polarization imaging dataset through a customized acquisition pipeline, and demonstrates the effectiveness of multimodal fusion for enhancing pathology representation learning.
3. **CardioInfuser: Multi-scale Semantic Infusion for Few-shot Echocardiogram Video Assessment.**
   Yao Du, Marawan Elbatel, Jiewen Yang, Xiaomeng Li. **Under Review 2026 (First author)**
   Investigates representation alignment strategies for echocardiogram model enhancement through external representation distillation.
4. **MUST: Multi-Style Virtual Staining with Incomplete Pairs.**
   Jiaxin Zhuang, **Yao Du**, et al. **Under Review 2026 (Second author)**
   Explores multi-style virtual staining using diffusion models under incomplete pairing, modeling cross-modality relationships in pathology.

Artificial Intelligence of Things (AIoT) / Structural Health Monitoring (SHM)
Infrastructure sensor anomaly detection, edge computing, and AIoT systems.

1. **Convolutional Neural Network-based Data Anomaly Detection Considering Class Imbalance with Limited Data.**
   Yao Du, Lingfang Li, et al. **Smart Structures and Systems, 2022 (First author)**
   Applies AI models to anomaly detection in SHM under limited and imbalanced data settings.
2. **Data Anomaly Detection through Semi-supervised Learning Aided by Customized Data Augmentation Techniques.**
   Xiaoyou Wang*, **Yao Du***, et al. **Structural Control and Health Monitoring, 2023 (Co-first author)**
   Investigates data augmentation and semi-supervised learning strategies for anomaly detection under label scarcity in structural health monitoring.
3. **Wireless IoT Monitoring System in Hong Kong-Zhuhai-Macao Bridge and Edge Computing for Anomaly Detection.**
   Xiaoyou Wang, Wanglin Wu, **Yao Du**, et al. **IEEE Internet of Things Journal, 2023**
   Develops an end-to-end wireless IoT monitoring framework with real-world deployment for the Hong Kong-Zhuhai-Macao Bridge.

Professional Service

Conference Reviewer: CVPR2025, ICCV2025, NeurIPS2025, ICML2026, BMVC2026, MICCAI2026
Journal Reviewer: IEEE Transactions on Neural Networks and Learning Systems (TNNLS)

Awards

National Scholarship, Northwestern Polytechnical University, 2016, 2017, 2018
Outstanding Reviewer, CVPR 2025