Zhuo **Zhi**

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Education

University College London (UCL) *UK*

PhD in Electronic and Electrical Engineering *Oct. 2021 - Oct. 2025 (expected)*

- Fully Funded by The Engineering and Physical Sciences Research Council (EPSRC), UK
- Research direction: Deep learning, Multimodal learning (including image, text, video, audio, EHR, sensor signal), Machine learning for healthcare, Portable Medical System

Harbin Institute of Technology (HIT) *China*

M.S. in Instrument Science and Technology *Sep. 2019 - June 2021*

- Research direction: Fault diagnosis of robotics by machine learning, Compensation of integrated navigation systems
- Core courses: Digital Signal Processing, Digital Image Processing, Advanced Sensing Technique

Shandong University (SDU) *China*

B.S. in Automation *Sep. 2015 - June 2019*

- Core courses: Analogue/Digital Electronic Technique, Automatic Control Theory, Signal and System, Computer Control System

Employment

Research Assistant

Shandong University *2019*

- Designed a desktop terminal for real-time monitoring of copepod zooplankton artificial cultivation.
- Used PH sensor, water oxygen content sensor, mechanical arm motion sensor to build the sensor net, used NRF for wireless communication and built the terminal with LCD, keyboard, etc.

Research Assistant

Shandong University *2018*

- Deployed the Yolov model for rubbish detection on the water surface.
- Designed an autopilot with MCU, gyroscope, accelerometer, magnetometer and GPS to achieve automatic driving of the rubbish removal vessel.

Publication & Patent

- **Zhi, Z**., Liu, Z., Elbadawi, M., Daneshmend, A., Orlu, M., Basit, A., Demosthenous, A. and Rodrigues, M., 2024. Borrowing Treasures from Neighbors: In-Context Learning for Multimodal Learning with Missing Modalities and Data Scarcity. arXiv preprint arXiv:2403.09428.
- Liu, Z., **Zhi, Z**., Bogunovic, I., Gerner-Beuerle, C. and Rodrigues, M., 2023. PROSAC: Provably Safe Certification for Machine Learning Models under Adversarial Attacks. NeurIPS 2023 Workshop on Regulatable ML.
- **Zhi, Z**., Elbadawi, M., Daneshmend, A., Orlu, M., Basit, A., Demosthenous, A. and Rodrigues, M., 2024. HgbNet: predicting hemoglobin level/anemia degree from EHR data. arXiv preprint arXiv:2401.12002.
- Liu, L., **Zhi, Z**., Yang, Y., Shirmohammadi, S. and Liu, D., 2023. Harmonic reducer fault detection with acoustic emission. IEEE Transactions on Instrumentation and Measurement.
- **Zhi, Z**., Elbadawi, M., Daneshmend, A., Orlu, M., Basit, A., Demosthenous, A. and Rodrigues, M., 2022, July. Multimodal diagnosis for pulmonary embolism from ehr data and ct images. In 2022 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) (pp. 2053-2057). IEEE.
- **Zhi, Z**., Liu, D. and Liu, L., 2022. A performance compensation method for GPS/INS integrated navigation system based on CNN–LSTM during GPS outages. Measurement, 188, p.110516.
- **Z. Zhi**, L. Liu, "Fault detection of the harmonic reducer based on CNN-LSTM with a novel denoising algorithm." IEEE Sensors Journal, 2021, 22(3), 2572-2581.
- **Zhi, Z**., Liu, L. and Liu, D., 2020, October. Enhancing the reliability of the quadrotor by formulating the control system model. In 2020 ICSMD (pp. 242-246). IEEE.
- "An early fault detection method for industrial robot harmonic reducer based on WLCTD and OMA-VMD". China Invention Patent. CN113878613A.
- "An early fault detection method for industrial robot harmonic reducer based on WLCTD and CNN-LSTM". China Invention Patent. CN113887702A.

Project & Research

Lab-on-an-App: AI Empowered Point-of-Care Diagnostics for Ageing Population

(PhD project) Funded by EPSRC, UK *2021-2025*

- Expected to develop a portable, non-invasive and accurate medical system (including sensor technology, multimodal machine learning technology and mobile APP development) to achieve personalized anemia prediction, personalized treatment planning and personalized monitoring.
- Proposed innovative multimodal medical system based on EHR, conjunctival images and PPG sensors.

Regularisation for promoting modality alignment and heterogeneity in multimodal transformer

(ongoing) *2024*

- Expected to propose a regularisation of multimodal transformers using a non-parametric approach for promoting modal alignment while preserving heterogeneity
- The method will be evaluated on 15 multimodal datasets (including image, text, video, audio, EHR, sensor signal) with modality noise/missing.

In-Context Learning for Multimodal Learning with Missing Modalities and Data Scarcity

HTTPS://ARXIV.ORG/ABS/2403.09428 (UNDER REVIEW)   2023

- Proposed a retrieval-augmented in-context learning method to improve the robustness of multimodal models under missing modalities and data scarcity.
- The proposed approach is evaluated under both multimodal medical and vision-language tasks to show the SOTA performance.

HgbNet: predicting hemoglobin level/anemia degree from EHR data

HTTPS://ARXIV.ORG/ABS/2401.12002 (UNDERVIEW)   2022

- The HgbNet is proposed for predicting the hemoglobin level and anemia degree from EHR data, which mainly solves the problem of missing values and irregular time intervals in medical time series.
- The proposed method is evaluated on two real-world EHR datasets, and two use cases are considered in the experiments, which cover common application scenarios. The performance of the proposed method is significantly improved over baseline

Multimodal Diagnosis for Pulmonary Embolism from EHR Data and CT Images

2022 44TH IEEE EMBC   2021

- Proposed a multimodal fusion machine learning model ingesting EHR data and CT images for PE diagnosis.
- The proposed MLP-2D-CNN model achieves the diagnosis accuracy at 97.3%, which is superior to all unimodal models.

An Easy and Fast Method for Landfill Identification by Image-Based Deep Learning

(UNDER REVIEW)   2023

- Proposed a classification-clustering-based cascade deep learning model to detect landfills from satellite images.
- The proposed model is evaluated in maps with different resolutions, showing better performance than traditional target detection models, and a reference for energy efficiency balance is given.

Fast design of dual-atom catalysts to C1 and C2 products through altering central metal atoms for electroreduction of carbon dioxide

(UNDER REVIEW)   2023

- Applied and compared different machine learning models in developing high-performance electrocatalysts for the CO2 reduction reaction.
- The results demonstrate the huge potential of the machine learning method in material design and provide theoretical guidance on the design of high-performance DMSCs for CO2RR.

A performance compensation method for GPS/INS integrated navigation system based on CNN–LSTM during GPS outages

Published in Measurement   2021

- Proposed a wavelet correlation threshold denoising algorithm to mitigate the noise of MEMS IMU.
- Designed a CNN-LSTM model to compensate for INS/GPS integrated navigation system under GPS failure, which achieved better performance than the existing compensation methods.

Research on Condition Acquisition and Fault Detection of Industrial Robot Reducer

Published in IEEE Sensor Journal and IEEE Transactions on Instrumentation and Measurement   2022

- Designed a test system for industrial robot reducer. Released the dataset of the harmonic reducer under different working conditions.
- Proposed the WRCTD algorithm for denoising and CNN-LSTM model for fault diagnosis from vibration/acoustic emission sensor signal and the performance surpasses all baselines.

Honors & Awards

2021	**UCL EPSRC DTP Research Studentship**,	
2018	**Shandong University Outstanding Undergraduate Research Assistant** ,	(Top 5%, 2/40)
2018	**First Prize of National College Student Smart Car Competition** ,	(Top 0.5%, 10/2000)
2020	**First-class Special Scholarship for Graduate Student**,	(Top 18%, 20/110)
2019	**First-class Scholarship for Outstanding Undergraduate Student**,	(Top 5%, 6/120)
2018	**Special Prize of China Engineering Robot Competition** ,	(Top 1.5%, 3/200)
2019	**Special Prize of China Engineering Robot Competition** ,	(Top 1.5%, 3/200)

Teaching & Service

2023	**Teaching assistant**,	Integrated Machine Learning Systems at UCL, Dept. EEE
2022	**Teaching assistant**,	Applied Machine Learning Systems at UCL, Dept. EEE
2023	**Teaching assistant**,	Machine Learning Masterclass at the UK Defence Science and Technology Laboratory
2023	**Organiser**,	Weekly Machine Learning Reading Group at UCL Dept. EEE
2024	**Mentor**,	Third-year undergraduate student project at UCL Dept. EEE
2024	**Mentor**,	Master student project at UCL Dept. EEE
now	**Reviewer**,	IEEE-TIM, IEEE sensor journal, Measurement