Mr. Hanlin Cai

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OVERVIEW

As a highly motivated and collaborative engineering student with a strong focus on Molecular Communication and the Internet of Nano Things, I have developed expertise in system modeling, data processing and machine learning. My experience spans roles in both industry and research institutions, four peer-reviewed publications, and six international awards from prestigious engineering competitions and conferences.

EDUCATION

University of Cambridge, United Kingdom ***Sep. 2024 – Sep. 2025***

Master of Philosophy in Engineering, supervised by IEEE Fellow Özgür B. Akan

- Research Project: Odor-based Molecular Communication System in Internet of Everything

National University of Ireland, Maynooth (NUIM) ***Sep. 2020 – Jun. 2024***

Bachelor of Science in Robotics and Intelligent Devices

- First Class Honours, Award Mark: 88.1% (**Ranking: 1/51**, Best Academic Performance Award)

Fuzhou University (FZU, China-Ireland Cooperative Program) ***Sep. 2020 – Jun. 2024***

Bachelor of Engineering in Automation (Taught in English)

- Average Score: 88.72 (Ranking: 1/60)
- **Scholarships:** Innovation Scholarship (Highest Award at NUIM, $2500), XiamenAir Scholarship ($1000), First Prize Scholarship ($1000, Four Times), Best Bachelor Thesis Award (Top 1/300).

HONOURS

ACM SIGKDD Undergraduate Scholars ($1000, for outstanding performance in data mining research) *2024*
AAAI Undergraduate Scholars ($5000, for outstanding performance in machine learning research) *2024*
Finalist of China International Internet+ Innovation and Entrepreneurship Competition (Top 3%) *2023*
Outstanding Finalist in International Mathematical Contest in Modeling (Top 1% out of 20508 paper) *2023*
Best Technology Award in China National Youth Science Innovation Project Competition (Top 1%) *2023*
First Prize in China Contemporary Undergraduate Mathematical Contest in Modelling (Top 5%) *2022*

PUBLICATIONS

[1] Hanlin Cai, Yuchen Fang, Jiacheng Huang, Hongling Liao, Meng Yuan, Zhezhuang Xu. **"Securing Billion Bluetooth Low Energy Devices Using Cyber-Physical Analysis and Deep Learning Techniques".** *The 30th ACM SIGKDD Conference on Knowledge Discovery and Data Mining, Undergraduate Consortium. Also presented in the 38th Annual AAAI Conference on Artificial Intelligence, 2024.*

[2] Hanlin Cai, Yuchen Fang, Jiacheng Huang, Meng Yuan, Zhezhuang Xu. **"Poster: Hybrid Detection Mechanism for Spoofing Attacks in Bluetooth Low Energy Networks".** *The 22nd ACM International Conference on Mobile Systems, Applications, and Services (MobiSys), 2024.*

[3] Hanlin Cai, Zheng Li, Jiaqi Hu, Wei Hong Lim, Sew Sun Tiang, Mastaneh Mokayef, Chin Hong Wong. **"Optimising Traffic Sign Detection System Using Deep Residual Neural Networks Combined with Analytic Hierarchy Process Model".** *The 28th International Conference on Artificial Life and Robotics. Recommended for expanding publication in the Journal of Advances in Artificial Life Robotics, 2023.*

[4] Hanlin Cai, Haotianfu Wang, Shaojie Zhang, Ozgur B. Akan. **"*E2E-MolCom*: End-to-End Learning Framework for Semantic-Driven Molecular Communication".** *Submitted to IEEE Internet of Things Journal (IEEE IoTJ). Under Review, 2025.*

RESEARCH EXPERIENCE

Postgraduate Researcher, Internet of Everything (IoE) Group, University of Cambridge, UK
Supervisor: Prof. Özgür B. Akan ***June 2024* – Present**

Outline:

- Developed an end-to-end deep learning framework for semantic-driven molecular communication systems, enabling efficient and robust transmission of task-relevant information in challenging environments.

Key Responsibilities:

- Implemented the *E2E-MolCom* framework based on joint source channel coding, incorporating semantic feature extraction and molecular signal modulation to enable end-to-end training with real-world constraints.

Achievement:

- Achieved a 32% performance improvement over traditional method; research paper submitted to ***IEEE IoTJ***.

Embedded Development Engineer, HUADING Intelligent Manufacturing Technology Co., Ltd., China
Mentor: Dr. Yuxiong Xia ***Jan. 2023 – June 2023***

Outline:

- Effectively tackled the complexities of instrument inspection with intricate industrial environments by devising an intelligent inspection system based smart IoT devices, quadruped robots and cloud computing.

Key Responsibilities:

- Integrated machine control with visual algorithms to empower quadruped robots to extract and analyse images of industrial instruments; Implemented real-time data collection of sensor modules using ESP32.

Achievement:

- Won the **Best Technology Award** in China National Youth Science Innovation Project Competition (top 1%).

Research Intern, State Key Laboratory of Industrial Automation Control Technology, China
Supervisors: Prof. Zhezhuang Xu and Dr. Yuan Meng ***Oct. 2022 – June 2024***

Outline:

- Addressed the security vulnerabilities and susceptibility to attacks in Bluetooth Low Energy Networks utilising a hybrid attack detection mechanism based on cyber-physical features and machine learning.

Key Responsibilities:

- Established a BLE experimental platform, collected datasets using BLE Sniffer, nRF Connect and Wireshark. Developed an attack detection mechanism based on temporal convolutional network, text-CNN and SVM.

Achievement:

- Secured a NSF Grant over $5000; Authored two research paper presented in ***MobiSys 2024*** and ***KDD 2024*.**

Research Intern, Centre for the Integration of Science, Technology & Culture, University of Cambridge, UK
Supervisor: Prof. Pietro Liò ***June 2022 – Dec. 2022***

Outline:

- Resolved the challenge of detecting multiple mixed attacks in wireless sensor networks (WSNs) by designing a learning-based detection framework that integrates reconstruction and classification methodologies.

Key Responsibilities:

- Developed a multiple-mix-attacks detection algorithm using graph neural network and random forest models.

Achievement:

- Established a state-of-the-art detection benchmark and a large-scale dataset for WSNs security research.

SKILLS

Language Skills: English (Fluent, IELTS 7.5), Mandarin (Native), Hokkien (Native).
Programming: Proficient in MATLAB, Python, LaTeX; experienced in C++, HTML, CSS, JavaScript, Bash.
Hobbies: Swimming (Reached China national second-level swimming athlete standard).