# 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)*

- GPA: 3.82/4.00, Average Score: 88.72
- **Scholarships:** Innovation Scholarship (Highest Award at NUIM, $2500), XiamenAir Scholarship ($1000), First Prize Scholarship ($1000, Four Times), Best Bachelor Thesis Award of NUIM (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, Jiacheng Huang, Yuchen Fang, Chen Dan, Zhezhuang Xu. **"Detecting Multiple-mix-attack in IoT Networks through Reconstruction and Classification Machine Learning Techniques".** *IEEE Sensors Journal. Under Review, 2024.*

## RESEARCH EXPERIENCE

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

**Outline:**

- Exploring novel molecular communication methods to expand the potential of nano-scale networks, focusing on Odor-based systems to enhance information transmission reliability in the Internet of Everything.

**Key Responsibilities:**

- Developed an efficient and resilient molecular communication system based on Odor intensity and frequency shift keying to encode information; employed RNN and CNN models to enhance odor molecule recognition.

**Achievement:**

- Achieved a threefold improvement over previous benchmarks; paper submitted to IEEE Trans. on MBMC.

**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 leveraging IoT devices, quadruped robots and cloud computing.

**Key Responsibilities:**

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

**Achievement:**

- Won the **Best Technology Award** in the 2023 China National Youth Science Innovation Project Competition.

**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 algorithm based on temporal convolutional network, text-CNN and SVM.

**Achievement:**

- Secured a research grant over $5000; Authored two research paper and accepted into **AAAI** and **ACM KDD.**

**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-mix-attacks within IoT networks by developing a detection framework that integrates reconstruction and classification learning approaches.

**Key Responsibilities:**

- Developed a multiple-mix-attacks detection algorithm based on LSTM model and random forest algorithm.

**Achievement:**

- Research report achieved a ranking within Top 3%; Won an outstanding oversea visiting scholarship ($2500).

## 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 Chinese national second-level swimming athlete standard).