KAIYUAN HOU

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RESEARCH INTEREST

My research lies at the intersection of Mobile Computing and Human-Computer Interaction, focusing on accessible health platforms and AR systems. Passionate about generative AI, I am working on enabling Large Language Models to better understand and interact with the physical world.

EDUCATION

Columbia University New York, NY, USA
Ph.D. Electrial Engineering **4.04/4.00** **09/2021 - Expected 2027**
Research Advisor: Dr. Xiaofan (Fred) Jiang
Course: Generative AI, RL, Deep Learning, Computer Network, Cloud Computing, Big Data, Embedded AI, Blockchain, Database, Random Signal Processing, DSP, Sparse Model, SaaS, Mobile Computing

University of Colorado Boulder Boulder, CO, USA
B.S. Electrical Engineering **3.98/4.00** **09/2017 - 05/2021**
Summa Cum Laude; Member of Tau Beta Pi; Dean's list from 2017 fall to 2021 fall; Merit Scholarship
Course: Computer Architecture, Control Theory, Microelectronics, Linear Systems, Embedded System, Algorithm, Data Structure, Complex Variables, ODE, Probability, Quantum Computing, Quantum Physics

RESEARCH EXPERIENCE

Intelligent and Connected Systems Lab, Columbia University **09/2021 - Present**
Graduate Research Assistant

Reconfigurable drone as an automated smart home assistant: Developed a lightweight indoor drone capable of acting as an autonomous smart home assistant for tasks such as item localization, monitoring, and delivery. By incorporating various foundation models, the system understands the environment and user commands. Designed a modular swapping platform, both mechanical and electrical, that enables the drone to load or unload sensing or actuating modules. Leveraged LangGraph to implement a large language model (LLM) agent for task comprehension and scene understanding using bird's-eye view images. Additionally, implemented an image cropping algorithm to enhance visual language model (VLM) performance, allowing it to detect small objects within the scene more effectively. (MobiCom 2024, SenSys 2025)

Airflow measurement with UAV: Developed a low-cost drone system for 3D airflow mapping in indoor environments. The motor controllers adaptively adjust their behavior to compensate for wind-induced turbulence, which makes the drone an effective tool for airflow measurement. Implemented various drone firmware with multiple control schemes to explore their impact on measurement accuracy. The system achieved wind speed and direction measurements with errors up to 0.41 m/s and 25.1°, outperforming the existing state of the art, and mapped 3D airflow fields with an average RMS error of 0.73 m/s. (MobiCom 2023)

AR assisted intelligent stethoscope platform: Created an Augmented Reality (AR)-assisted stethoscope platform to guide users in performing auscultation at home. The system leverages pose estimation, computer graphics, acoustic intelligence, human-computer interaction, and signal processing algorithms, enabling non-expert users to perform 4-point auscultation screening in approximately 13 seconds per point. This approach achieved a 46.57% improvement in accuracy for auscultation point positioning compared to baseline methods. Comprehensive evaluations confirmed the effectiveness of AR guidance in enhancing user performance. (Sensys 2022, IPSN 2023)

Continuous multi-person fever screening system: Developed a low-cost RGB-thermal camera system for continuous multi-person fever screening. Implemented real-time algorithms for tracking and reconstructing personalized 3D head model for each head detected. The system achieved a measurement error rate of within 0.4°F at 2 meters and 0.6°F at 3.5 meters across diverse demographics without introducing bias on different skin colors. Deployed multiple systems at a clinic, a medical school, and a restaurant for a total of about three years, successfully screening over 40,000 individuals and detecting more than 3,000 fever cases. (IPSN 2022)

Modular sensing platform: Developed a plug-and-play platform based on Raspberry Pi, designed for no-code data acquisition, enabling users to easily mix and match various sensors. Contributed to system architecture design and conducted evaluations focused on ease of use, flexibility, and scalability. (Mobisys 2022, IoTDI 2023)

AIoT Lab, The Chinese University of Hong Kong **01/2024 - 06/2024**
Visiting Student & Research Assistant
AR-Enhanced Sensor Representation: Transformed sensor data from smart buildings into intuitive, immersive 3D visualizations using Augmented Reality (AR) and 3D Gaussian Splatting (3DGS). Developed an embedding blending approach to address biases in the embedding space, where the similarity between embeddings of different values does not always align with their actual differences, impacting visualization quality. This method uses anchor-based estimations, blending pre-computed embeddings of anchor points after profiling the embedding space, rather than directly computing the embedding for each input. This approach ensures continuous and smooth visualization transitions, maintaining stability even under changing conditions, by ensuring the visualization accurately reflects changes in sensor inputs without abrupt or inconsistent transitions. (Under review)

LASP, University of Colorado Boulder **09/2020 - 05/2021**
Undergraduate Research Assistant
The Medium Energy Electron Telescope (MEET): A 1U CubeSat-compatible instrument to study the source, loss, intensity, and dynamic variation of 30-400 keV electrons in Earth's inner belt. Implement a detector simulator circuit that met stringent performance metrics, including an energy resolution of less than 500 eV, a charge collection time of 200 ns, and a maximum count rate exceeding 500 kHz. Design the simulator's PCB board, and also contribute to the design of the charge-sensitive amplifier (CSA). The project's performance was validated through ground-based simulations using FPGA on CmodA7.

Medtronic Research **08/2020 - 06/2021**
Project Leader
Intelligent Surgery Device: Led a five-student research group working on an ultrasonic dissector (a minimal invasive surgery device) with enhanced connectivity and intelligence under the guidance of Medtronic's professional engineers and researchers.

AWARDS

· Best Paper Award, ACM HumanSys 2025
· Best Demo Award Runner-up, ACM MobiCom 2024
· Third Place - ECE Capstone Project 2021, University of Colorado Boulder
· J. Ranald Fox Memorial Scholarship, 2019, University of Colorado Boulder
· James H. Cole Scholarship, 2019, University of Colorado Boulder
· Best ECE Undergraduate Freshman Project 2017, University of Colorado Boulder

NEWS AND MEDIA

EurekAlert! 2022 - Cheaper, faster, safer way to screen temperatures

TEACHING AND OUTREACH

Columbia University **09/2021 - 05/2025**
Teaching Assistant

ELEN E6908 Embedded AI	Spring 2025
ELEN E6883 An Introduction to Blockchain Technology	Spring 2022&2023
EECS E6892 Reinforcement Learning in Information Systems	Spring 2022
EECS E4764 Internet of Things – Intelligent and Connected Systems	Fall 2021

University of Colorado Boulder **09/2019 - 05/2021**
Course Assistant

ECEN/CSCI 4593 Computer Organization	Spring 2021, Fall 2020
ECEN 2260 Circuits as Systems	Spring 2020, Fall 2019

Outreach & Service

High School Science & Innovation Seminar, Alma Mater 2024
Invited speaker; presented sensing technologies for smart health, autonomous driving, and UAVs, highlighting emerging research directions.

Society of Women Engineers STEM Workshop 2023
Co-organized and taught a hands-on session on sensor networks for female high-school students, fostering interest in engineering.

Undergraduate Research Mentor

Columbia University Undergraduate Research Symposium 2023
– *Thilina Balasooriya*: study the impact of skin tone in thermal-camera fever screening.

Columbia-Amazon Summer Undergraduate Research Experience 2022
– *Alfonso Rivas*: design a scalable, low-cost fever-screening system.
– *Nia Cole*: build an AR-enabled digital stethoscope (Best Presentation Award).

PUBLICATIONS

** denotes co–first authors*

M. Zhao*, J. Xia*, **K. Hou***, Y. Liu, S. Xia, X. Jiang (2025). **FlexiFly: Interfacing the Physical World with Foundation Models Empowered by Reconfigurable Drone Systems.** *The 23rd ACM Conference on Embedded Networked Sensor Systems (SenSys)*, pp. 463–476.

K. Hou*, M. Zhao*, L. Xu, Y. Fan, X. Jiang (2025). **TDBench: Benchmarking Vision-Language Models in Understanding Top-Down Images.** *arXiv preprint* arXiv:2504.03748.

L. Xu*, **K. Hou***, X. Jiang (2025). **Exploring the Capabilities of LLMs for IMU-based Fine-grained Human Activity Understanding.** *International Workshop on Foundation Models for Cyber-Physical Systems & Internet of Things (FMSys'25).*

Y. Sui, Y. Zhang, Y. Liu, M. Zhao, **K. Hou**, J. Nie, X. Jiang, S. Xia (2025). **DomAIn: Towards Programless Smart Homes.** *International Workshop on Human-Centered Sensing, Modeling, and Intelligent Systems (HumanSys'25)*, pp. 7–12. **Best Paper Award**.

Y. Guo, **K. Hou**, H. Fu, H. Chen, Z. Yan, G. Xing, X. Jiang,(2024). **Vivar: A Generative AR System for Intuitive Multi-Modal Sensor Data Presentation.** *arXiv preprint* arXiv:2412.13509.

K. Hou, Y. Guo, H. Fu, H. Chen, Z. Yan, G. Xing, X. Jiang (2024). **Improving On-Device LLMs' Sensory Understanding with Embedding Interpolations.** *The 30th ACM International Conference on Mobile Computing and Networking (MobiCom)*, pp. 1674–1676.

M. Zhao*, **K. Hou***, J. Xia, S. Xia, X. Jiang (2024). **EmbodiedRDA: Connecting Foundation Models with the Physical World using Reconfigurable Drone Agents.** *MobiCom 2024*, pp. 1745–1747. **Best Demo Runner-Up**.

Y. Liu, M. Zhao, **K. Hou**, J. Xia, C. Carver, S. Xia, X. Zhou, X. Jiang (2024). **AIRA: A Low-cost IR-based Approach Towards Autonomous Precision Drone Landing and NLOS Indoor Navigation.** *arXiv preprint* arXiv:2407.05619.

Y. Guo, **K. Hou**, Z. Yan, H. Chen, G. Xing, X. Jiang (2024). **Sensor2Scene: Foundation Model-driven Interactive Realities.** *FMSys'24*, pp. 13–19.

S. Xia, M. Zhao, C. Adhivarahan, **K. Hou**, Y. Chen, J. Nie, E. Wu, K. Dantu, X. Jiang (2023). **Anemoi: A Low-cost Sensorless Indoor Drone System for Automatic Mapping of 3D Airflow Fields.** *The 29th ACM International Conference on Mobile Computing and Networking (MobiCom)*, pp. 1–16.

K. Hou, S. Xia, E. Bejerano, J. Wu, X. Jiang (2023). **ARSteth: Enabling Home Self-Screening with AR-Assisted Intelligent Stethoscopes.** *The 22nd ACM/IEEE Conference on Information Processing in Sensor Networks (IPSN)*, pp. 205–218.

M. Zhao, S. Xia, J. Nie, **K. Hou**, A. Dhupar, X. Jiang (2023). **LegoSENSE: An Open and Modular Sensing Platform for Rapidly-Deployable IoT Applications.** *8th ACM/IEEE Conference on Internet of Things Design and Implementation (IoTDI)*, pp. 367–380.

K. Hou, S. Xia, J. Wu, M. Zhao, E. Bejerano, X. Jiang (2022). **AI Stethoscope for Home Self-Diagnosis with AR Guidance.** *The 20th ACM Conference on Embedded Networked Sensor Systems (SenSys).*

K. Hou, S. Xia, X. Jiang (2022). **BuMA: Non-Intrusive Breathing Detection using Microphone Array.** *ACM International Workshop on Intelligent Acoustic Systems and Applications (IASA)*, pp. 1–6.

M. Zhao, Y. Liu, A. Dhupar, **K. Hou**, S. Xia, X. Jiang (2022). **A Modular and Reconfigurable Sensing and Actuation Platform for Smarter Environments and Drones (Demo Abstract).** *20th ACM International Conference on Mobile Systems, Applications and Services (MobiSys)*.

K. Hou, Y. Liu, P. Wei, C. Yang, H. Kang, S. Xia, T. Spada, A. Rundle, X. Jiang (2022). **A Low-Cost In-Situ System for Continuous Multi-Person Fever Screening.** *Information Processing in Sensor Networks (IPSN)*, pp. 15–27.