Haoran Wan

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Research Interest

My current research interests are mobile and ubiquitous computing, including designing and implementing ubiquitous and wireless sensing systems for Internet-of-Things applications (localization, smart homes/buildings, vital sign monitoring/healthcare, and 3D human-mobile interaction). Besides, I have a broad interest in wireless network as well. Currently, most of my projects are based on acoustic signals on commercial-off-the-shelf mobile devices.

Education

- **Nanjing University** — Nanjing, China
  M.S. in Computer Science and Technology; Average Score: 91.27/100 — Sep. 2019 - Jun. 2023
  Advisor: Wei Wang
- **University of Electronic Science and Technology of China** — Chengdu, China
  B.Eng - Networking Engineering; GPA: 3.83/4.0 — Sep. 2015 - Jul. 2019
  Elite Class: Liren Leadership Class
- **National Chiao Tung University** — Taiwan, China
  Exchange Student - Electrical and Computer Engineering; GPA: 4.15/4.3 — Feb. 2017 - Jul. 2017

Publications and Research

- Multi-user Room-scale Respiration Tracking using COTS Acoustic Devices
  Haoran Wan, Shuyu Shi, Wenyu Cao, Wei Wang, and Guihai Chen
  ACM TOSN, May 2023.[PDF]
  Extended version of INFOCOM 2021 paper
- SCALAR: Self-Calibrated Acoustic Ranging for Distributed Mobile Devices
  Lei Wang, **Haoran Wan**, Ting Zhao, Ke Sun, Shuyu Shi, Haipeng Dai, Guihai Chen, Haodong Liu, and Wei Wang
  IEEE TMC 2023, Feb. 2023.[PDF]
- ALT: Boosting Deep Learning Performance by Breaking the Wall between Graph and Operator Level Optimizations
  Zhiying Xu, Jiafan Xu, Hongding Peng, Wei Wang, Xiaoliang Wang, **Haoran Wan**, Haipeng Dai,
  Yixu Xu, Hao Cheng, Kun Wang, and Guihai Chen
  ACM EuroSys 2023, May 2023. [Arxiv]
- mSilent: Towards General Corpus Silent Speech Recognition using COTS mmWave Radar
  Shang Zeng, **Haoran Wan**, Shuyu Shi and Wei Wang
  ACM Ubicomp/IMWUT 2023, Oct. 2023. [PDF]
- VECTOR: Velocity Based Temperature-field Monitoring with Distributed Acoustic Devices
  Haoran Wan, Lei Wang, Ting Zhao, Ke Sun, Shuyu Shi, Haipeng Dai, Guihai Chen, Haodong Liu, and Wei Wang
  ACM Ubicomp/IMWUT 2022, Sep. 2022. [PDF]
- HeadTracker: Fine-grained Head Orientation Tracking System Based on Headphones
  Jinpeng Song, Haipeng Dai, Shuyu Shi, Lei Wang, **Haoran Wan**, Zhizheng Yang, Fu Xiao, and Guihai Chen
  Springer WASA 2022, Nov. 2022. [PDF]
- RespTracker: Multi-user Room-scale Respiration Tracking with Commercial Acoustic Devices
  Haoran Wan, Shuyu Shi, Wenyu Cao, Wei Wang, and Guihai Chen
  IEEE INFOCOM 2021, Apr. 2021. [PDF]

Major Projects

- **General Corpus Silent Speech Recognition with mmWave Radar** — Dec. 2021 - Nov. 2022
  - Did a comprehensive study on silent speech recognition with mmWave radar, the corpus is formed with 1000+ daily conversation sentences, and we collected $21K+$ samples as our dataset.
  - Designed a signal processing pipeline, including cluster selection algorithm to localize users' head and filter out unrelated motions.
  - Proposed a transformer-based neural network backend with user-adaptive design to recognize the speech and achieved words error rate comparable with video-based SOTA ($< 10\%$).
  - This work was accepted by Ubicomp/IMWUT 2023.
- **Air Temperature Field Reconstruction with COTF Acoustic Devices** — Apr. 2021 - May. 2022
  - Estimate the air temperature with shorter response time than traditional temperature sensors by monitoring the speed changes of sound signal. Achieve average errors 0.25°C across months of evaluations.

- Combine Radon transform and Taylor Series to reconstruct the air temperature field with decimeter-level spatial resolution using multiple acoustic devices.
- Leverage LOS paths and reflections to estimate the temperature in multiple slots in a car or on the table with only one pair of devices.
- This work was accepted by Ubicomp/IMWUT 2022.

- **High Accuracy Localization System between Distributed Devices** Aug. 2020 - Mar. 2021
  - Model the sampling frequency offset between distributed acoustic devices precisely.
  - Cancel the frequency offset and unknown delays in sound playback and recording process between devices in real time, and return the absolute distance measurement without user's intervention/calibration.
  - Achieve 0.6 mm 1D localization errors up to 3 m and 1.86 mm 3D localization errors. Maintain the accuracy in long-term without performance drop (up to 8 hours).
  - This work was accepted by TMC.

- **Multi-user Room-scale Respiration Tracking using COTS Acoustic Devices** Oct. 2019 - Aug. 2020
  - Expand the acoustic based respiration sensing range to 3 m by combining multiple reflection paths.
  - Separate multiple users with modulated Zadoff-Chu sequence, and can recover the breath patterns for at least 4 users in the same room simultaneously.
  - Track users by re-synchronizing the reflection signals before and after users move.
  - This work was accepted by INFOCOM 2021.

- **In-air Continuous Hand Gesture Recognition with Acoustic Signal** Nov. 2019 - Feb. 2020
  - Develop a continuous hand gesture recognition system on mobile phone with acoustic signal, cooperating with partners in industry.
  - Solve the practical problem of ambiguous gestures in continuous using scenario, e.g. scrolling up is similar to the reset process of scrolling down in consecutive use.
  - Design and deploy signal processing algorithm and deep learning model on mobile phone that run in real-time.

Honors and Awards

- Outstanding graduate students of Nanjing University - Dec. 2021
- Huawei Graduate Scholarship - Nov. 2021
- Principal Special Scholarship for Graduate Students - Nov. 2019
- Second Class People's Scholarship - Nov. 2016, 2018
- Undergraduate China National Scholarship, Nov. 2017

Skills Summary

- **Languages:** Python, MATLAB, Java, C/C++, SQL, Bash, Verilog
- **Tools:** Scikit, Pytorch/TorchLightning, TensorFlow, Keras
- **Platforms:** Linux, Raspberry, Android, FPGA, Microcontroller
- **Domain Knowledge:** (Array) Signal Processing, Machine Learning, Wireless Network

Experience

- Digital Logic Design and Computer Organization — Nanjing, China
  Teaching Assistant — Sep. 2021 - Jan. 2022
- Digital Circuit and Digital System Experiment — Nanjing, China
  Teaching Assistant — Sep. 2020 - Jan. 2021
- ChinaSoft International — Chengdu, China
  Student Developer (Intern) — Jul. 2017 - Aug. 2017
- Chengdu Modern Hospital — Chengdu, China
  Volunteer for Elderly Care — Jul. 2016