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 - Current
  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

- 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]
- Multi-user Room-scale Respiration Tracking using COTS Acoustic Devices
  Haoran Wan, Shuyu Shi, Wenyu Cao, Wei Wang and Guihai Chen
  ACM TOSN 2022, Finished Major Revision and Resubmitted.
  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 2022, Finished Major Revision and Resubmitted.
- JOG: Joint Graph and Operator level Optimizations for Deep Learning Compilation
  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, Under Review. [Arxiv]

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 ($< 10\%$).
  - We submitted this work to IMWUT in Nov. 2022.
- **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 submitted to TMC 2022.

- **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 Huawei.
  - 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