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

B.Eng - Networking Engineering; GPA: 3.83/4.0

Elite Class: Liren Leadership Class

National Chiao Tung University

Exchange Student - Electrical and Computer Engineering; GPA: 4.15/4.3

Chengdu, China Sep. 2015 - Jul. 2019

Taiwan, China

Feb. 2017 - Jul. 2017

Publications and Research

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]

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]

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.

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]

mSilent: Towards General Corpus Silent Speech Recognition using COTS mmWave Radar

Shang Zeng, Haoran Wan, Shuyu Shi and Wei Wang

ACM Ubicomp/IMWUT 2023, Under Review. Submit in Nov. 2022.

Major Projects

• General Corpus Silent Speech Recognition with mmWave Radar

Dec. 2021 - Nov. 2022

- o 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.
- o 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.
- o Track users by re-synchronizing the reflection signals before and after users move.
- $\circ\,$ 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
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• Domain Knowledge: (Array) Signal Processing, Machine Learning, Wireless Network

EXPERIENCE

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