Haoran Wan

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Education

- **Princeton University** — Princeton, NJ, USA
  Ph.D. in Computer Science — Sep. 2023 - Jun. 2028
  Advisor: Kyle Jamieson
- **Nanjing University** — Nanjing, Jiangsu, China
  M.S. in Computer Science — Sep. 2019 - Jun. 2023
  Advisor: Wei Wang
- **University of Electronic Science and Technology of China** — Chengdu, Sichuan, China
  B.Eng - Networking Engineering — Sep. 2015 - Jul. 2019
- **National Chiao Tung University** — Hsinchu, Taiwan
  Exchange Student - Electrical and Computer Engineering — Feb. 2017 - Jul. 2017

Publications and Research

- Telesa: Evolving Mobile Cloud Gaming with 5G Standalone Network Telemetry
  Haoran Wan, Kyle Jamieson
  Under Preparation.
- 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 (Distinguished Paper Award), 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 (Best Paper Award), 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

- **Enhance Mobile Cloud Gaming through 5G Telemetry** — May 2023 - Jan. 2024
  - Developed a tool to analyze 5G base station's signal with USRP and decode the downlink control information for every user in every transmission time interval (0.5 ms) in the RAN, through which we know the bandwidth resource allocated to every user and spare bandwidth in the 5G physical layer.
  - Enhanced the real-time video streaming of an open-source mobile cloud gaming platform (sunshine and moonlight) with the fine-grained RAN resource information.
  - We plan to submit this work to Sigcomm 2024.
- **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:** C/C++, Python, MATLAB, Java, SQL, Bash, Verilog
- **Tools:** Scikit, Pytorch/TorchLightning, TensorFlow, Keras
- **Platforms:** Linux, Raspberry, Android, FPGA, Microcontroller

Teaching 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