XIAOLU ZENG

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EDUCATION

Xidian University, China *Aug. 2014 - Jun. 2020*
Ph.D. in Information and Communication Engineering
Harbin Institute of Technology, China *Aug. 2010 - Jun. 2014*
B.S. in Electronic Information Engineering
University of Maryland College Park, USA *Sep. 2017 - Jun. 2020*
Joint Ph.D. student in Electric and Computer Engineering

WORKING EXPERIENCE

Department of Electrical & Computer Engineering, University of Maryland, College Park, MD, USA

- Postdoc Research Associate (*Advisor: Prof. K. J. Ray Liu, IEEE President-Elect*) *Jul. 2020 - Present*

- Faculty Assistant (*Advisor: Prof. K. J. Ray Liu*) *Dec. 2019 - Jun. 2020*

- Research Scholar (*Advisor: Prof. K. J. Ray Liu*) *Sep. 2017 - Sep. 2019*
  - Time Reversal Based High Accuracy Localization and Tracking (see ☝)

Origin Wireless AI, Inc, Greenbelt, MD, USA

- Principle Data Scientist *Dec. 2019. - Present*

  - Wireless AI for wireless sensing and localization using ambient radio signals (see ☝)

SKILLS

Languages	Matlab, Python, G-LabView, Linux/Unix Shell (beginner)
Technologies	Machine/Deep Learning, Signal Processing, Wireless AI, Radar, mmWave, 5G, Massive MIMO

PROJECT

Device-free Wireless Monitoring System

- Worked on the development and validation of a highly accurate and calibration-free wireless motion detector with large through-the-wall coverage by using Channel Station Information (CSI) related techniques.
- The research has been commercialized by Origin Wireless AI Inc. and won the CES 2020 Innovation Award. In partnership with Belkin, it has been deployed over 150 countries worldwide as LinkSysAware (see more 1, 2, 3,...)

Wireless Vital Signs Detection System

- Development of the Breathing Rate Detection System using CSI extracted from commercial WiFi devices.
- The research was then developed as a Sleep Monitoring System and commercialized as Origin Health by Origin Wireless AI Inc., which won the CES 2021 Best of Innovation Award.

Wireless Driver Arrival Sensing for Smart Car

- Designed the system by using WiFi-FTM (IEEE 802.11mc, 2016). By enabling driver's arrival time sensing, the car is more smart in multiple-service management than the existing driver's presence sensing only system.
- Implemented the system and ported it into Linux OS for real-world validation. Experiments in varieties of parking lots and garages show that it can robustly achieve $\geq 92.5\%$ accuracy with less than ≤ 1s error [C3].

mmWave-Based Vital Signs Monitoring

- Worked on the design and development of a Millimeter Wave (mmWave) based Vital Sign Monitoring System which can accurately estimate the breathing rate, heart rate and heart rate viability for multiple objects [J4] [C2].
- The research has been implemented by using off-the-shelf mmWave Radar and part of the system has been invited to demo for Qualcomm. It is being commercialized by Origin Wireless AI Inc. for Non-contact Vital Sign Monitoring.

mmWave and 5G Massive MIMO for Localization and Tracking

- Developed and implemented the system on the base of Time Reversal and Massive MIMO techniques, which overcomes the unavoidable multipath distortions and thus improving the scalability in different environments [P1].
- Derived and validated the theoretical performance of the system which can achieve up to centimeter-accuracy while enjoys low overhead by leveraging the existing 5G Massive MIMO base stations and multipath signals [J2] [J3].

Time Reversal Based Localization and Tracking

- Built the signal model on the base of Time Reversal theory which turns the detrimental multipath signal from enemy to friend for target localization and tracking.
- Utilized DNN to learn the feature of background perturbations and thus make the system work robustly in both static and dynamic environments regardless of multipath distortions [J1], [P3].

RF-based Indoor Tracking System

- Worked on the development and validation of two calibration-free Indoor Tracking Systems with decimeter-accuracy by exploring the statistical properties of the received signals.
- The research facilitated three ongoing products including Cart-tracking in supermarkets, Fall-detector and Gait-recognition, which has been partly invited for demo to Apple, HP, Qualcomm, Verizon, Marvell [P2].

PUBLICATIONS

[J1] **X. Zeng**, M. Yang, B. Chen and Y. Jin, "Estimation of Direction of Arrival by Time Reversal for Low-Angle Targets," in IEEE Transactions on Aerospace and Electronic Systems (IEEE TAES), vol. 54, no. 6, pp. 2675-2694, Dec. 2018. (**JCR:** Q1, **IF:** 3.672)

[J2] **X. Zeng**, F. Zhang, B. Wang and K. J. R. Liu, "Radio Frequency Based Direction Sensing Using Massive MIMO," in IEEE Access, vol. 8, pp. 26827-26838, Jan. 2020. (**JCR:** Q1, **IF:** 3.745)

[J3] **X. Zeng**, F. Zhang, B. Wang and K. J. R. Liu, "Massive MIMO for High-Accuracy Target Localization and Tracking," in IEEE Internet of Things Journal (IEEE IoTJ), Jan. 2021 (Early Access). (**JCR:** Q1, **IF:** 9.936)

[J4] F. Wang, **X. Zeng**, C. Wu, B. Wang, and K. J. Ray Liu, "mmHRV: Contactless Heart Rate Variability Monitoring using Millimeter-Wave Radio," IEEE Internet of Things Journal (IEEE IoTJ), Feb. 2021 (Accepted, to appear). (**JCR:** Q1, **IF:** 9.936)

[C1] **X. Zeng**, F. Zhang, B. Wang and K. J. Ray Liu, "High Accuracy Tracking of Targets Using Massive MIMO," 2021 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Toronto Canada, Jun. 2021 (Accepted, to appear).

[C2] F. Wang, **X. Zeng**, C. Wu, B. Wang and K. J. Ray Liu, "Radio Frequency Based Heart Rate Variability Monitoring," 2021 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Toronto Canada, Jun. 2021 (Accepted, to appear).

[C3] **X. Zeng**, B. Wang and K. J. Ray Liu, "Driver Arrival Sensing for Smart Car using WiFi Fine Time Measurements," 2020 Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC), Auckland, New Zealand, Dec. 2020.

[C4] **X. Zeng**, B. Chen and M. Yang, "DOA estimation for low angle targets using time reversal in frequency domain model," 2018 IEEE Radar Conference (RadarConf18), Oklahoma City, OK, Apr. 2018.

[C5] **X. Zeng**, M. Yang, B. Chen and Y. Jin, "Low angle direction of arrival estimation by time reversal," 2017 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), New Orleans, LA, Mar. 2017.

[C6] **X. Zeng**, B. Chen, Y. Zhao and M. Yang, "Design and implementation of a T/R module automatic test system," 2016 CIE International Conference on Radar (RADAR), Guangzhou, Oct. 2016.

PATENTS

[P1] "Method, apparatus, and system for outdoor target tracking," (US Patent No.: 16790627).

[P2] "Method, Apparatus, and System for Wireless Gait Recognition," (Europe Patent No.:3695783).

[P3] "Time Reversal Based DOA Estimation," (China Patent No.: ZL201610702654.8 [P]).

[P4] "DOA Estimation by Using Nested Minimum-redundancy Arrays," (China Patent No.: ZL201510725142.9 [P]).

[P5] "Sub-nested Minimum-redundancy Arrays for DOA estimation," (China Patent No.: ZL201610236372.3 [P]).

[P6] "Design and implementation of a T/R module automatic test system," (China Patent No.: ZL201510566320.8 [P]).

SELECTED HONORS AND AWARD

Four times of 1st-Class Ph.D. Student Scholarship at Xidian University,	*2015-2019*
Chinese Scholarship Council for Joint Ph.D students	*2017-2019*
Outstanding Doctoral Candidate, Xidian University (1/37)	*2015-2016*