

Kai Zheng

Curriculum Vitae

Education

- 2020–2025 **Ph.D.**, *University of California San Diego*, La Jolla, CA.
Expected June Advisor: Prof. Xinyu Zhang
Research interest: wireless sensing and communication, mobile computing, mmWave/THz software-defined radios.
- 2017–2019 **Masters of Science**, *New York University*, Brooklyn, NY.
Computer Engineering
- 2011–2015 **Bachelor of Science**, *Fudan University*, Shanghai, China.
Electronic Information Science and Technology

Publication Highlights

Kai Zheng, Wuqiong Zhao, Timothy Woodford, Renjie Zhao, Xinyu Zhang, Yingbo Hua. “Enhancing mmWave Radar Sensing Using a Phased-MIMO Architecture.” *ACM MobiSys*, 2024. (16.3% acceptance rate)

Kai Zheng, Kun Qian, Timothy Woodford, Xinyu Zhang. “NeuroRadar: A Neuromorphic Radar Sensor for Low-Power IoT Systems.” *ACM SenSys*, 2023. (19.0% acceptance rate, **best paper award**, **getMobile research highlight**)

Renjie Zhao, Kejia Wang, **Kai Zheng**, Xinyu Zhang, and Vincent Leung. “SlimWiFi: Ultra-Low-Power IoT Radio Architecture Enabled by Asymmetric Communication.” *USENIX NSDI*, 2023. (16.0% acceptance rate)

Kun Qian, Lulu Yao, **Kai Zheng**, Xinyu Zhang, and Tse Nga Ng. “UniScatter: a Metamaterial Backscatter Tag for Wideband Joint Communication and Radar Sensing.” *ACM MobiCom*, 2023. (29.4% acceptance rate)

Lulu Yao, **Kai Zheng**, Nandu Koripally, Naresh Eedugurala, Jason D. Azoulay, Xinyu Zhang, Tse Nga Ng. “Structural Pseudocapacitors with Reinforced Interfaces to Increase Multifunctional Efficiency.” *Science Advances*, 2023.

Kai Zheng, Aditya Dhananjay, Marco Mezzavilla, Arjuna Madanayake, Shubhendu Bharadwaj, Viduneth Ariyaratna, Abhimanyu Gosain, et al., “Software-defined Radios to Accelerate mmWave Wireless Innovation.”, *IEEE DySPAN*, 2019.

Graduate Research

- 2024–Present **mmWave Radar-Readable Smart Road Sign**, *UC San Diego*.
- Proposed a low-cost, passive road sign identifiable by mmWave radars through the use of polarization conversion.
 - Currently designing and engineering a split-ring resonator metasurface to enable distinct polarization conversion states and a semi-retroreflective beam pattern.
 - Fabricated an initial prototype using hot stamping, with plans to validate its performance on a custom 60 GHz polarimetric radar platform.
- 2023–Present **Raynet: mmWave Software Defined Radio (SDR) Testbed**, *UC San Diego*.
- Developing a 20-node 60 GHz SDR testbed by repurposing a 64-antenna phased array module from a commercial 802.11ay radio.
 - Designed a 15 GHz intermediate frequency (IF) bridge board for signal up/down conversion and interfacing with the phased array and the baseband processor.
 - Implemented real-time phased array control and 802.11ad/ay Golay-based channel impulse response estimation on a Xilinx RFSoc 4x2 platform.
- 2020–2023 **mmWave Phased-MIMO Radar with Massive Antennas**, *UC San Diego*.
- Developed a first-of-its-kind 60 GHz FMCW radar platform with a scalable phased-MIMO architecture (up to 256 antennas) by retrofitting a commodity 802.11ad radio.
 - Studied optimal phased subarray layouts using *Sum Co-Array* and *Difference Co-Array* principles, achieving superior spatial resolution (2.46°).
 - Designed a high-resolution 3D point cloud synthesis algorithm for phased-MIMO radars.
 - Created a compressive sensing algorithm to significantly reduce beam scanning time, enabling real-time sensing capabilities.
- 2021–2022 **Neuromorphic Radar Sensing System (NEURORADAR)**, *UC San Diego*.
- Developed NEURORADAR, a low-power radar platform inspired by biological sensing, enabling direct integration with energy-efficient neuromorphic computers.
 - Eliminated power-hungry components of conventional radars by encoding ambient motion into spiking signals for low-power, spike-based processing.
 - Built an array of spike-generating radar sensors—each operating at a distinct frequency and location—and trained Spiking Neural Networks (SNNs) for gesture sensing and target tracking/localization.
 - Prototyped the system and demonstrated high sensing accuracy with orders-of-magnitude lower power consumption (1~2 mW) compared to traditional radar solutions.
- 2022 **Asymmetric Communication for Ultra-Low-Power IoT Systems**, *UC San Diego*.
- Proposed a novel asymmetric communication paradigm enabling commercial off-the-shelf (COTS) Wi-Fi devices to decode on-off keying (OOK) signals from ultra-low-power radios.
 - Developed two decoding approaches: (1) a handcrafted algorithm and (2) a transformer-based machine learning model to reverse OFDM demodulation and recover OOK bits.
 - Demonstrated a goodput of approximately 100 kbps at a range of 60 m, with a power consumption of just 90 μ W—around three orders of magnitude lower than COTS Wi-Fi radios.

Experience

Professional

- 2019–2020 **RF Engineer**, *Pi Radio Inc.*, Brooklyn, NY.
- Designed a 4-channel 60 GHz fully-digital software defined radio.
 - Performed part selection, schematic design, PCB layout, and patch antenna simulation.

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- 2015–2017 **Hardware Engineer (Consumer Electronics)**, *Huawei Tech.*, Shanghai, China.
- Designed schematics for smartphones; performed unit tests and failure analysis.
 - Supported mass production in factories and ramped production volume to full capacity.

Teaching

- 2021–Present **Teaching Assistant for ECE191 (Group Engineering Project)**, *UC San Diego*, La Jolla, CA.
- Provide administrative and technical support for undergraduate student engineering projects.
- 2024 **Teaching Assistant for ECE257A (Modern Communication Networks)**, *UC San Diego*, La Jolla, CA.
- Host discussion session and office hours; grade assignments.
 - Topics include: network architecture, packet and signal processing, network protocols and operations, and mobile applications.

Awards

- 2023 ACM SenSys'23 Best Paper Award (1/179)

Skills

- Programming C, C++, Matlab, Python, Verilog, VHDL, Perl, Bash, Assembly
- AI/ML PyTorch, Tensorflow, Nengo-DL, SNN-torch, NumPy, Pandas
- RF Circuits Altium Designer, Ansys HFSS, LTSpice, Cadence Virtuoso, Keysight ADS
- Lab Skills Ettus USRP, Xilinx RFSoc, Oscilloscope, Spectrum Analyzer, Vector Network Analyzer, Signal Generator, SMD Soldering