Kai Zheng

Curriculum Vitae

Education

2020–2025 Expected June **Ph.D.**, *University of California San Diego*, La Jolla, CA.
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 Ariyarathna, Abhimanyu Gosain, et al., "Software-defined Radios to Accelerate mmWave Wireless Innovation.", IEEE DySPAN, 2019.

3535 Lebon Dr. – San Diego, CA 92122
+1 (646) 717 4078 • kaizheng28@gmail.com • kaizheng.me

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 µW—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.

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
Protocols	Wi-Fi, WiGig, 5G-NR, BLE, UWB, ZigBee, RFID
Lab Skills	Ettus USRP, Xilinx RFSoC, Oscilloscope, Spectrum Analyzer, Vector Network Analyzer, Signal Generator, SMD Soldering