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Zheng Liu

Education

02/2019-05/2023 **Princeton University**, *Ph.D. Electrical and Computer Engineering*, *GPA –3.84/4.0*
Advisor: Prof. Kaushik Sengupta (IEEE Fellow). **Bede Liu Best Ph.D Dissertation Award**.

13-15 **University of California, Los Angeles**, *M.S. Electrical Engineering*, *GPA –3.7/4.0*

09-13 **Peking University, Beijing, China**, *B.S. Electronics, B.A. Economics*, *GPA –3.7/4.0*

Research Interest

High frequency integrated circuits, systems and AI/ML-driven algorithmic techniques for next-generation communication and sensing applications: 1) RF/mmWave/THz broadband high-efficiency power amplifiers; 2) Antenna array architecture and beamforming IC; 3) AI/ML enabled wireless chip inverse design methodology

Professional Experiences

10/2023-Present **RF/mmWave IC research Engineer**, ***Kilby Labs, Texas Instruments***, **Dallas, Texas, USA**
- Leading R&D efforts for GaN-on-Si power amplifier and module/package design for TI's inaugural RF GaN product line targeting 6G-FR3 wireless infrastructure.
- Developing 120GHz transceiver IC for integrated molecular clock system targeting atomic clock accuracy.
- Liaison for university research program and contributing to proposal writing for new Kilby Labs initiatives.

02/2019-05/2023 **Doctoral Researcher**, ***Princeton University***, **Princeton**, **NJ, USA**
- Developed multi-hierarchy techniques (device + architecture) for broadband high-efficiency PAs across 30-110GHz in SiGe, CMOS and InP HBT technologies.
- Developed a frequency-agile array system using algorithmically synthesized non-periodic sparse array architecture and co-designing ultra-wideband beamforming front-end IC with antenna array packaging.
- First demonstration of using AI to discover new architectures for wireless chips and enable rapid on-demand synthesis. This work laid the foundation for the group's acquisition of **$10 million** in funding from the National Semiconductor Technology Center under the US CHIPS and Science Act.

05/2022 - 08/22 **Cellular RF Engineering Intern**, ***Apple, Inc***, **San Diego**, **California, USA**
- Investigated phased array receiver architecture enabled by phase shifter innovation in advanced CMOS.

05/2015 - 11/2018 **Senior Electrical Engineer**, ***Skyworks Solutions, Inc***, **Thousand Oaks**, **California, USA**
- Served as the core PA designer for an LTE Band 42 envelope-tracking push-pull PA engine, driving mass production with over **30 million units shipped for Apple's iPhone 8/X in the Japan market**.
- Developed a 3.3 to 4.2 GHz linear Doherty PA for 5G N77 wireless communication. The design becomes **Skyworks's first 5G prototype in** $Sky5^{TM}$ **product portfolio. Shipped over 10 million parts.**

Academic Awards

02/2025 **2023 JSSC Best Paper Award (1 per year)**, *IEEE*

05/2023 **Bede Liu Best Ph.D Dissertation Award (1 awardee annually in ECE)**, *Princeton University*

06/2022 **Advanced Practice Paper Award (1st Author, Top 1/325)** , *IEEE IMS 2022*

07/2021 **Best Student Paper Awards (Two papers, Both 1st Author, Top 6/314)**, *IEEE IMS 2021*

08/2020 **Best Student Paper Award (Top 3/317)** , *IEEE IMS 2020*

01/2022 **IEEE MTT-S Graduate Fellowship (10 awardees globally per year)**, *IEEE*

01/2022 **ADI Outstanding Student Designer Award**, *Analog Devices, Inc*

05/2022 **Qualcomm Innovation Fellowship Finalist**, *Qualcomm,Inc*

12/2021 **Yan Huo 94* Graduate Fellowship**, *Princeton University*

04/2017 **Excellent Performance Award**, *Skyworks Solutions, Inc*

Journal Publications

J1. **Zheng Liu** and K.Sengupta. "A 44-64 GHz mmWave Broadband Linear Doherty PA in Silicon with Quadrature Hybrid Combiner and Non-Foster Impedance Tuner", IEEE Journal of Solid-State Circuits (**JSSC**), Aug, 2022

J2. Emir Ali Karahan, **Zheng Liu*** and Kaushik Sengupta et al. "Deep-Learning-Based Inverse-Designed Millimeter-Wave Passives and Power Amplifiers", IEEE Journal of Solid-State Circuits (**JSSC**), May, 2023 (**2023 JSSC Best Paper Award**, * Corresponding author)

J3. **Zheng Liu** et al. "A 42-62 GHz Transformer-based Broadband mm-Wave InP PA with Second Harmonic Waveform Engineering and Enhanced Linearity", IEEE Transactions on Microwave Theory and Techniques (**TMTT**). (**Invited**), Jan, 2021

J4. **Zheng Liu**, E Karahan and K.Sengupta." A 36-91 GHz Broadband Beamforming Transmitter Architecture with Phase Error between 1.2-2.8^o for Joint Communication and Sensing", IEEE Transactions on Microwave Theory and Techniques (**TMTT**), Oct, 2023 (**TMTT featured article**)

J5. Emir Karahan, **Zheng Liu**, Aggraj Gupta, Zijian Shao, Jonathan Zhou and Kaushik Sengupta "Deep-learning Enabled Generalized Inverse Synthesis of Multi-Port Radio-frequency and Sub-Terahertz Integrated Circuits", **Nature Communications**, Dec, 2024.

J6. **Zheng Liu** et al "Deep Learning enabled Inverse Design of 30-94 GHz Psat,3dB SiGe-based PA supporting Multi-Gbps Concurrent Multi-band Operation ", IEEE Microwave and Wireless Component Letter, May 2022, (**IMS2022 Advanced Practice Paper Award (Top1/325), Best student paper finalist, MWCL Special Issue of "Top 50 IMS 2021 Papers"**)

J7. **Zheng Liu**, T.Sharma and K.Sengupta. "80-110 GHz Broadband Linear PA with 33% peak PAE and Comparison of Stacked Common-Base and Common-Emitter PA in InP", IEEE Microwave and Wireless Component Letter, May 2021. (**IEEE IMS2021 Best student paper award (3rd place, Top6/314), MWCL Special Issue of "Top IMS 2021 Papers"**)

J8. **Zheng Liu** et al "A Compact SiGe Stacked Common-Base Dual-band PA with 20/18.8dBm Psat at 36/64 GHz Supporting Concurrent Modulation ", IEEE Microwave and Wireless Component Letter, March 2022.(**MWCL Special Issue of "Top 50 IMS 2021 Papers"**)

J9. **Zheng Liu**, Y.Yu and K.Sengupta. "A 44-64 GHz Broadband 90^o Hybrid Doherty PA with Quasi Non-Foster Tuner in 0.13μm SiGe", IEEE Microwave and Wireless Component Letter, May 2021. (**IEEE IMS2021 Best student paper award (3rd place, Top6/314), MWCL Special Issue of "Top IMS 2021 Papers"**,)

J10. **Zheng Liu**, T Sharma and K.Sengupta. "Stacked Common-base vs Common-emitter mmWave PA Cells and 68-105 GHz Broadband Asymmetrical PA in 250nm InP HBT", IEEE Access, Feb,2023

J11. Xiaolong Huang*, **Zheng Liu***, E.Krahan, K.Sengupta "Synthesized Design of Millimeter-Wave Low-Loss Wideband Bandpass Filter and Filtering Impedance Transformer in 90-nm BiCMOS Technology", IEEE Journal of Microwave, 2025 (* co-first authors).

J12. Wynand Lambrechts, **Zheng Liu** et al. "Intelligent Integrated Circuits and Systems for 5G/6G Telecommunications" IEEE Access 2024

J13. Sherif Ghozzy, Muhamed Allam, Emir Karahan, **Zheng Liu**, Kaushik Sengupta "Towards milliWatt-level Integrated sub-Terahertz Kramers-Kronig Receivers with Nonlinear Analog and Mixed-signal Computing", **Nature Electronics** (under review).

J14. **Zheng Liu**, Emir Ali Karahan, Zijian Shao, Sherif Ghozzy , Muhamed Allam, Xiaolong Huang and Kaushik Sengupta. "Frequency-agile 120 element Aperiodic Sparse Transmitter Phased Array across 36-98 GHz" (In preparation for high impact publications)

J15. Xiaolong Huang and **Zheng Liu**. "Low-Cost W-Band Dual-Mode SIW Bandpass Filters Using Commercially Available Printed-Circuit-Board Technology", Electronics 12.17 (2023): 3624.

J16. Saurabh Sinha, Kaushik Sengupta and **Zheng Liu** et al. "Large Layout Models (L2Ms): Generative AI for Analog and Mixed-Signal Circuit Design Automation", Submitted

J17. K. Sengupta, J. Zhou, **Z. Liu** and E. A. Karahan, "AI Enabling Discovery and Design of Radio and High-Frequency Wireless Chips Beyond Human Intuition" Computer, vol. 58, no. 8, pp. 117-122, Aug. 2025.

Conference Publications

C1. **Zheng Liu**, Emir Karahan and K.Sengupta. "A 36-91 GHz 35 dB Gain Tx Phased-Array Beamformer with Low RMS Phase Error of 1.24-2.8^o Supporting 10.8 Gbps 64QAM in 90 nm SiGe", IEEE 49th European Solid-State Circuits Conference (ESSCIRC), Sept, 2023.

C2. **Zheng Liu**, T.Sharma, K.Sengupta "Transformer-Based Broadband High Efficiency mm-Wave InP Power Amplifier with Linearity Enhancement ", IEEE IMS 2020 (**Late Breaking News paper**)

C3. **Zheng Liu**, E.Emir, K.Sengupta "A 30-97 GHz Psat,3dB Broadband PA with 18.5-21.5dBm Psat and 18-26% PAE in 90nm SiGe Supporting Concurrent Multi-Band Operation ", IEEE European Microwave Integrated Circuits Conference 2022.

C4. **Zheng Liu** and K.Sengupta. "A 30-88 GHz Phase Shifter with Broadband 90^o Hybrid- Marchand Balun Network and Common-base Buffer Achieving 1.34-3.1^o RMS Phase Error in 90 nm SiGe", IEEE IMS 2023.

C5. Sherif Ghozzy, Muhamed Allam, Emir Karahan, **Zheng Liu**, Kaushik Sengupta "A mmWave/Sub-THz Synthesizer-free Coherent Receiver With Phase Reconstruction Through Analog Kramer-Kronig Processing", International Solid-State Circuits Conference (**ISSCC**) 2024.

C6. Jonathan Zhou, Emir Ali Karahan, **Zheng Liu**, Kaushik Sengupta "AI-enabled Design Space Discovery and End-to-end Synthesis for RFICs with Reinforcement Learning and Inverse Methods Demonstrating mmWave/sub-THz PAs between 30-120 GHz", International Solid-State Circuits Conference (**ISSCC**) 2025.

C7. T.Sharma*, **Zheng Liu***, C.R.Chappidi, H.Saeidi, S.Venkatesh, K.Sengupta "Broadband PA Architectures with Asymmetrical Combining and Stacked PA Cells across 50-70GHz and 64-110GHz in 250nm InP", IEEE IMS 2020 (Equally contributing authors)

C8. C.R.Chappidi, T.Sharma, **Zheng Liu**, K.Sengupta "Load Modulated Balanced mm-Wave CMOS PA with Integrated Linearity Enhancement for 5G Applications", IEEE IMS 2020.**(Best student paper award (2nd place, Top2/317))**

C9. Xiaolong Huang, **Zheng Liu**, E.Karahan, K.Sengupta "A Millimeter-Wave Low-Loss On-chip Filter Design Using A Wideband Synthesis Method in 90-nm SiGe BiCMOS Process" IEEE IMS 2024 (**Advanced Practice Paper Award Finalist**)

C10. E. A. Karahan, **Zheng Liu**, and K. Sengupta,"Deep Learning Enabled Generalized Synthesis of Multi-Port Electromagnetic Structures and Circuits for mmWave Power Amplifiers" IEEE IMS 2024 (**MWCL Special Issue of "Top 50 IMS 2024 Papers"**, give up the opportunity)

C11. Kun Chen, **Zheng Liu**, Xuelin Hong, Ruinan Chang, Weimin Sun "Balun Modeling for Differential Amplifiers", WCECS 2019

C12. Eric C. Blow, Chaoran Huang, **Zheng Liu**, Samuel J. Markoff, Paul R. Prucnal "Silicon Photonic Weights for Microwave Photonic Canceller", CLEO 2020

C13. XY zhou, WS Chan, T Sharma, J Xia, **Zheng Liu**, SC Chen, WJ Feng. "High Efficiency, Extended Back-off Range Doherty Power Amplifier Using A Three Port Harmonic Injection Network" IEEE APMC 2020

C14. XY zhou, WS Chan, WJ Feng, XH F, T Sharma, **Zheng Liu**. "Bandwidth Enhanced Doherty Power Amplifier Based on Coupled Phase Compensation Network With Specific Optimal Impedance" IEEE IWS 2020

C15. E. A. Karahan, J. Zhou, **Zheng Liu**, Z. Shao, S. Fisher and K. Sengupta, "Deep Learning Enabled Design of RF/mmWave IC and Antennas" 2024 IEEE MWSCAS

C16. K. Sengupta, E. A. Karahan and **Zheng Liu**, "Deep Learning enabled mmWave PA and Antenna Design," 2022 IEEE RFIT.(**Invited**)

C17. K. Sengupta, E. A. Karahan, Jonathan. Zhou and **Zheng Liu**, "AI-enabled RF-to-THz IC Design Space Discovery and Inverse Design Flow," 2025 IEEE International Symposium on Circuits and Systems (ISCAS) (**Invited**)

Patents

P1. **Zheng Liu** and Siraj Akhtar "Broadband Power Amplifier Combiner", U.S. patent application, 18,651,514

P2. C.R.Chappidi, T.Sharma, **Zheng Liu**, K.Sengupta. "Load Modulated Balanced Power Amplifier Integrated Circuit Including Transformer-Based Hybrid Splitter/Combiner" U.S. patent granted, 11,949,390.

P3. **Zheng Liu**, Emir Karahan, K.Sengupta. "Machine learning enabled inverse design of power amplifier" U.S. patent application, 18,073,482.

P4. **Zheng Liu**, K.Sengupta. "Topologies and methods for ultra-broadband/multi-band planar phased array antenna with reduced side lobe levels across wide range of beam steering " U.S. patent application, 63,325,706

P5. **Zheng Liu**, K.Sengupta. "Broadband and multi-band planar antenna array architectures" U.S. patent application,18,886,714.

P6. **Zheng Liu**, Siraj Akhtar. "Tunable Hybrid Coupler" U.S. patent application, T105674US01

P7. **Zheng Liu**, Ali Omar Hassan. "Hamonic-tuned Impedance Inverter for High Efficiency Doherty Power Amplifiers" U.S. patent application (To be filed)

P8. **Zheng Liu**, Siraj Akhtar. "Adaptive Doherty Power Amplifier System" U.S. patent application (To be filed)

P9. Emir Karahan, **Zheng Liu**, Jonathan Zhou and Kaushik Sengupta "Deep Learning Enabled Generalized Synthesis of Multi-Port Electromagnetic Structures and Circuits for Radio-Frequency Systems", U.S. patent application, 63,660,874

P10. Zijian Shao, **Zheng Liu**, Emir Karahan and Kaushik Sengupta "A Dual-Port Antenna Architecture for Ultra-wideband Phased Array Applications", U.S. patent application, 63,660,874

Talks, Posters and Workshops

W1. "AI-Driven mmWave Beamforming Transmitter Architecture with Over an Octave Bandwidth for Joint Communication and Sensing", invited presentation at 2025 IEEE Radio and Wireless Week (RWW), Puerto Rico, USA, Jan, 2025.

W2. "mm-Wave 5G Power Amplifiers : Bandwidth, Back-off Efficiency and VSWR Tolerance." 2019 TxACE Symposium Poster Session, Dallas, TX, Oct 2019

W3. "Load Modulated Balanced mm-Wave CMOS PA with Integrated Linearity Enhancement for 5G Applications." 2020 AMS-CSD/TxACE Symposium Poster Session, Dallas, TX, Oct 2020

W4. "Universal and Aperiodic Array Architectures for Joint Sensing and Communication from 10-100+ GHz", NextG Symposium Poster Session, Princeton, NJ, March 2023

W5. "Universal Frequency-Agnostic Ultrabroadband Antennas and Antenna Arrays", Boston THz workshop (MIT,Brown,Rice,Princeton and Northeast), Boston, MA, April 2023

Teaching and Mentoring

Fall 20 **Wireless and High Speed Integrated Circuits and Systems (ELE582)**
Engaged in the conceptualization, guidance, and evaluation of the final graduate student high-speed circuit design project. Received a nomination for a graduate school teaching award.

Spring 21 **Electronic Circuits: Devices to ICs (ELE304)**, *Teaching Assistant*
Migrated the design project platform to a web-based Linux environment to facilitate seamless and expedited remote student access during the pandemic.

20-23 **Mentor of Junior Graduate Students**
Emir Ali Karahan: *mmWave Doherty Power Amplifier in HBT Technology, guiding his first tapeout and high frequency measurement.*
Tyler Blundo: *Reconfigurable Metasurfaces With Integrated Sensing, guiding optimization and PCB design.*
Developed instructional videos and documented tutorials covering high-frequency measurements, PDK installation, and active/passive circuit design flow. These tutorials continue to be utilized in the IMRL lab.

16-18 **Mentor of Industry Internship Students**
Zhengliu Zhou: *Development of transformer 3D parametric geometry model in HFSS at Skyworks.*
Xing Hu: *Optimization of UHB transformer on IPD technology for PA output matching at Skyworks.*
Yuhan Zheng: *Load modulated balanced PA development using GaN-on-Si technology at TI Kilby Labs.*

Technical Skills

Technical Skills **Circuit design tools**: Cadence Virtuoso, Keysight ADS, Altium Designer. **EM design tools**: HFSS, Momentum simulator, EMX, RFpro. **Programming**: Matlab, Python, SCPI

Lab Skills Experiences with various mmWave/RF validation and instruments including probing system, active/passive load-pull system, spectrum analyzer, VNA and calibration, vector signal analyzer, stability test, far-field antenna measurement in anechoic chamber.

Press/Media Coverage

JSSC Best Paper Award, *Sengupta group wins best journal paper of the year award for AI-designed chips*

Deep learning for RF chip design , *Deep learning approach to wireless chip design wins best paper at International Microwave Symposium*

IEEE Fellowship, *Flexible designs for high-speed wireless systems earn IEEE honors for two grad students*

Yan Huo 94* Fellowship, *Yan Huo *94 fellowship powers advances in wireless sensing, networked systems and 2D electrons*

Best Thesis Award, *2023 Graduate Awards*

Efficient 5G device, *Researchers win best student paper for work making 5G devices more efficient*

IEEE T-MTT Featured Article, *Frequency agile beanmformer work is selected as featured article in IEEE T-MTT journal*

Professional/Community Service

Technical Program Committee (TPRC), *2025 IEEE International Microwave Symposium (IMS)*

Session Chair, *Session: AI for Design and Optimization of RFIC and Arrays, 2025 IEEE International Microwave Symposium (IMS)*

Technical Committee Member, *IEEE Microwave Theory & Technology Society (MTT-S) Technical Committee (TC-14 on Microwave and mmWave Integrated Circuits Committee)*

Reviewer, *IEEE Journal of Solid-State Circuits*

Reviewer, *IEEE Transactions on Microwave Theory and Techniques*

Reviewer, *IEEE Transactions on Circuits and Systems I: Regular Papers*

Reviewer, *IEEE Solid-State Circuits Letters*

Reviewer, *IEEE Microwave and Wireless Components Letters*

Reviewer, *IEEE Access*

Reviewer, *IEEE Transactions on Components, Packaging and Manufacturing Technology*

Reviewer, *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*

Reviewer, *IEEE Journal on Emerging and Selected Topics in Circuits and Systems*

Deputy Reviewer, *2025 IEEE International Solid State Circuits Conference (ISSCC)-RF subcommittee*

Reviewer, *2025 IEEE Internatioal Microwave Symposium (IMS)-AI/ML for RF to mmWave subcommittee*

Judge, *2025 IEEE Internatioal Microwave Symposium (IMS) Student Paper Competition*