ALI NAJAFI

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SUMMARY

I build **embedded sensing systems and low power wireless networks for Internet of Things and Mobile Health applications.** I am also experienced in analog/mixed-signal/RF IC design. My skillset in embedded system prototyping and integration, signal processing, sensing, IC design, machine learning and deep understanding of applied physics enables me to tackle challenging new applications. Currently, I am a PhD candidate working with Shyam Gollakota in the Networks and Mobile Systems Lab.

EDUCATION

University of Washington, Seattle, WA *Sep. 2014 to Sep. 2020*
PhD Candidate in Electrical and Computer Engineering
Advisor: Shyam Gollakota
Research: Low power wireless networks, Mobile health, Embedded systems

Sharif University of Technology, Tehran, Iran *Sep. 2011 to Sep. 2013*
Master of Science in Electrical Engineering
Advisor: Mehrdad Sharif-Bakhtiar
Research: Designing low power RFID tags for wireless remote sensing applications

Sharif University of Technology, Tehran, Iran *Sep. 2007 to Sep. 2011*
Bachelor of Science in Electrical Engineering
Advisor: Sina Khorasani
Research: Analyzing symmetry in gyro-magnetic photonic crystals

WORKING EXPERIENCE

Sound Life Sciences, Seattle, WA *Feb. 2020 to Apr. 2020*
Embedded Systems Consultant
Project: Designing ultrasound capable custom smart speaker for respiratory rate detection

Jeeva Wireless Inc., Seattle, WA *Apr. 2018 to Oct. 2018*
Embedded Engineering Intern
Project: Flexible small form-factor camera tag

Apple Inc., Cupertino, CA *Aug. 2017 to Nov. 2017*
Hardware Engineering Intern
Project: Non-linearity compensation in ADC-based SerDes circuits
Manager: Mansour Keramat

Qualcomm Inc., Irvine, CA *Sep. 2016 to Dec. 2016*
Interim Engineering Intern
Project: Low power crystal oscillator circuit design for IoT Applications
Manager: Rabih Makarem

SKILLS

Embedded Hardware	Microcontrollers (TI, Nordic, PIC, NXP), FPGAs (Lattice ECP5, Microsemi IGLOO, Altera Cyclone), Sensors (Microphone, Image Sensor, IMU, Pressure Sensor), USRP
PCB Design	Altium Designer
EM Simulations	HFSS, EMX
IC design	Cadence Virtuoso, Calibre, Assura, HSpice, Agilent ADS, Design Complier, Synopsys VCS
Programming	Python, C/C++, Android, Java, Verilog, Verilog-A, MATLAB, Machine Learning, Deep Learning (TensorFlow, PyTorch)

PUBLICATIONS

- **A. Najafi***, J. Chan*, L. Mancl, S. Gollakota, "Measuring Middle Ear Function Using a Smartphone-based Tympanometer" In preparation to be submitted to Nature Biotechnology (*Co-primary student authors).
- **A. Najafi***, V. Iyer*, J. James, S. Fuller and S. Gollakota, "Wireless Steerable Vision for Live Insects and Insect-scale Robots" *Science Robotics*, Jul. 2020 (*Co-primary student authors).
- **A. Najafi***, M. Hessar*, V. Iyer and S. Gollakota, "TinySDR: Low-Power SDR Platform for Over-the-Air Programmable IoT Testbeds," *USENIX Symposium on Networked Systems Design and Implementation (NSDI)*, Feb. 2020 (*Co-primary student authors).
- **A. Najafi***, M. Hessar* and S. Gollakota, "NetScatter: Enabling Large-Scale Backscatter Networks," *USENIX Symposium on Networked Systems Design and Implementation (NSDI)*, Feb. 2019 (*Co-primary student authors).
- V. Talla, M. Hessar, B. Kellogg, **A. Najafi**, J. R. Smith, and S. Gollakota. "LoRa Backscatter: Enabling The Vision of Ubiquitous Connectivity," *ACM Interact. Mob. Wearable Ubiquitous Technol. (Ubicomp)*, Sept. 2017 (*Distinguished paper award*)
- T. Zhang, C. Su, **A. Najafi** and J. C. Rudell, "A Wideband Dual-Injection Path Self-Interference Cancellation Architecture for Full-Duplex Transceivers," in *IEEE Journal of Solid-State Circuits*, June 2018.
- T. Zhang, **A. Najafi**, C. Su and J. C. Rudell, "18.1 A 1.7-to-2.2GHz full-duplex transceiver system with > 50dB self-interference cancellation over 42MHz bandwidth," *IEEE International Solid-State Circuits Conference (ISSCC)* Feb. 2017
- T. Zhang, **A. Najafi**, M. Taghivand and J. C. Rudell, "A Precision Wideband Quadrature Generation Technique with Feedback Control for Millimeter-Wave Communication Systems," in *IEEE Transactions on Microwave Theory and Techniques*, Jan. 2018.
- **A. Najafi**, J. C. Rudell, and V. Sathe. "Regenerative Breaking: Recovering Stored Energy from Inactive Voltage Domains for Energy-efficient Systems-on-Chip," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, Aug. 2016.
- **A. Najafi**, S. Khorasani, and F. Gholami, "Analyzing Symmetry in Photonic Band Structure of Gyro-magnetic Photonic Crystals," *SPIE*, Aug. 2011.

PATENTS

- V. Talla, M. Hessar, B. Kellogg, **A. Najafi**, J. R. Smith, S. Gollakota, "Backscatter Systems, Devices and Techniques Utilizing CSS Modulation and/or Higher Order Harmonic Cancellation" Patent filed with University of Washington and licensed by Jeeva Wireless Inc.
- **A. Najafi**, S. Golara, R. Makarem, S. Moloudi, "Low power crystal oscillator" Patent filed with Qualcomm Inc.

PROJECTS

- **Smartphone-based OAE Screening Instrument to Measure Inner Ear Function.**
  - Built a device to measure distortion product otoacoustic emissions (DPOAE) leveraging smartphone
  - Measures the DPOAE signal using cheap microphone and headphone connected to a smartphone for processing
- **Smartphone-based Tympanometer to Measure Middle-Ear Function.**
  - Built a tympanometer (typically > $2000) leveraging smartphone with less than $20
  - Uses a microphone, speaker, pressure sensor and pressure pump which are air-sealed
  - Microphone and speaker measure ear canal acoustic immittance while pressure is changing
- **Smart Speaker for Medical Research.**
  - Built a smart speaker for real-time respiratory pattern and cough monitoring
  - Transmits an ultrasound (>20 KHz) signal, processes the received 8-microphone array signal reflected from the human body on the Raspberry Pi to extract the real-time respiratory patterns
  - Deployed 50 of these devices across homes in Seattle
- **Low-Power Insect-Scale Wireless Steerable Vision.**
  - Built a steerable wireless vision system compatible with small insects and insect-scale robots
  - Electronics and actuator weigh 248 mg which can be carried by small robots and insects
  - Streams 160×120 monochrome video at 1–5 frames per second (fps) using Bluetooth
  - Developed an energy efficient boost converter circuitry to drive the actuator
- **TinySDR: Low-Power SDR Platform for IoT applications.**
  - Built a low-power, cheap and small form-factor SDR platform suitable for IoT applications
  - Supports over the air update for physical layer on FPGA and MAC layer on microcontroller
  - 30uW of sleep power, 10000 times lower than other SDR platforms
  - Supports 4 MHz of bandwidth on sub-GHz and 2.4GHz bands and provides sensor interfaces.
- **NetScatter: Large-Scale Backscatter Networks.**
  - Developed the first wireless protocol supporting 100s of concurrent backscatter transmissions
  - Our coding technique combines Chirp Spread Spectrum and ON-OFF keying
  - Deployed a network of 256 devices using a bandwidth of only 500 kHz
- **LoRa Backscatter: Long-Range Ubiquitous Connectivity.**
  - Developed the first wireless communication technology supporting long-range at microwatts of power
  - Implemented Chirp Spread Spectrum on ultra-low power backscattering tag
  - Showed several hundred meters of range
- **Full-duplex radios and self-interference cancellation system.**

  - Fabricated a wireless transceiver IC for self-interference (SI) cancellation using 40nm TSMC
  - Dual-injection SI path on at receiver input and one at baseband
  - Measured 50 dB cancellation over 52 MHz bandwidth
- **Precision Wideband Quadrature Generation Technique for Millimeter-Wave Communication Systems.**
  - mm-Wave transceiver with highly accurate in-phase and quadrature-phase signals using 28nm TSMC
  - Two-stage polyphase filter with feedback control for quadrature local oscillator generation
  - Measured the worst case phase/amplitude imbalance of 2°/0.55 dB reported over 7-GHz
- **Regenerative Breaking: Recovering Stored Energy from Inactive Voltage Domains.**
  - Leveraging existing buck/boost converters to recover the otherwise wasted energy of the significant output capacitance
  - Implemented low-overhead all-digital run-time control system on 65nm TSMC using SAPR
  - Recovered over 90% of the stored energy across a range of operating system voltages
- **Microprocessor IC design.**
  - Designed a 16-bit ARM-based 2-stage pipelined CPU in 65nm TSMC CMOS
  - Designed logic standard cells from scratch
  - Ran post-layout simulations
- **Passive sensing tag design.**
  - Designed a 900 MHz low-power passive backscattering tag for remote sensing applications
  - Temperature sensor is integrated with the tag
  - Ran post-layout simulations

HONORS

- Distinguished paper award for *ACM Interact. Mob. Wearable Ubiquitous Technol. (Ubicomp)* 2017.
- Honorary admission to graduate program in microelectronics at Sharif University of Technology.

TEACHING EXPERIENCES

- **University of Washington.** Teaching Assistant for "Mobile Systems and Applications", "Computer Communication and Networks", "Introduction to Computer Communication Networks", "Linear IC Design", "Analog Circuit Design", "Switched-cap circuit design"
- **Sharif University of Technology.** Teaching Assistant for "Pulse Technique and Digital Circuits", "Principles of Electrical Engineering", "Principles of Electronic", "Energy Conversion 1"