

# ALI NAJAFI

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## SUMMARY

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I build **low power wireless networks and embedded sensing systems 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 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

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**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

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**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

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

## PUBLICATIONS

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- **A. Najafi\***, J. Chan\*, S. Gollakota, “Measuring Middle Ear Function Using a Smartphone-based Tympanometer” In preparation (\*Co-primary student authors).
- **A. Najafi\***, V. Iyer\*, J. James, S. Fuller and S. Gollakota, “Low-Power Insect-Scale Wireless Steerable Vision” Under revision in *Science Robotics* (\*Co-primary student authors).
- **A. Najafi\***, M. Hesar\*, 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. Hesar\* 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. Hesar, 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

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- V. Talla, M. Hesar, 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

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- **Smartphone-based Tympanometer.**
  - 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
- **Building a 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
  - Sends the respiratory data to the cloud
- **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.**
  - 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  $2^\circ/0.55$  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

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- 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

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- **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”