Ajay Singhvi

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Research Interests

Analog and Mixed-Signal IC Design, Sensor Interfaces, Signal Processing, Acoustics, Biomedical Sensing and Imaging, Remote Sensing

Education

Stanford University — Stanford, CA, USA
Ph.D. in Electrical Engineering — Expected Graduation: Sept 2024
Advisor: Amin Arbabian

Stanford University — Stanford, CA, USA
M.S. in Electrical Engineering — Fall 2018
GPA: 4.1/4.0

Birla Institute of Technology and Science Pilani — Pilani, RJ, India
B.E. in Electrical and Electronics Engineering — Spring 2015
GPA: 9.8/10.0

Experience

Graduate Research Assistant, **Arbabian Lab, Stanford University** — Ongoing
Advisor: Amin Arbabian
- Designed next-generation, highly sensitive, air-coupled multi-modal ultrasonic integrated circuit systems for imaging and communication applications. Work published in JSSC'22, ISSCC'22, and T-UFFC'19 [J2, C5, J5].
- Developed signal processing and ML algorithms for high-fidelity image reconstruction with improved resolution. Work presented at ISCAS'22, IUS'22, IUS'21, IUS'20, and Sensors'20 [C3, C7, C8, C10, C9].
- Built a first-of-its-kind non-contact thermoacoustic imaging system for high-throughput, non-invasive phenotyping of below-ground traits. Related work published in TCAS-II'22, ISCAS'22, IUS'21, IUS'20, Sensors'20, IUS'19, and T-UFFC'19 [J3, C6, C8, C10, C9, C11, J5].
- Devised an airborne sonar system leveraging laser ultrasound via the photoacoustic effect for high-throughout communication and sensing across the air-water interface. Related work published in Nature Comms. Eng '23, ISCAS'22, IUS22, ISSCC'22, and Access'20 [J1, C3, C7, C5, J4, C1].

System Engineering Intern, **Kilby Labs**, **Texas Instruments** — June 2018 - Aug 2018
Mentors: Ali Kiaei, Miaad S. Aliroteh
- Worked on designing a noise, power, and area efficient integrated circuit front-end for a LiDAR system interface employing on-chip APD arrays.
- The system included an APD sensor array, with distributed low noise amplifiers, calibration, and processing circuitry [P1].

Research Intern, E^2S^2C **Group, University of Southern California** — May 2014 - Aug 2015
Advisor: Peter Beerel
- Worked on the design of programmable, voltage scalable delay elements for bundled-data asynchronous VLSI systems. Work published in JETC'16, VLSID'15, and ISVLSI'15 [J6, C12, C13].

Technical Skills

Tools
Cadence Virtuoso, Cadence Spectre, Altium, Cadence Allegro PCB Designer, Keysight ADS, HFSS

Programming Languages
MATLAB, Python, SPICE

Teaching Assistant, Stanford University

EE214A - Fundamentals of Analog Integrated Circuit Design	Fall 2016, 2017, 2023
EE214B - Advanced Analog Integrated Circuit Design	Winter 2017
EE292Q (now EE219) - 3D+ Imaging Sensors	Spring 2022

Guest Lectures, Stanford University

EE214A - Fundamentals of Analog Integrated Circuit Design	Fall 2018-23
EE219 - 3D+ Imaging Sensors	Spring 2024

AWARDS

James F. Gibbons Outstanding Student Teaching Award, Stanford University	2022
Analog Devices Outstanding Student Designer Award	2020
L. K. Maheshwari Best Graduating Student Award, BITS Pilani	2014
Silver Medallist and Salutatorian, BITS Pilani	2014
OP Jindal Scholarship for Engineering and Management Students	2011, 2012, 2014
Merit Scholarship, BITS Pilani	2011, 2012, 2013, 2014

PEER-REVIEWED JOURNAL PUBLICATIONS

[J1] Aidan Fitzpatrick, Roshan P Mathews, **Ajay Singhvi**, and Amin Arbabian. Multi-modal sensor fusion towards three-dimensional airborne sonar imaging in hydrodynamic conditions. *Nature Communications Engineering*, 2(1):16, 2023.

[J2] Christopher Sutardja, **Ajay Singhvi**, Aidan Fitzpatrick, Andreia Cathelin, and Amin Arbabian. Multi-Watt-Level 4.9-GHz Silicon Power Amplifier for Portable Thermoacoustic Imaging. *IEEE Journal of Solid-State Circuits*, 57(5):1421–1431, 2022.

[J3] **Ajay Singhvi**, Aidan Fitzpatrick, Johannes Daniel Scharwies, José R. Dinneny, and Amin Arbabian. A Thermoacoustic Imaging System for Non-Invasive and Non-Destructive Root Phenotyping. *IEEE Transactions on Circuits and Systems II: Express Briefs*, 69(5):2493–2497, 2022.

[J4] Aidan Fitzpatrick, **Ajay Singhvi**, and Amin Arbabian. An Airborne Sonar System for Underwater Remote Sensing and Imaging. *IEEE Access*, 8:189945–189959, 2020.

[J5] **Ajay Singhvi***, Kevin C. Boyle*, Mojtaba Fallahpour, Butrus T. Khuri-Yakub, and Amin Arbabian. A Microwave-Induced Thermoacoustic Imaging System with Non-Contact Ultrasound Detection. *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control*, 66(10):1587–1599, 2019.

[J6] **Ajay Singhvi**, Matheus T. Moreira, Ramy N. Tadros, Ney L.V. Calazans, and Peter A. Beerel. A Fine-Grain, Uniform, Energy-Efficient Delay Element for 2-Phase Bundled-Data Circuits. *ACM Journal on Emerging Technologies in Computing Systems (JETC)*, 13(2):1–23, 2016.

PEER-REVIEWED CONFERENCE PUBLICATIONS

[C1] Aidan Fitzpatrick, **Ajay Singhvi**, Jordy Mukania, Brion Ye, Eastan Giebler, and Amin Arbabian. Three-Dimensional Mapping of Water Surface Waves Using Air-Coupled Sonar. In *OCEANS 2023-MTS/IEEE US Gulf Coast*, pages 1–7. IEEE, 2023.

[C2] Jingzhi Zhang, **Ajay Singhvi**, Sherif S Ahmed, and Amin Arbabian. A W-Band Transceiver Array with 2.4 GHz LO Synchronization Enabling Full Scalability for FMCW Radar. In *2023 IEEE International Solid-State Circuits Conference (ISSCC)*, pages 282–284. IEEE, 2023.

[C3] Aidan Fitzpatrick*, **Ajay Singhvi***, and Amin Arbabian. Dynamic Tuning of Sensitivity and Bandwidth of High-Q Transducers via Nested Phase Modulations. In *2022 IEEE International Symposium on Circuits and Systems (ISCAS)*, pages 1–4. IEEE, 2022.

[C4] William L Meng, Aidan Fitzpatrick, **Ajay Singhvi**, and Amin Arbabian. Laser Scanning for Single-Shot Frequency Diverse Photoacoustic Excitation. In *2022 IEEE International Ultrasonics Symposium (IUS)*, pages 1–4. IEEE, 2022.

[C5] **Ajay Singhvi**, Aidan Fitzpatrick, and Amin Arbabian. An Electronically Tunable Multi-Frequency Air-Coupled CMUT Receiver Array with sub-100μPa Minimum Detectable Pressure Achieving a 28kb/s Wireless Uplink Across a Water-Air Interface. In *2022 IEEE International Solid-State Circuits Conference (ISSCC)*, volume 65, pages 498–500. IEEE, 2022.

[C6] **Ajay Singhvi**, Aidan Fitzpatrick, Johannes Daniel Scharwies, José R. Dinneny, and Amin Arbabian. A Thermoacoustic Imaging System for Non-Invasive and Non-Destructive Root Phenotyping. In *2022 IEEE International Symposium on Circuits and Systems (ISCAS)*, pages 1–4. IEEE, 2022.

[C7] Max L Wang*, **Ajay Singhvi***, Gift Nyikayaramba*, Boris Murmann, and Amin Arbabian. Adaptive Beamforming for Wireless Powering of a Network of Ultrasonic Implants. In *2022 IEEE International Ultrasonics Symposium (IUS)*, pages 1–4. IEEE, 2022.

[C8] **Ajay Singhvi***, Max L. Wang*, Aidan Fitzpatrick*, and Amin Arbabian. Multi-Task Learning for Simultaneous Speed-of-Sound Mapping and Image Reconstruction Using Non-Contact Thermoacoustics. In *2021 IEEE International Ultrasonics Symposium (IUS)*, pages 1–5. IEEE, 2021.

[C9] Aidan Fitzpatrick, **Ajay Singhvi**, and Amin Arbabian. Spatial Reconstruction of Soil Moisture Content using Non-Contact Thermoacoustic Imaging. In *2020 IEEE SENSORS*, pages 1–4. IEEE, 2020.

[C10] **Ajay Singhvi**, Aidan Fitzpatrick, and Amin Arbabian. Resolution Enhanced Non-Contact Thermoacoustic Imaging using Coded Pulse Excitation. In *2020 IEEE International Ultrasonics Symposium (IUS)*, pages 1–4. IEEE, 2020.

[C11] **Ajay Singhvi**, Bo Ma, Johannes Daniel Scharwies, José R. Dinneny, Butrus T. Khuri-Yakub, and Amin Arbabian. Non-Contact Thermoacoustic Sensing and Characterization of Plant Root Traits. In *2019 IEEE International Ultrasonics Symposium (IUS)*, pages 1992–1995. IEEE, 2019.

[C12] Guilherme Heck, Leandro S. Heck, **Ajay Singhvi**, Matheus T. Moreira, Peter A. Beerel, and Ney L.V. Calazans. Analysis and Optimization of Programmable Delay Elements for 2-Phase Bundled-Data Circuits. In *2015 28th international conference on VLSI design*, pages 321–326. IEEE, 2015.

[C13] **Ajay Singhvi**, Matheus T. Moreira, Ramy N. Tadros, Ney L.V. Calazans, and Peter A. Beerel. A Fine-Grained, Uniform, Energy-Efficient Delay Element for FD-SOI Technologies. In *2015 IEEE Computer Society Annual Symposium on VLSI*, pages 27–32. IEEE, 2015.

ISSUED PATENTS

[P1] Sensor array with distributed low noise amplifier. US Patent 10,879,856 (issued on December 29, 2020).

RESEARCH PRESS COVERAGE

ROOTS: Non-Contact Thermoacoustic Below-Ground Sensing
Stanford News, Stanford SoE, Engadget, CNET

PASS: Photoacoustic Airborne SONAR System
Forbes, The Economist, IEEE Spectrum, Stanford News

INVITED TALKS AND DEMONSTRATIONS

ROOTS: Non-Contact Thermoacoustic Below-Ground Sensing

Bayer US - Crop Science	Feb 2021, June 2022
ARPA-E Energy Innovation Summit	Mar 2018, July 2019, May 2021

PASS: Photoacoustic Airborne SONAR System

Ocean IoT: Technologies, Industries, Sustainability, MIT	Nov 2021
Internet of Robotic Things Research Seminar, University of Washington	Jan 2021

SERVICE

IEEE Symposium on VLSI Technology and Circuits (VLSI), Reviewer
IEEE Symposium on Radio Frequency Integrated Circuits (RFIC), Reviewer
IEEE International Symposium on Circuits and Systems (ISCAS), Reviewer
IEEE Biomedical Circuits and Systems Conferences (BioCAS), Reviewer
Physics in Medicine and Biology, Reviewer
Medical Physics, Reviewer and Associate Editor
IEEE Transactions on Biomedical Circuits and Systems, Reviewer
IEEE Transactions on Medical Imaging, Reviewer