Shubham Chandak | CV

shubhamchandak94.github.io

Fifth year PhD student in Electrical Engineering at Stanford University, advised by Prof. Tsachy Weissman.
Interested in DNA storage, bioinformatics, data compression, information theory and machine learning.

Education

Stanford University — **Stanford, CA, USA**
PhD, Electrical Engineering, ongoing — *2016–2021*

Stanford University — **Stanford, CA, USA**
MS, Electrical Engineering, GPA 4.2/4 — *2016–2018*

Indian Institute of Technology Bombay — **Mumbai, India**
B.Tech. in Electrical Engineering with Honours, CPI 9.99/10, Minor in Math — *2012–2016*

Academic Achievements

- **Siemens Inventor of the Year 2020** award in Open Innovation category for sensor time-series compression project.
- **Qualcomm Innovation Fellowship** Finalist in 2019.
- **Beckman Technology Development Award** in 2018 for project on DNA Storage.
- Recipient of **The Numerical Technologies Co-Founders Fellowship** in 2017-18 awarded to the top performers in Stanford Electrical Engineering PhD qualifying exam.
- **Institute Silver Medal** at IIT Bombay for best academic standing in B.Tech. Electrical Engineering in 2016.
- **Prof. K. C. Mukherjee Award** at IIT Bombay for best project among B.Tech. Electrical Engineering students in 2016.
- Awarded the **Aditya Birla Scholarship** for 2012-16 by India's premier business house viz. Aditya Birla Group.
- **Gold medalist (International Rank 9)** at the **44th International Chemistry Olympiad**, Washington DC, USA in 2012.
- **All India Rank 15** in IIT-JEE 2012 (IIT-Joint Entrance Exam) among more than 470,000 candidates.
- Recipient of **KVPY** Fellowship by Govt. of India with **All India Rank 6** in 2010.
- **NTSE** scholarship (National Talent Search Exam conducted by NCERT, Govt. of India) in 2009.

Publications

Journal

- S. Chandak, K. Tatwawadi, S. Sridhar and T. Weissman; Impact of lossy compression of nanopore raw signal data on basecall and consensus accuracy, *To appear in Bioinformatics*.
- S. Chandak, K. Tatwawadi, I. Ochoa, M. Hernaez and T. Weissman; SPRING: A next-generation compressor for FASTQ data, *Bioinformatics*, Volume 35, Issue 15, 1 August 2019, Pages 2674–2676.
- S. Chandak, K. Tatwawadi and T. Weissman; Compression of genomic sequencing reads via hash-based reordering: algorithm and analysis, *Bioinformatics*, Volume 34, Issue 4, 15 February 2018, Pages 558–567.
- N. Desai, C. Juvekar, S. Chandak and A. P. Chandrakasan, "An Actively Detuned Wireless Power Receiver With Public Key Cryptographic Authentication and Dynamic Power Allocation," in *IEEE Journal of Solid-State Circuits*, vol. 53, no. 1, pp. 236-246, Jan. 2018.

Conference

- S. Chandak, J. Neu, K. Tatwawadi, J. Mardia, B. Lau, M. Kubit, R. Hulett, P. Griffin, M. Wootters, T. Weissman and H. Ji; "Overcoming high nanopore basecaller error rates for DNA storage via basecaller-decoder integration and convolutional codes," *2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, Barcelona, Spain, 2020, pp. 8822-8826.
- S. Chandak, K. Tatwawadi, C. Wen, L. Wang, J.A. Ojea and T. Weissman; "LFZip: Lossy compression of multivariate floating-point time series data via improved prediction," *2020 Data Compression Conference (DCC)*, Snowbird, UT, USA, 2020, pp. 342-351.
- M. Goyal, K. Tatwawadi, S. Chandak and I. Ochoa; "DZip: improved general-purpose lossless compression based on novel neural network modeling," *2020 Data Compression Conference (DCC)*, Snowbird, UT, USA, 2020, pp. 372-372.
- S. Chandak, K. Tatwawadi, B. Lau, J. Mardia, M. Kubit, J. Neu, P. Griffin, M. Wootters, T. Weissman and H. Ji; "Improved read/write cost tradeoff in DNA-based data storage using LDPC codes," *2019 57th Annual Allerton Conference*

on Communication, Control, and Computing (Allerton), Monticello, IL, USA, 2019, pp. 147-156.

- A. Bhown, S. Mukherjee, S. Yang, S. Chandak, I. Fischer-Hwang, K. Tatwawadi and T. Weissman; "Humans are still the best lossy image compressors," *2019 Data Compression Conference (DCC)*, Snowbird, UT, USA, 2019, pp. 575-575.
- M. Goyal, K. Tatwawadi, S. Chandak and I. Ochoa; "DeepZip: Lossless Data Compression using Recurrent Neural Networks," *2019 Data Compression Conference (DCC)*, Snowbird, UT, USA, 2019, pp. 558-558.
- N. V. Desai, C. Juvekar, S. Chandak and A. P. Chandrakasan, "21.8 An actively detuned wireless power receiver with public key cryptographic authentication and dynamic power allocation," *2017 IEEE International Solid-State Circuits Conference (ISSCC)*, San Francisco, CA, 2017, pp. 366-367.

Patents

- S. Chandak and Y.H. Cheung. System and method for effective compression, representation and decompression of diverse tabulated data. *Patent application filed.*
- S. Chandak, K. Tatwawadi, I. Ochoa, M. Hernaez and T. Weissman. Systems and Methods for Compressing Genetic Sequencing Data and Uses Thereof. *U.S. Patent Application No. 16/545,751.*
- C. Wen, L. Wang, J. Aparicio, S. Chandak, K. Tatwawadi and T. Weissman. Embedded Deep Compression for Time Series Data. *U.S. Patent Application No. 2019/023501.*
- A. P. Chandrakasan, N. Desai, C. Juvekar and S. Chandak. Detuning for a resonant wireless power transfer system including cryptography. *U.S. Patent No. 10,651,687* issued 12 May 2020.

Preprints

- R. Prabhakar, S. Chandak, C. Chiu, R. Liang, H. Nguyen, K. Tatwawadi and T. Weissman; Reducing latency and bandwidth for video streaming using keypoint extraction and digital puppetry, *arXiv (2020), Submitted to DCC 2021.*
- K. Tatwawadi and S. Chandak; Tutorial on algebraic deletion correction codes, *arXiv (2019).*

Talks

- Genomic data compression. *Roche*, November 13, 2020. *Invited.*
- Error correcting codes for DNA based data storage. *ISMB/ECCB 2019*, Basel, July 21-25, 2019.
- SPRING: A next-generation compressor for FASTQ data. *ISMB/ECCB 2019*, Basel, July 21-25, 2019. *Invited.*
- SPRING: A next-generation compressor for FASTQ data. *Stanford Compression Workshop 2019*, Stanford, February 15, 2019. *Invited.*
- SPRING: A practical compressor for short-read FASTQ data. *56th Annual Allerton Conference on Communication, Control, and Computing*, Urbana, IL, October 3-5, 2018. *Invited.*

Poster

- Error correcting codes for DNA based data storage. *ISMB/ECCB 2019*, Basel, July 21-25, 2019.
- SPRING: A practical compressor for short-read FASTQ data. *ISMB 2018*, Chicago, IL, July 6-10, 2018.
- Compression of genomic sequencing reads with and without preserving the order. *2017 Biomedical Computation at Stanford Symposium*, Stanford University, 10 April, 2017.

Experience

Philips Research North America   **Cambridge, MA, USA**
Data Compression Research Intern   *June–September 2019*
Worked on genomic data compression, supervised by Patrick Cheung.

Massachusetts Institute of Technology   **Cambridge, MA, USA**
Summer Intern   *May–July 2015*
Worked on hardware implementation of Elliptic Curve Cryptography for IoT applications, supervised by Prof. Anantha Chandrakasan.

Oxford Brookes University   **Oxford, UK**
Summer Intern   *May–July 2014*
Worked on electrode design for Functional Electrical Stimulation using numerical analysis, supervised by Prof. Cristiana Sebu.

Course Projects

CS 349T/EE 192T: Video and Audio Technology for Live Theater in the Age of COVID   *Autumn 2020-21*

The course focused on developing technologies to enable live theater performance over the internet.

- Developed systems for emoji and audio-based audience feedback along with audiovisual effects in the video player.
- Researched low-latency video transmission using WebRTC to enable live audience interaction.

o **Implementation and analysis of stabilizer codes in pyQuil**   *Spring 2018-19*
Stabilizer codes form a large family of quantum error correcting codes that includes well-known codes such as Shor code, Steane code, CSS codes and toric codes.

- As part of "CS 269Q: Quantum Computer Programming", we built a framework for encoding and decoding of general stabilizer codes on pyQuil and tested specific single qubit codes with standard quantum noise models.

o **Understanding the Amazon Rainforest from Space using CNNs**   *Spring 2016-17*

- Participated in Kaggle contest "Understanding the Amazon from Space" by Planet Labs, as part of course project for "CS231N: Convolutional Neural Networks for Visual Recognition".
- Tested various architectures for multi-class, multi-label prediction of weather and land-use features based on satellite images of the Amazon rainforest.
- Received Bronze medal from Kaggle for getting leaderboard rank of 67 among 938 teams.

Coursework

o **Electrical Engineering:** Modern Coding Theory, Universal Schemes in Information Theory, Information Theory, Convex Optimization, Digital Signal Processing, Digital Communications, Control Systems, Microprocessors

o **Computer Science:** Advanced Cryptography, Cryptocurrencies & Blockchain Technologies, Quantum Computing, Convolutional Neural Networks for Visual Recognition, Probabilistic Graphical Models, Machine Learning, Automata & Complexity Theory, Web Applications, Audio/Video technology for live theater

o **Statistics & Probability:** Advanced Probability & Random Processes

o **Mathematics:** Probabilistic Methods, Measure Theory, General Topology, Graph Theory, Abstract Algebra, Fourier Analysis, Complex Analysis, Real Analysis, Partial Differential Equations

o **Genomics:** Genomics, The Human Genome Source Code

o **Humanities & Social Sciences:** Economics, Sociology, Environmental Studies

Other Experience

o Collaboration project with Siemens on compression of sensor data since 2017.
o Teaching Assistant:
  - EE 178 - Probabilistic Systems Analysis, Autumn 2017-18
  - EE 376A - Information Theory, Winter 2018-19.
  - EE 276 - Information Theory, Winter 2019-20.
  - Helped redesign information theory course to be accessible to wider audience, helped organize outreach event at local school, mentored course projects, and gave guest lecture on entropy rate and universal compressors.
o Co-organizer of Stanford Compression Workshop 2019.
o Contributing to genie, an open-source codec for the MPEG-G standard for genomic information representation since 2018.
o Mentor for STEM to SHTEM summer internship for high school students in 2020.
o Reviewed papers for Bioinformatics, Journal of Bioinformatics and Computational Biology, PLOS One, IEEE Access, ISIT, DCC and ITW.

Technical and Personal Skills

o **Programming:**
  - Proficient in: C++, Python (incl. NumPy)
  - Experience with: JavaScript, Tensorflow, Keras, Julia, Matlab, VHDL, Arduino
o Introductory Piano Class at Stanford.
o **Languages:** Hindi, English