Jatin Chowdhury

Audio Signal Processing Engineer

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Education

Stanford University, Center for Computer Research in Music and Acoustics *Palo Alto, CA*

M.A. in Music, Science, and Technology *Sept. 2018 - June 2020*

- Denning Family Fellowship for the 2018-2019 academic year.
- Relevant Coursework: Physical Audio Signal Processing, Time-Frequency Audio Signal Processing, Machine Learning, Digital Instrument Design, Spatial Audio, Music Recording.

University of Southern California *Los Angeles, CA*

B.S. in Electrical Engineering *Aug. 2014 - May 2018*

- USC Presidential Scholarship for outstanding academic achievement.
- Completed Minors in Physics and Music Recording.
- USC Renaissance Scholar certificate for excelling academically while pursuing separate fields of study.
- Relevant Coursework: Signal Processing, Circuit Design, Digital Logic, Electromagnetics, Software Design.

Experience

Chowdhury DSP *Denver, C0*

Audio Signal Processing Engineer *Oct. 2021 - PRESENT*

- Developed signal processing algorithms for real-time audio processing and synthesis.
- DSP algorithms include: virtual analog modelling, machine learning, and frequency-domain processing.
- Developed audio plugins including DSP, UI implementation, preset management, copy protection, installers, etc.
- Contributed to open-source audio plugins as well as signal processing and C++ libraries.
- Rendered services for clients including: BABY Audio, Tone Empire, Impact Soundworks, ADPTR Audio, Bogren Digital, Mayk.it, and Schwabe Digital

Tesla Motors *Palo Alto, CA*

Audio Test Engineer *Aug. 2020 - Oct. 2021*

- Developed audio system signal flow layouts for vehicles using AudioWeaver.
- Contributed to audio system testing and tuning including telephony, equalization, and spatialization.
- Developed end-of-line tests to ensure vehicle audio system quality using Python and C++.
- Contributed to the signal processing and tuning for the vehicle pedestrian warning speaker.
- Contributed to testing and validation software for audio system firmware.

Persp3ctive VR *Los Angeles, CA*

Software/DSP Engineer *June 2019 - Mar. 2020*

- Developed and implemented audio effects for use in a VR audio production environment including:
- Implemented the audio effects as an audio plugin with a fully featured UI.
- Built DSP framework for integrating effects made by other engineers into the plugin.
- Implemented OSC communication for sharing parameters and metering data with VR headset.
- Developed unit testing framework to make overall software more robust.

Audioworks Technologies *Toronto, ON*

Software Engineer *July 2018 - Dec. 2018*

- Member of of the SoundsUnite developement team: building a digital audioworkstation (DAW) using JUCE/C++.
- Developed DSP features for the application including panning algorithms, level detection, and “smart” track exporting.
- Developed UX features for the application including meters, file browsers, and tempo controls.
- Integrating the application file management system with the SoundsUnite web store.

McGill Space Institute *Montreal, QC*

Research Trainee *May 2017 - Aug. 2017*

- Recipient of an Undergraduate Student Research Award from the National Sciences and Engineering Research Council of Canada.
- Member of the CHIME/FRB Working Group: building a software pipeline to detect Fast Radio Bursts (FRBs).
- Developed a “Flux Estimator” module for the CHIME/FRB software pipeline: Use incoming data from the telescope to estimate the intrinsic brightnes of the astrophsyical source.
- Contributed to science and unit testing frameworks for the CHIME/FRB software pipeline.
- Presented work for CHIME/FRB Working Group and CHIME/FRB Pipeline Gamma Release.

USC Viterbi Academic Resources Center *Los Angeles, CA*
Engineering Tutor *Aug. 2018 - May 2018*
- Tutored undergraduate engineering students in math, physics, and electrical engineering classes.
- Served as a tutor for the university chapter of the Society of Hispanic Professional Engineers.
- Trained new tutors in interacting with students and presenting material in a clear, concise, and cohesive manner.

KXSC Radio *Los Angeles, CA*
Disc Jockey, Jazz Director *Jan. 2015 - May 2018*
- On-air host and disc jockey for live jazz radio program "Jam Sessions".
- Co-host of live radio talk-show programs "Squaminous Science Hour", and "TeXulous Talk Show".
- KXSC Jazz Director tasked with researching, reviewing, and organizing jazz music for the station library.

iD Technology Camps *Denver, CO*
Instructor *May 2015 - Aug. 2016*
- Taught students age 12-17 programming in C++ and Arduino.
- Taught students age 6-12 in building simple robots using LEGO Mindstorm kits.

Skills

Programming Languages	C/C++, Python, Bash, MATLAB, Faust, LaTex, Rust, Javascript
Signal Processing	Virtual analog modelling, filter design, neural networks, time-frequency analysis
Frameworks	JUCE API, TensorFlow, Web Audio API, Arduino
Tools	CMake, Git, Linux CLI, Visual Studio, Xcode, GitHub Actions, Inno Setup

Publications

Computationally Efficient Physics Approximating Neural Networks for Highly Nonlinear Maps *Oct. 2022*
Proc. of the Conference on Research in Adaptive and Convergent System *New York, USA*
- Co-authored with Christopher Johann Clarke and others.
- Available on the ACM Digital Library.

chowdsp_wdf: An Advanced C++ Library for Wave Digital Circuit Modelling *Oct. 2022*
ArXiv E-Prints: Audio and Speech Processing *Online*
- Presents a wave digital circuit modelling library with fixed-topology optimizations and other advancements.
- Available on the ArXiv.

Emulating Diode Circuits with Differentiable Wave Digital Filters *June 2022*
19th Sound and Music Computing Conference *Saint Etienne, France*
- Co-authored with Christopher Johann Clarke.
- Available on Zenodo.

A Wave Digital Filter Modeling Library for the Faust Programming Language *June 2021*
Proc. of the 18th Sound and Music Computing Conference *Torino, IT*
- Co-authored with Dirk Roosenburg, Eli Stine, and Romain Michon.
- Available on GitHub.

RTNeural: Fast Neural Inferencing for Real-Time Systems *June 2021*
ArXiv E-Prints: Audio and Speech Processing *Online*
- Presents a neural network inferencing library for real-time systems.
- Available on the ArXiv.

Water Bottle Synthesis with Modal Signal Processing *Sept. 2020*
Proc. of the 23rd International Conference on Digital Audio Effects *Vienna, Austria*
- Presented at the DAFx-2020 conference.
- Available on the DAFx Archives.

Stable Structures for Nonlinear Biquad Filters *Sept. 2020*
Proc. of the 23rd International Conference on Digital Audio Effects *Vienna, Austria*
- Presented at the DAFx-2020 conference.
- Available on the DAFx Archives.

Real-Time Physical Modelling for Analog Tape Machines *Sept. 2019*
Proc. of the 22nd International Conference on Digital Audio Effects *Birmingham, UK*
- Presented at the DAFx-2019 conference.
- Available on the DAFx Archives.

The CHIME Fast Radio Burst Project: System Overview *Aug. 2018*
The Astrophysical Journal *Vol. 836, No. 1*
- Co-authored with the CHIME/FRB Collaboration
- Available on the ArXiv.

Presentations

Replacing the AudioProcessorValueTreeState *December 2022*
The Audio Programmer Monthly Meetup *Online*
- Discussed the historical and current methods of audio plugin state management with the JUCE framework.
- Proposed a new approach for managing plugin state with an emphasis on real-time safety.

Physical Modelling for Analog Tape Emulation *December 2022*
Acoustical Society of America Annual Meeting *Nashville, USA*
- Discussed the development of a physical-modelling algorithm for real-time tape emulation.
- Discussed the physical basis for modelling magnetic hysteresis with nonlinear differential equations.
- Discussed implementation challenges for real-time tape emulation algorithms.

Analog Modelling with Wave Digital Filters in C++ *December 2021*
The Audio Programmer Monthly Meetup *London, UK*
- Discussed the basic formulation of Wave Digital Filters (WDFs) as a technique for modelling analog circuits.
- Discussed two approaches for implementing WDFs in C++, with trade-offs between flexibility and performance.
- Demonstrated example applications of WDF models in developing digital audio effects.

CI/CD for Audio Plugin Development *November 2021*
Audio Developer Conference *London, UK*
- Discussed the basic concepts and motivations for continuous integration and continuous deployment (CI/CD).
- Discussed the usefulness of CI/CD for developing audio plugins.
- Demonstrated several CI/CD workflows in the context of audio plugin development.

Creating Audio Effect Plugins for the 21st Century *February 2021*
SARC Virtual Events Series *Belfast, UK*
- Presented at the Sonic Arts Research Centre (SARC) at Queen's University Belfast.
- Presented a paradigm for developing original and innovative digital audio software.
- Discussed techniques and philosophies for designing audio software as part of a creative process, including signal processing algorithms and user interfaces.

A Comparison of Virtual Analog Modelling Techniques *November 2020*
Audio Developer Conference *London, UK*
- Presented a virtual analog model of the Klon Centaur guitar pedal developed using multiple modelling techniques, including nodal analysis, Wave Digital Filters, and Recurrent Neural Networks.
- An accompanying paper is published on the ArXiv.

Complex Nonlinearities for Audio Signal Processing *May 2019*
CCRMA DSP Seminar *Stanford, CA*
- Presented at the Center for Computer Research in Music and Acoustics (CCRMA) at Stanford University.
- Presented a series of audio effects constructed from innovative uses of nonlinear signal processing techniques.
- Audio effects presented include harmonic exciters, hysteresis, nonlinear filters, subharmonics generators, and more.

Exploring Real-Time DSP Systems for Mixing and Performance *Apr. 2019*
CCRMA DSP Seminar *Stanford, CA*
- Presented at the Center for Computer Research in Music and Acoustics (CCRMA) at Stanford University.
- Presented overview of previous research and projects to an audience of peers, professors, and the public.
- Discussed topics including real-time timbral conversion, methods of integrating "imperfection" into audio DSP systems, and designing user interfaces for DSP systems as an extension of the DSP systems themselves.

Research

Differentiable Wave Digital Filters
Lead Researcher *July 2021 - PRESENT*
- Demonstrated a process for constructing Wave Digital Filter (WDF) circuit models, in conjunction with neural network models of specific circuit elements.
- Developed a Python library for creating differentiable WDF models, allowing them to be trained via backpropagation.
- Project documentation is available on GitHub.

Real-Time Neural Network Inferencing
Stanford, CA

Lead Researcher
June 2020 - June 2021

- Developed a C++ library for performing neural inferencing for real-time audio systems.
- Developed benchmarks to compare the library performance with the PyTorch C++ API.
- Project documentation is available on GitHub.

Klon Centaur Emulation
Stanford, CA

Lead Researcher
Mar. 2020 - Aug. 2020

- Developed a digital emulation of the Klon Centaur guitar distortion pedal.
- Used circuit modelling methods including nodal analysis, Wave Digital Filters, and Recurrent Neural Networks.
- Developed emulation as an audio plugin and guitar pedal using an Arduino Teensy microcontroller.
- Project documentation is available on GitHub.

Modal Waterbottles
Stanford, CA

Researcher
June 2019 - April 2020

- Worked with a team of researchers to develop acoustical models of water bottles using modal signal processing.
- Developed a real-time water bottle synthesizer using the JUCE framework.
- Project documentation is available on GitHub.

Complex Nonlinearities

Lead Researcher
Aug. 2019 - June 2020

- Built frameworks for developing complex nonlinear audio signal processors.
- Developed a series of open-source plugins to demonstrate the nonlinear frameworks.
- Published a series of Medium articles explaining nonlinear signal processing techniques for a non-technical audience.
- Project documentation can be found on GitHub.

Bad Circuit Modelling

Lead Researcher
Nov. 2019 - June 2020

- Researched methods for virtual analog circuit modelling to account for imperfections that exist in real-world circuits.
- Developed simulations and real-time circuit-modelling systems that accurately model the aging and component tolerances of resistors and capacitors.
- Project documentation can be found on GitHub.

Analog Tape Modelling
Stanford, CA

Lead Researcher
Jan. 2019 - Apr. 2019

- Researched and developed a physical model of an analog, reel-to-reel tape machine.
- Modelled the nonlinear process of analog tape recording using the Jiles-Atherton model for magnetic hysteresis.
- Modelled other effects created by analog tape machines, including flutter, playhead loss effects, and biasing effects.
- Developed an open-source audio plugin implementing the analog tape model as a real-time system. Source code and documentation are available on GitHub.

notGuitar
Los Angeles, CA

Research Partner
Jan. 2018 - May 2018

- notGuitar is real-time timbral conversion system designed to process a guitar input signal to sound like a saxophone.
- notGuitar was implemented using a Texas Instruments DSK6713 DSP board in May 2018.
- Documentation for the project can be found on GitHub.

Projects

Chowdhury DSP

Founder, Engineer
June 2018 - PRESENT

- Developed audio plugins including:
  - ChowTapeModel: An analog tape emulation based on the DAFx-19 paper "Real-Time Physical Modelling for Analog Tape Machines".
  - BYOD: A modular system for creating guitar effect signal chains.
  - ChowMatrix: A dynamic matrix of stereo delay effects.
  - ChowKick: A kick drum synthesizer based on creative circuit modelling.
  - ChowCentaur: A digital emulation of the Klon Centaur distortion pedal, using Wave Digital Filters and recurrent neural networks.
  - ChowPhaser: A phaser effect based loosely on the Schulte Compact Phasing 'A' circuit.
- Contributed audio effects and other DSP code to the open-source Surge Synthesizer project.
- Developed modules for the VCV Rack modular synthesis environment.
- For more information, see the Chowdhury DSP website.

CLever Audio Plugins (CLAP)

Contributor *Mar. 2022 - PRESENT*

- Contributed to the CLAP plugin standard with testing and documentation.
- Contributed to a wrapper to allow developers using the JUCE framework to export CLAP plugins.
- Contributed to a JUCE module allowing JUCE applications to host CLAP plugins.

Wave Digital Filters

Programmer *Jan. 2020 - PRESENT*

- Created a minimal C/C++ Library for modelling circuits with Wave Digital Filters (WDFs).
- Currently includes WDF implementations for basic circuit elements (resistors, capacitors, inductors), basic circuit adaptors (series, parallel), "1-port" nonlinear circuit elements, and "R-Type" adaptors.
- Includes several example WDF models implemented as audio plugins using the JUCE framework, as well as a graphical WDF prototyping tool.
- Developed an auxiliary script for deriving scattering matrices for "R-Type" adaptors.
- Ongoing development and documentation can be found on GitHub.

audio-dspy

Programmer *Oct. 2019 - June 2020*

- Created a Python package for audio signal processing.
- Currently includes tools for filter design, impulse response manipulation, modal modelling, and nonlinear processing.
- Development and documentation can be found on GitHub.

NewMixer

Creator *Dec. 2018 - Dec. 2019*

- A unique digital audio workstation designed to break away from the traditional "virtual console" user interface.
- Individual audio sources are visualized as sound sources in a room; the user can arrange the sources to create a mix with stereo width, and reverberative depth.
- NewMixer is currently a fully functional mixing tool, supporting saving, exporting, automation, plugin hosting and more.
- Documentation of NewMixer can be found on GitHub.

The SGUM (Squaminous Geometrically Uncanny Matrix) *Stanford, CA*

Creator *Mar. 2019*

- The SGUM is an expressive standalone drum machine, comprised of nine velocity-sensitive drum pads, with programmable samples and configurations.
- Designed and built from the SGUM from scratch, including drum pads, circuitry, frame, etc.
- Programmed firmware for the SGUM, which runs on a Teensy 3.6 microcontroller with an audio shield and uses embedded Faust processing.
- The entire process was completed in two weeks, and for less than $100 USD.
- Documentation for the SGUM can be found on YouTube.

NoLava Recording Studios *Los Angeles, CA*

Co-Founder, Audio Engineer, Technical Advisor *Aug. 2017 - July 2018*

- Recorded, mixed, and mastered for artists of various styles including acoustic, electronic, rock, country, and punk.
- Installed, repaired, and maintained speakers, microphones, keyboards, amplifiers, and other studio equipment.