

# Jatin Chowdhury

## Audio Signal Processing Engineer

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## Education

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### 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

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### Tesla Motors

Palo Alto, CA

AUDIO TEST ENGINEER

Aug. 2020 - PRESENT

- Developed end-of-line tests to ensure audio system quality for vehicles coming off the production line.
- Contributed to the signal processing and tuning for the vehicle pedestrian warning speaker.
- Contributed to testing and validation software for audio system firmware.
- Developed interactive tools reporting the results of previous tests.

### 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:
  - Lowpass and highpass filters with smoothly varying cutoff frequency and rolloff rate.
  - EQ filters for a parametric EQ including bell, notch, and shelf filter shapes.
  - Dynamic range compression, including virtual analog models of an optical compressor circuit, an analog level detector circuit, and an output transformer.
- 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.
- Built software installers for Windows platform using Inno Setup.

### Audioworks Technologies

Toronto, ON

SOFTWARE ENGINEER

July 2018 - Dec. 2018

- Member of the SoundsUnite development team: building a digital audioworkstation (DAW) using JUCE/C++.
- Developed and implemented DSP features for the application including panning algorithms, level detection, and "smart" track exporting.
- Developed UX features for the application.
- Developed file management features for the application, including integrating the file management system with the SoundsUnite web store.
- Presented work to engineering team, managers, and investors.

### 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).
- CHIME is a telescope in British Columbia; has detected more FRBs in the Northern Hemisphere than any other telescope to date.
- Developed a "Flux Estimator" module for the CHIME/FRB software pipeline: Use incoming data from the telescope to estimate the intrinsic brightness of the astrophysical 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

### ENGINEERING TUTOR

Los Angeles, CA

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

### DISC JOCKEY, JAZZ DIRECTOR

Los Angeles, CA

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 "Squamous Science Hour", and "TeXulous Talk Show".
- KXSC Jazz Director tasked with researching, reviewing, and organizing jazz music for the station library.

## iD Technology Camps

### INSTRUCTOR

Denver, CO

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

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<b>Programming Languages</b>	C/C++, Python, Bash, MATLAB, Faust, LaTeX, Javascript
<b>Signal Processing</b>	Virtual analog modelling, filter design, time-frequency analysis
<b>Frameworks</b>	JUCE API, VST SDK, AAX SDK, Web Audio API, Arduino
<b>Tools</b>	Linux CLI, Visual Studio, CMake, Git, Travis CI, Inno Setup

## Publications

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### Water Bottle Synthesis with Modal Signal Processing

Sept. 2020

PROCEEDINGS OF THE 23RD INTERNATIONAL CONFERENCE ON DIGITAL AUDIO EFFECTS (DAFx-20)

Vienna, Austria

- Presented at the DAFx-2020 conference.
- Available on the DAFx Archives.

### Stable Structures for Nonlinear Biquad Filters

Sept. 2020

PROCEEDINGS OF THE 23RD INTERNATIONAL CONFERENCE ON DIGITAL AUDIO EFFECTS (DAFx-20)

Vienna, Austria

- Presented at the DAFx-2020 conference.
- Available on the DAFx Archives.

### Real-Time Physical Modelling for Analog Tape Machines

Sept. 2019

PROCEEDINGS OF THE 22ND INTERNATIONAL CONFERENCE ON DIGITAL AUDIO EFFECTS (DAFx-19)

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.

### Cassettes - An Online Audio Editor

Dec. 2019

WEB AUDIO CONFERENCE 2019

Trondheim, Norway

- Poster session and demonstration by project leader Xingxing Yang at WAC-2019.
- Presented an online audio editor built with the Web Audio API and Audio Worklet.

## Presentations

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### 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.

## Web Audio Module (WAM) Distortion

Mar. 2019

CCRMA OPEN HOUSE

Stanford, CA

- Presented a distortion effect originally made in C++, then ported to Web Audio using the Emscripten toolchain.

# Research

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## Klon Centaur Emulation

Stanford, CA

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 - PRESENT

- Built frameworks for developing complex nonlinear audio signal processors, largely independent of analog signal processing concepts.
- 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 - PRESENT

- 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

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.

## Non-Uniform Perfect Reconstruction Filterbanks

LEAD RESEARCHER

Mar. 2019 - Jun. 2019

- Researched and developed a method for real-time filterbank analysis and synthesis, with perfect magnitude reconstruction and linear phase reconstruction.
- Implemented the filterbank in digital audio effect plugins including a Graphic Equalizer and real-time Noise-Suppressor.
- Project documentation can be found on GitHub.

## notGuitar

RESEARCH PARTNER

Los Angeles, CA

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

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### Chowdhury DSP

FOUNDER, ENGINEER

June 2018 - PRESENT

- Developed audio plugins including:
  - ChowTape Model: An analog tape emulation based on the DAFx-19 paper “Real-Time Physical Modelling for Analog Tape Machines”.
  - ChowCentaur: A digital emulation of the Klon Centaur distortion pedal, using Wave Digital Filters and recurrent neural networks.
  - ChowMatrix: A dynamic matrix of stereo delay effects.
  - ChowPhaser: A phaser effect based loosely on the Schulte Compact Phasing ‘A’ circuit.
  - DrumFixer: A plugin that uses modal signal processing to fix drum sounds with unpleasant “ringing”.
  - CHOW: A maximally trulent distortion effect.
  - Chowdhury Distortion: A “crunchy” distortion effect with adjustable stereo imperfection.
- Developed modules for the VCV Rack modular synthesis environment.
- For more information, see the Chowdhury DSP website.

### 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), and several nonlinear circuit elements.
- Includes several example WDF models implemented as audio plugins using the JUCE framework, as well as a graphical WDF prototyping tool.
- Ongoing development and documentation can be found on GitHub.

### audio-dspy

PROGRAMMER

Oct. 2019 - PRESENT

- Created a Python package for audio signal processing.
- Currently includes tools for filter design, impulse response manipulation, modal modelling, and nonlinear processing.
- Ongoing 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.

### Destroy All Circuits

DSP ENGINEER

June 2019 - PRESENT

- Developed DSP models for various effects and characteristics of vintage synthesizers, tape machines, and effects.
- DSP methods include recording and manipulating impulse responses, circuit modelling, and physical modelling.

### The SGUM (Squamous 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.

## **Cassettes: A Web Audio Digital Audio Workstation**

*Stanford, CA*

CONTRIBUTOR

*June 2019 - Sept. 2019*

- Developed digital audio effects using the Web Audio API and Audio Worklet.
- Effects include:
  - Delay: Stereo, Ping-Pong
  - Harmonic: Soft-Clipping Distortion, Aural Exciter
  - Modulation: Chorus, Flanger
  - Dynamics: Limiter, Gate

## **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 musical equipment.