

Nicholas Solem
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<https://nvssynthesis.github.io/>

Nicholas Solem is an audio DSP software engineer with 8 years of experience. He holds a Master of Music in Music Technology and is an ABD Ph.D. candidate in Computer Music at the University of California, San Diego. He has developed several nuanced plugins and music software, including audio processors, synthesizers, and analyzers. His research focuses on using machine learning by leveraging psychoacoustics measurement data for augmented sound synthesis methods. Nicholas has shared his expertise by teaching college courses in computer music programming, acoustics, and sound synthesis. His diverse experiences and extensive knowledge in audio technology make him a valuable contributor to projects in the domain of computer music software development.

EDUCATION

University of California, San Diego

San Diego, CA

Doctor of Philosophy in Computer Music

Winter 2023

- Dissertation Working Title: *Navigating Timbre Space: Adaptable Corpus-Based Sound Synthesis*
- Conducted research in DSP with a primary emphasis on leveraging ML techniques for sound generation, timbre space exploration, and innovative sound modeling.
- Committee: Tom Erbe (Advisor), Miller Puckette, King Britt, Shahrokh Yadegari, Mauricio de Oliveira, Julian McAuley
- 4.0 GPA

New York University

New York, NY

Master of Music in Music Technology

Fall 2017

- Specialized in Digital Signal Theory, including digital filter design, digital synthesis, and frequency domain morphing.
- Advisor: Tae Hong Park

The College of Wooster

Wooster, OH

Bachelor of Arts in Philosophy

Spring 2015

- Conducted an independent study, titled "Can Pure Music Be Meaningful?"
- Graduated with Cum Laude and Honors

SOFTWARE DEVELOPMENT PROJECTS

Slicer Granular (AU/VST/CLAP plugin)

- Developed a Granular Synthesis plugin designed with maintainability and stability in mind, ensuring seamless integration into digital audio workstations (DAWs) and long-term usability for musicians and sound designers.
- Demonstrated a commitment to audio DSP development by adhering to best practices in software design, resulting in a plugin that is both technically proficient and artistically inspiring.

TSARA (Timbre Space Analysis-Resynthesis Application)

- Developed an approachable GUI application for streamlined audio analysis, enabling users to save analyses as YAML files.
- Integrated the Essentia Audio Analysis C++ Library and utilized the JUCE framework to create a versatile tool compatible with various abstract corpus-based multidimensional digital synthesizers.
- Makes use of cluster analysis to identify relations between audio events, reduce redundant portions of the audio data, and act as preprocessing for further machine learning methods.

TSARA Granular (AU/VST/CLAP plugin)

- Leveraged TSARA technology by integrating it into the foundation of Slicer Granular, resulting in a real-time synthesizer where sound grains are accessed via a dimensionally-reduced timbre space.
- Employed feature extraction using user-imported raw audio datasets to enhance sound manipulation and synthesis capabilities, bridging the gap between TSARA's audio analysis and Slicer Granular's granular synthesis.

TSARA Additive (AU/VST/CLAP plugin)

- Designed and implemented an Additive + Residual synthesizer utilizing the custom TSARA format for audio resynthesis.
- Employed graph & probability theory to achieve Stochastic Timbre Space Traversal, enabling dynamic, expressive synthesis.

WTIANNNS (Wavetable-Inspired Artificial Neural Network Synthesizer, Pure Data external)

- Created a Pure Data external that leverages the TSARA format to navigate high-dimensional wavetables.
- Utilized the Keras Deep Learning API and Keras2c to achieve advanced realtime neural wavetable synthesis capabilities.
- Presented research findings at Sound and Music Computing 2022, showcasing contributions to the field of generative audio through a live demonstration.

Shredverb (AU/VST/CLAP plugin)

- Developed a reverb plugin with the JUCE framework, incorporating a novel distortion algorithm based on modulated Time-Variant Allpass Filters for distinctive and unconventional reverberation effects.

Binaural Chaos

- Explored chaotic systems in spatial audio effects, applying Runge-Kutta modeling alongside SPAT spatial audio processing in Max/MSP. Demonstrated expertise in creating expressive spatial audio effects through chaos theory.

stm32f7_wtsynth (Wavetable Synthesizer for STM32 MCU)

- Created a wavetable synthesizer for the STM32 microcontroller, featuring a pressure-sensitive touch screen user interface for intuitive interaction.
- Showcased technical skills in hardware-software integration and firmware development.

nvssynthesis DSP C++ Template Libraries

- Designed and built custom lightweight DSP libraries, comprising of over 50 filters, oscillators, envelopes, interpolators, nonlinear transfer functions, and utilities for signal processing.

A Realtime Algorithm for Spectral Morphing (Master's Thesis)

- Developed and improved a novel method for realtime frequency-domain morphing between arbitrary sounds, contributing to the field of audio signal processing.

RESEARCH PRESENTATIONS & CONFERENCES

Wavetable-Inspired Artificial Neural Network Synthesis

Sound and Music Computing | St. Etienne, France, 2022

Presented recent developments in automated waveform generation within continuous multidimensional timbre spaces. This paper is part of ongoing research motivated by the use of audio files as seeds for new digital synthesis instruments.

Curl and Skew Generator

Heretical Sound Synthesis Mini-Symposium | Helsinki, Finland, 2019

Outlined the inner workings of experimental digital noise synthesizer, the CSG. Demonstrated how a handful of simple principles creatively fused can create a complex, chaotic system, ready for use in experimental music.

EMPLOYMENT

UNIVERSITY OF CALIFORNIA SAN DIEGO

San Diego, CA

Associate Instructor

Spring 2022 – Summer 2023

- Designed and led a variety of college courses, covering topics such as sound synthesis, machine learning/AI in music, and music production with a foundation in digital signal processing fundamentals.
- Fostered a collaborative learning environment, assisting individual students in mastering course content and providing guidance on technical and creative aspects of audio production.

Teacher Assistant/Reader

Fall 2018 – Winter 2023

- Assessed and graded undergraduate student papers and projects, demonstrating strong attention to detail and analytical skills.
- Provided individualized support to students, helping them achieve a solid understanding of course material and addressing any challenges they encountered.

- Assisted in course delivery and facilitated discussions on topics related to musical psychoacoustics, computer music, and audio and MIDI studio techniques.

Graduate Student Researcher – Sound Designer

Summer 2020 – Winter 2022

- Analyzed and processed a diverse library of arctic field recordings, showcasing a keen ear for audio quality and aesthetics.
- Determined best practices for reducing noise and enhancing desired portions of recordings.

ART INSTITUTE OF MICHIGAN

Novi, MI

Adjunct Audio Professor

Winter 2018 – Summer 2018

- Taught Acoustics, Sound for Interactive Media, and other undergraduate Audio courses.
- Developed and delivered engaging lectures, led in-class labs, facilitated discussions to foster a dynamic learning environment.

EVENTIDE AUDIO

Little Ferry, NJ

Audio Software Intern

Winter 2017 – Fall 2017

- Created Python script to automate the generation of end-user documentation from C++ source code.
- Identified faults in multi-effects units and maintained accurate records, contributing to product quality assurance.

NEW YORK UNIVERSITY

New York, NY

Max/MSP Tutor

Winter 2017 – Summer 2017

- Assisted students with Max/MSP course material, offering support to enhance proficiency in audio programming.
- Developed an individualized approach for each student, tailoring instruction to address their unique challenges and needs.

TECHNICAL SKILLS

Programming Languages: C++, C, Python, Matlab

Libraries & Frameworks: JUCE, Essentia, Boost, Librosa, FFTW, Eigen, Armadillo, NumPy

Machine Learning Libraries: PyTorch, Keras, FANN, mlpack

Build Systems: CMake

Audio Expertise: Acoustics, Psychoacoustics, Spatial Audio

Computer Music Software: Max/MSP, Pure Data

DAWs: Live, Logic, Pro Tools, Reaper

Music: Music Theory, Production, Mixing, Mastering

VOLUNTEERING

Computer Music Graduate Representative

Spring – Winter 2019

- Served as a liaison between the graduate student body and faculty/administration.
- Took on organizational responsibilities regarding planning and hosting graduate student meetings.

PROFESSIONAL REFERENCES

Tom Erbe

Professor in Computer Music, University of California San Diego

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Miller Puckette

Professor Emeritus, University of California San Diego

mpp@ucsd.edu

King Britt

Assistant Teaching Professor, University of California San Diego

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Dafna L Naphtali

Music Adjunct Professor, New York University

dln1@nyu.edu

Kyle Kramer

Associate Program Chair in Media Arts, Art Institute of Michigan

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