

ETHAN MANILOW

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RESEARCH INTERESTS

Generative Modeling, Music, Music Information Retrieval, Machine Listening, Audio Signal Processing, Open Source Software & Data, Audio Source Separation, Automatic Music Transcription

PROFESSIONAL EXPERIENCE

Google DeepMind

Research Scientist

Magenta Team

Chicago, IL

Aug 2022 - Present

Google Brain

Student Researcher (Remote)

Research Intern (Remote)

Magenta Team

Mentors: Jesse Engel and Curtis “Fjord” Hawthorne

Mountain View, CA

Oct 2020 - April 2022

June 2020 - Oct 2020

Mitsubishi Electric Research Labs (MERL)

Student Researcher (Remote)

Research Intern

Speech and Audio Group

Mentors: Jonathan Le Roux and Gordon Wichern

Cambridge, MA

April 2019 - Jan 2020

Sept 2018 - April 2019

Northwestern University

Research Assistant

Interactive Audio Lab

Advisor: Bryan Pardo

Evanston, IL

Sept 2015 - July 2022

National Instruments

Software Engineer

LabVIEW Core/Compiler Team

Austin, TX

Nov 2013 - Aug 2015

University of Michigan

Research Assistant

Physics Department, ATLAS Group, Large Hadron Collider (LHC)

Mentor: Dan Levin

Ann Arbor, MI

April 2011 - Jan 2013

University of Michigan

Research Assistant

Department of Mechanical Engineering, Mechanosynthesis Group

Mentors: Justin Beroz and A. John Hart

Ann Arbor, MI

Summer 2012

HONORS AND AWARDS

Outstanding Reviewer Award

IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)

Jun 2023

Oral Presentation (Top 1%)

International Conference on Learning Representations (ICLR)

April 2022

Spotlight Presentation (Top 5%) <i>International Conference on Learning Representations (ICLR)</i>	April 2022
Outstanding Paper Award <i>NeurIPS CtrlGen Workshop</i>	Dec 2021
Best Paper Award <i>International Society of Music Information Retrieval (ISMIR)</i>	Nov 2021
Best Video Presentation <i>International Society of Music Information Retrieval (ISMIR)</i>	Oct 2020
Best Poster Presentation <i>International Society of Music Information Retrieval (ISMIR)</i>	Oct 2020
Merit-Based Travel Grant <i>Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA)</i>	Oct 2017
Segal Design Cluster Fellowship <i>Northwestern University</i>	Winter 2017
SXSW Music Hackathon Winner <i>3 Awards: Best Use of Rdio, Best Use of MusicGraph, & Best Use of Kinect. \$1k in Prizes.</i>	March 2015
University Honors <i>University of Michigan</i>	Winter 2008, Winter 2009, Fall 2011

EDUCATION

Northwestern University , Evanston, IL Ph.D. in Computer Science & Communication Dissertation: Score-Informed and Hierarchical Methods for Computational Musical Scene Analysis Committee: Bryan Pardo (advisor), Jesse Engel, Jessica Hullman, Doug Downey	2022
Northwestern University , Evanston, IL Masters of Science in Computer Science & Communication	2017
University of Michigan , Ann Arbor, MI Bachelor of Science in Physics	2013
University of Michigan , Ann Arbor, MI Bachelor of Fine Arts in Jazz Studies (Guitar)	2013

PUBLICATIONS

- Chris Donahue*, Antoine Caillon*, Adam Roberts*, **Ethan Manilow**, Philippe Esling, Andrea Agostinelli, Mauro Verzetti, Ian Simon, Olivier Pietquin, Neil Zeghidour, Jesse Engel. SingSong: Generating Musical Accompaniments from Singing. *Preprint*, 2023. (*Authors contributed equally.)
Paper: [arxiv/2212.08038](https://arxiv.org/abs/2212.08038)
Demo: <https://g.co/magenta/singsong>
- Christian Detweiler, Beth Coleman, Fernando Diaz, Lieke Dom, Chris Donahue, Jesse Engel, Cheng-Zhi Anna Huang, Larry James, **Ethan Manilow**, Amanda McCroskery, Kyle Pedersen, Pamela Peter-Agbia, Negar Rostamzadeh, Robert Thomas, Marco Zamarato, Ben Zevenbergen Redefining Relationships in Music. *Cultures in AI/AI in Culture Workshop at NeurIPS*, 2022

25. Curtis Hawthorne, Ian Simon, Adam Roberts, Neil Zeghidour, Josh Gardner, **Ethan Manilow**, Jesse Engel. Multi-instrument Music Synthesis with Spectrogram Diffusion. In *Proceedings of the International Society of Music Information Retrieval (ISMIR)*, 2022.
24. Ian Simon, Josh Gardner, Curtis Hawthorne, **Ethan Manilow**, Jesse Engel. Scaling Polyphonic Transcription with Mixtures of Monophonic Transcriptions. In *Proceedings of the International Society of Music Information Retrieval (ISMIR)*, 2022.
23. Noah Schaffer, Boaz Cogan, **Ethan Manilow**, Max Morrison, Prem Seetharaman, Bryan Pardo. Music Separation Enhancement with Generative Modeling. In *Proceedings of the International Society of Music Information Retrieval (ISMIR)*, 2022.
22. Yusong Wu, Josh Gardner, **Ethan Manilow**, Ian Simon, Curtis Hawthorne, Jesse Engel. The Chamber Ensemble Generator: Limitless High-Quality MIR Data via Generative Modeling. *Preprint*, 2022.
Blog: <https://g.co/magenta/ceg-and-cocochoales>
Dataset website: <https://magenta.tensorflow.org/datasets/cocochoales>
21. Yusong Wu, Josh Gardner, **Ethan Manilow**, Ian Simon, Curtis Hawthorne, Jesse Engel. Generating Detailed Music Datasets with Neural Audio Synthesis. *Machine Learning for Audio Synthesis at the International Conference on Machine Learning (ICML)*, 2022.
Demo: <https://chamber-ensemble-generator.github.io/>
20. **Ethan Manilow**, Patrick O'Reilly, Prem Seetharaman, Bryan Pardo. Source Separation by Steering Pretrained Music Models. In *Proceedings of IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2022.
Demo: <https://ethman.github.io/tagbox>
19. **Ethan Manilow**, Curtis Hawthorne, Cheng-Zhi Anna Huang, Bryan Pardo, Jesse Engel. Improving Source Separation by Explicitly Modeling Dependencies Between Sources. In *Proceedings of IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2022.
18. Josh Gardner, Ian Simon, **Ethan Manilow**, Curtis Hawthorne, Jesse Engel. MT3: Multi-Task Multitrack Music Transcription. *International Conference for Learning Representations (ICLR)*, 2022. **Spotlight Presentation** (Top 5% of submissions)
Demo: <https://storage.googleapis.com/mt3/index.html>
Blog: <https://g.co/magenta/mt3>
17. Yusong Wu, **Ethan Manilow**, Yi Deng, Rigel Swavely, Kyle Kastner, Tim Cooijmans, Aaron Courville, Jesse Engel, Cheng-Zhi Anna Huang. MIDI-DDSP: Detailed Control of Musical Performance via Hierarchical Modeling. *International Conference for Learning Representations (ICLR)*, 2022. **Oral Presentation** (Top 1% of submissions)
Demo: <https://midi-ddsp.github.io/>
Blog: <https://g.co/magenta/midi-ddsp>
16. Yusong Wu, **Ethan Manilow**, Yi Deng, Rigel Swavely, Kyle Kastner, Tim Cooijmans, Aaron Courville, Jesse Engel, Cheng-Zhi Anna Huang. MIDI-DDSP: Hierarchical Modeling of Music for Detailed Control. *NeurIPS 2021 CtrlGen Workshop: Controllable Generative Modeling in Language and Vision*, 2021. **Outstanding Paper Award**
Demo: <https://midi-ddsp.github.io/>
15. Hugo Flores García, Aldo Aguilar, **Ethan Manilow**, Dmitry Vedenko, Bryan Pardo. Deep Learning Tools for Audacity: Helping Researchers Expand the Artist's Toolkit. *NeurIPS 2021 Workshop on Machine Learning for Creativity and Design*, 2021.
Project Website: <https://interactiveaudiolab.github.io/project/audacity.html>

14. Curtis Hawthorne, Ian Simon, Rigel Swavely, **Ethan Manilow**, Jesse Engel. Sequence-to-Sequence Piano Transcription with Transformers. In *Proceedings of the International Society of Music Information Retrieval (ISMIR)*, 2021.
13. Hugo Flores García, Aldo Aguilar, **Ethan Manilow**, Bryan Pardo. Leveraging Hierarchical Structures for Few-Shot Musical Instrument Recognition. In *Proceedings of the International Society of Music Information Retrieval (ISMIR)*, 2021. **Best Paper Award**
12. **Ethan Manilow**, Prem Seetharaman, Justin Salamon. Open Source Tools and Data for Music Source Separation. *Interactive Online Book*, 2020.
11. **Ethan Manilow**, Gordon Wichern, Jonathan Le Roux. Hierarchical Musical Instrument Separation. In *Proceedings of the International Society of Music Information Retrieval (ISMIR)*, 2020. **Best Poster Presentation**, and **Best Video Presentation**
Poster, video, and paper: https://program.ismir2020.net/poster_3-07.html
10. **Ethan Manilow**, Bryan Pardo. Bespoke Neural Networks for Score-Informed Source Separation. Late-Breaking Demo at *International Society of Music Information Retrieval (ISMIR)*, 2020.
Demo: <https://ethman.github.io/bespoke-demo>
9. Verena Haunschmid, **Ethan Manilow**, Gerhard Widmer. audioLIME: Listenable Explanations Using Source Separation. *13th International Workshop on Machine Learning and Music*, 2020.
Paper: [arxiv/2008.00582](https://arxiv.org/abs/2008.00582).
8. Verena Haunschmid, **Ethan Manilow**, Gerhard Widmer. Towards Musically Meaningful Explanations Using Source Separation. *Preprint*, 2020. Paper: [arxiv/2009.02051](https://arxiv.org/abs/2009.02051).
7. **Ethan Manilow**, Prem Seetharaman, Bryan Pardo. Simultaneous Separation and Transcription of Mixtures with Multiple Polyphonic and Percussive Instruments. In *Proceedings of IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2020.
Demo: <https://interactiveaudiolab.github.io/demos/cerberus>
6. **Ethan Manilow**, Gordon Wichern, Prem Seetharaman, Jonathan Le Roux. Cutting Music Source Separation Some Slakh: A Dataset to Study the Impact of Training Data Quality and Quantity. In *Proceedings of the IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA)*, 2019. Dataset website: www.slakh.com
5. Gordon Wichern, Joe Antognini, Michael Flynn, Licheng Richard Zhu, Emmett McQuinn, Dwight Crow, **Ethan Manilow**, Jonathan Le Roux. WHAM!: Extending Speech Separation to Noisy Environments. In *Proceedings of the 20th Annual Conference of the International Speech Communication Association (InterSpeech)*, 2019. Dataset website: <http://wham.whisper.ai/>
4. **Ethan Manilow**, Prem Seetharaman, and Bryan Pardo. The Northwestern University Source Separation Library. In *Proceedings of the International Society of Music Information Retrieval (ISMIR)*, 2018.
Demo: <https://interactiveaudiolab.github.io/demos/nussl.html>
3. **Ethan Manilow***, Prem Seetharaman*, Fatemeh Pishdadian*, and Bryan Pardo. Predicting Algorithm Efficacy for Adaptive Multi-Cue Source Separation. In *Proceedings of the IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA)*, 2017. (*Authors contributed equally.) **Merit-based Travel Grant Recipient**
Demo: <https://interactiveaudiolab.github.io/demos/multicue.html>
2. **Ethan Manilow** and Bryan Pardo. Leveraging Repetition to Do Audio Imputation. In *Proceedings of the IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA)*, 2017.

1. N. Amram, et al. (**ATLAS Group**). Streamlined Calibrations of the ATLAS Precision Muon Chambers for Initial LHC Running. In *Nuclear Instruments and Methods in Physics Research Section A*, April 2012.

PATENTS

1. **Ethan Manilow**, Gordon Wichern, Jonathan Le Roux. “System and Method for Hierarchical Audio Source Separation.” US Patent #20220101869. Filed 10/07/2020. Awarded 03/31/2022.

PRESENTATIONS

15. Source Separation Techniques Inspired by Large Language Modeling. *Adobe Audio Research Intern Seminar Series*, Virtual. July 26, 2022. Invited Talk.
14. Musical Scene Analysis and Generative Modeling. *London Audio and Music AI Meetup*, Virtual. March 23, 2022. Invited Talk.
13. Musical Scene Analysis and Generative Modeling. *Music + AI Reading Group @ MILA x Vector Institute*, Virtual. March 18, 2022. Invited Talk.
12. Source Separation: Explorations and Applications. *Music Demixing Workshop 2021 (MDX21)*, Satellite event of *International Society of Music Information Retrieval (ISMIR)*, Virtual. November 12, 2021. Invited Talk.
11. Cooking With MSG: Enhancing the Output of Source Separation Using Generative Adversarial Networks. Boaz Cogan, Noah Schaffer, **Ethan Manilow**, Bryan Pardo. *Music Demixing Workshop 2021 (MDX21)*, Satellite event of *International Society of Music Information Retrieval (ISMIR)*, Virtual. November 12, 2021. Poster.
10. Programming MIR Baselines from Scratch: Three Case Studies. Rachel Bittner, Mark Cartwright, **Ethan Manilow**. *International Society of Music Information Retrieval (ISMIR)*, Virtual. November 7, 2021. Tutorial.
9. Combining Pretrained Music Models for Unsupervised Source Separation and Style Transfer. *Bay Innovative Signal Hackers Bash (BISH Bash)*, Virtual. October 27, 2021. Talk.
8. Open Source Tools & Data for Music Source Separation: A Pragmatic Guide for the MIR Practitioner. **Ethan Manilow**, Prem Seetharaman, Justin Salamon. *International Society of Music Information Retrieval (ISMIR)*, Montreal, ON (Virtual). October 11, 2020. Tutorial.
7. Synthesize, Separate, and Repeat: Some Notes on Incorporating Notes into Source Separation. *Audio Engineering Society (AES) Virtual Symposium: Applications of Machine Learning in Audio*. September 28-29, 2020. Talk.
6. Cutting Music Source Separation Some Slakh: A Dataset to Study the Impact of Training Data Quality and Quantity. *Speech and Audio in the Northeast (SANE)*, New York, NY. October 24, 2019. Poster.
5. Libraries and Datasets to Power the Next Generation of Source Separation Research, *Midwest Music and Audio Day (MMAD)*, Bloomington, IN. June 17, 2019. Talk.
4. The Northwestern University Source Separation Library, *Speech and Audio in the Northeast (SANE)*, Google, Cambridge, MA. October 18, 2018. Poster.
3. WUT? A New Interface for Interactive Audio Source Separation, *Human Computer Interaction Consortium (HCIC)*, Pajaro Dunes, Watsonville, CA. June 24 - June 28, 2018. Poster.
2. Leveraging Repetition to Do Audio Imputation, *Speech and Audio in the Northeast (SANE)*, Google, New York, NY. October 19, 2017. Poster.

1. nussl: A Flexible Python Audio Source Separation Library, *Midwest Music and Audio Day (MMAD)*. Evanston, IL. June 23, 2017. Talk.

OPEN SOURCE PROJECTS

Audacity (Audio Editor)

2021 - 2022

Advisor

Added the ability to download and run neural networks directly within Audacity. We support audio-to-audio and audio-to-labels models and uses HuggingFace in the backend as a model hub for deployment. Started with a grant from the 2021 Google Summer of Code program.

Project Website: <https://interactiveaudiolab.github.io/project/audacity.html>

Dev blog: <https://www.audacityteam.org/category/gsoc/gsoc-2021-source-separation/>

Open Source Tools and Data for Music Source Separation

2020

Lead Developer

An online, interactive book providing a practical approach to training deep learning models for music source separation. Complete with explanations of key concepts, animations, and interactive, runnable code, this gives users the conceptual and practical tools for making their own source separation systems. Stats since launch: **74k visitors** (17k unique). Reached **#2 on Hacker News** day of launch!

View tutorial at <https://source-separation.github.io/tutorial/>

DDSP: Differentiable Digital Signal Processing

2020 - 2022

Contributing Developer

DDSP is a library of differentiable signal processing functions (synthesizers, reverbs, filters, etc) that enables them to be used with deep learning systems for audio generation or analysis.

More info at <https://github.com/magenta/ddsp/>

Slakh

2019 - Present

Lead Developer

Slakh2100 is an open dataset of 2,100 audio files and mixtures, synthesized from MIDI data using professional-grade virtual instruments. The first release contains an order of magnitude more data (in terms of hours of mixture data) than comparable datasets for source separation, and contains time-aligned transcription data for many more instruments than previously released datasets. Code to generate virtually unlimited amounts of data also available.

More info at <http://www.slakh.com/>

nussl

2015 - 2021

Lead Developer

nussl is a flexible, object oriented Python audio source separation library that contains implementations of many classic and state-of-the-art source separation algorithms and models. Users can train their own models with the included hooks for common datasets.

More info at <https://github.com/nussl/nussl/>

TEACHING

Teaching Assistant

Fall 2016, Spring 2019

Northwestern University

EECS 349 – Intro to Machine Learning

Course Designer and Teaching Assistant

Spring 2018

Northwestern University

EECS 397/SAI 402 – Digital Luthier

Article/Video: <http://bitly.com/2A9jprL>

SERVICE

Mentor 2021-2023
Women in Music Information Retrieval (WiMIR) Mentoring program.

Mentor 2022
AI Song Contest Mentoring program.

Board Member Summer 2017 - Fall 2019
Northwestern University Computer Science PhD Advisory Counsel (CSPAC).

Organizing Staff Summer 2017
Midwest Music and Audio Day (MMAD), Evanston, IL.

Student Volunteer Summer 2012
New Interfaces for Musical Expression (NIME), Ann Arbor, MI.

Peer Reviewer

- IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP). 2017-2023.
- International Society for Music Information Retrieval (ISMIR). 2021-2023.
- Music Demixing Workshop @ ISMIR, 2021-2023
- Transactions of the International Society for Music Information Retrieval (TISMIR). 2020-2023.
- IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA). 2017, 2019, 2021, 2023.
- IEEE Signal Processing Letters. 2021.
- IEEE Signal Processing Magazine. 2018.
- European Signal Processing Conference (EUSIPCO). 2018, 2021.
- ACM International conference on Tangible, Embedded and Embodied Interaction (TEI). 2018.

SKILLS

Programming Languages: *Expert:* Python, *Past Experience:* C++, Javascript, C#

Machine Learning: *Expert:* Jax/Flax, Tensorflow 2, Keras, PyTorch, Scikit-learn, Scipy, Numpy
Other Experience: Apache Beam, hdf5, AWS, GCP, Chainer

Web: *Past Experience:* Flask, Javascript, Django, jQuery, Redis, PHP

AS A MUSICIAN

Freelance Musician 2008 - Present
Performed as a professional guitarist across the U.S. and Mexico playing in dance ensembles, pit orchestras, jazz combos, and rock groups. I have worked with Woody Goss (Vulfpeck), Diane McIntyre, Christine Hucal (Woman Believer), Jeremy Daly (Lou Breed), as well as on my own projects.

RECORDINGS

The Hot Years – LP 2021
Woman Believer
Composer on 1 song & 2 interstitials.
<https://open.spotify.com/album/19rm51XCTAFmfVdS36SgSp>

- Technicolor** – EP 2015
The Voluptuous Neighbors
Lead Guitar.
<https://thevoluptuousneighbors.bandcamp.com/album/technicolor>
- Stoned Out Two: Morning of the Way to Love** – LP 2013
Lou Breed
Guitar on 2 songs.
<https://loubreed.bandcamp.com/album/stoned-out-two-morning-of-the-way-to-love>
- Senior Recital** – Live Recording 2013
Ethan Manilow
Guitar & Composer.
<http://ethanmanilow.bandcamp.com/>
- AAURAL II** – Compilation 2012
Composer on 1 song.
<http://grlmtn.com/album/aaural-ii>