

# ETHAN MANILOW

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**web:** ethman.github.io ♦ **github:** github.com/ethman

## RESEARCH INTERESTS

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Music Information Retrieval, Musical Scene Analysis, Machine Listening, Audio Signal Processing, Open Source Software & Data, Audio Source Separation, Automatic Music Transcription

## EDUCATION

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**Northwestern University**, Evanston, IL *2015 - Present*  
Ph.D. in Computer Science & Communication

**Northwestern University**, Evanston, IL *2015 - 2017*  
Masters in Computer Science & Communication

**University of Michigan**, Ann Arbor, MI *2008 - 2013*  
Bachelor of Science in Physics

**University of Michigan**, Ann Arbor, MI *2008 - 2013*  
Bachelor of Fine Arts in Jazz Studies (Guitar)

## PROFESSIONAL EXPERIENCE

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**Google Brain** Mountain View, CA  
*Student Researcher (Remote)* *Oct 2020 - Present*  
*Research Intern (Remote)* *June 2020 - Oct 2020*  
Magenta Project  
Mentors: Jesse Engel and Curtis “Fjord” Hawthorne

**Mitsubishi Electric Research Labs (MERL)** Cambridge, MA  
*Research Consultant (Remote)* *April 2019 - Jan 2020*  
*Research Intern* *Sept 2018 - April 2019*  
Speech and Audio Group  
Mentors: Jonathan Le Roux and Gordon Wichern

**Northwestern University** Evanston, IL  
*Research Assistant* *Sept 2015 - Present*  
Interactive Audio Lab  
Advisor: Bryan Pardo

**National Instruments** Austin, TX  
*Software Engineer* *Nov 2013 - Aug 2015*  
LabVIEW Core/Compiler Team

**University of Michigan** Ann Arbor, MI  
*Research Assistant* *April 2011 - Jan 2013*  
Physics Department, ATLAS Group, Large Hadron Collider (LHC)  
Mentor: Dan Levin

**University of Michigan** Ann Arbor, MI  
*Research Assistant* *Summer 2012*  
Department of Mechanical Engineering, Mechanosynthesis Group  
Mentors: Justin Beroz and A. John Hart

## HONORS AND AWARDS

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

## PUBLICATIONS

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19. **Ethan Manilow**, Patrick O'Reilly, Prem Seetharaman, Bryan Pardo. Unsupervised Source Separation by Steering Pretrained Music Models. In *Proceedings of IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2022. (Forthcoming)  
Demo: <https://ethman.github.io/tagbox>
18. **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. (Forthcoming)
17. 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://magenta.tensorflow.org/transcription-with-transformers>
16. 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/>
15. 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/>

14. Hugo Flores Garcia, 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>
13. 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.
12. Hugo Flores Garcia, 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**
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](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](http://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

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1. **Ethan Manilow**, Gordon Wichern, Jonathan Le Roux. “System and Method for Hierarchical Audio Source Separation.” US Patent Filed, Oct. 2020.

## PRESENTATIONS

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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

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### **Audacity (Audio Editor)**

2021 - Present

*Advisor*

Advising a 2021 Google Summer of Code project to add neural network-based Machine Listening models into Audacity, including Source Separation and Sound Event Detection models.

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. October 2020 stats: [10k visitors](#) (8k unique). Reached [#2 on Hacker News](#) on October 11th 2020! View tutorial at <https://source-separation.github.io/tutorial/>

### **DDSP: Differentiable Digital Signal Processing**

2020 - Present

*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 - Present

*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, or download pretrained models from our zoo.

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

## TEACHING

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### **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

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**Mentor** 2021  
*Women in Music Information Retrieval (WiMIR) 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). 2017-2021.
- IEEE Signal Processing Letters. 2021.
- International Society for Music Information Retrieval (ISMIR). 2021.
- Music Demixing Workshop @ ISMIR, 2021
- Transactions of the International Society for Music Information Retrieval (TISMIR). 2020-2021.
- IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA). 2017, 2019, 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

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**Programming Languages:** *Expert:* Python, *Past Experience:* C++, Javascript, C#  
**Machine Learning:** *Expert:* Tensorflow 2, Keras, PyTorch, Scikit-learn, Scipy, Numpy  
*Other Experience:* Apache Beam, hdf5, AWS, GCP, Chainer  
**Web:** *Past Experience:* Flask, Django, jQuery, Redis, PHP

## AS A MUSICIAN

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**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>

<b>Stoned Out Two: Morning of the Way to Love – LP</b>	2013
<i>Lou Breed</i>	
Guitar on 2 songs.	
<a href="https://loubreed.bandcamp.com/album/stoned-out-two-morning-of-the-way-to-love">https://loubreed.bandcamp.com/album/stoned-out-two-morning-of-the-way-to-love</a>	
<b>Senior Recital – Live Recording</b>	2013
<i>Ethan Manilow</i>	
Guitar & Composer.	
<a href="http://ethanmanilow.bandcamp.com/">http://ethanmanilow.bandcamp.com/</a>	
<b>AAURAL II – Compilation</b>	2012
Composer on 1 song.	
<a href="http://grlmtn.com/album/aaural-ii">http://grlmtn.com/album/aaural-ii</a>	