ETHAN MANILOW

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RESEARCH INTERESTS

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

EDUCATION

Northwestern University, Evanston, IL   *2022*
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

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

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

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

PROFESSIONAL EXPERIENCE

Google Brain   Chicago, IL
Research Scientist   *Aug 2022 - Present*
Magenta Team

Google Brain   Mountain View, CA
Student Researcher (Remote)   *Oct 2020 - April 2022*
Research Intern (Remote)   *June 2020 - Oct 2020*
Magenta Team
Mentors: Jesse Engel and Curtis "Fjord" Hawthorne

Mitsubishi Electric Research Labs (MERL)   Cambridge, MA
Student Researcher (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 - July 2022*
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

Outstanding Paper Award   Dec 2021
NeurIPS CtrlGen Workshop

Best Paper Award   Nov 2021
International Society of Music Information Retrieval (ISMIR)

Best Video Presentation   Oct 2020
International Society of Music Information Retrieval (ISMIR)

Best Poster Presentation   Oct 2020
International Society of Music Information Retrieval (ISMIR)

Merit-Based Travel Grant   Oct 2017
Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA)

Segal Design Cluster Fellowship   Winter 2017
Northwestern University

SXSW Music Hackathon Winner   March 2015
3 Awards: Best Use of Rdio, Best Use of MusicGraph, & Best Use of Kinect. $1k in Prizes.

University Honors   Winter 2008, Winter 2009, Fall 2011
University of Michigan

PUBLICATIONS

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-cocochorales`
    Dataset website: `https://magenta.tensorflow.org/datasets/cocochorales`

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`.

8. Verena Haunschmid, **Ethan Manilow**, Gerhard Widmer. Towards Musically Meaningful Explanations Using Source Separation. *Preprint*, 2020. Paper: `arxiv/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 - Present
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 - 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.
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, 2022
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). 2017-2021.

- 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). 2020-2022.

- 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

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

Freelance Musican   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