

MARK RAU – CURRICULUM VITAE

Assistant Professor, Music and Theater Arts and Electrical Engineering and Computer Science,
Research Laboratory of Electronics,
Massachusetts Institute of Technology
(650) 686-8841 ◊ mrau@mit.edu
<https://rau.mit.edu>

RESEARCH OBJECTIVES

My research focuses on the way objects produce sound, and physics-based methods for modifying the sound at the source or as an audio effect. I have a particular interest in the measurement and modeling of string instruments for use in the instrument-building process.

EDUCATION

- | | |
|---|-------------|
| Stanford University , Stanford, USA | 2016 – 2023 |
| Ph.D., Computer-Based Music Theory and Acoustics. | |
| M.A., Music, Science, and Technology. | |
| McGill University , Montreal, Canada | 2011 – 2016 |
| B.S., Physics. | |
| B.Mus., Jazz Guitar with minor in Musical Applications of Technology. | |

PROFESSIONAL EXPERIENCE

- | | |
|---|-----------------------------|
| Music & Theater Arts and Electrical Engineering and Computer Science, Massachusetts Institute of Technology | January 2025 – |
| <i>Assistant Professor</i> | <i>Cambridge, MA, USA</i> |
| · Music Technology and Computation program with Assistant Professorship shared between Music & Theater Arts and Electrical Engineering and Computer Science. Member of the Research Laboratory of Electronics. Research on stringed instrument measurement, modeling, and synthesis methods. Undergraduate and graduate teaching and advising students. | |
| Research Laboratory of Electronics, Massachusetts Institute of Technology | August 2024 – |
| December 2024 | |
| <i>Visiting Scientist</i> | <i>Cambridge, MA, USA</i> |
| · Researcher working on stringed instrument measurement, modeling, and synthesis methods. | |
| Computational Acoustic Modeling Laboratory, McGill University | December 2023 – |
| December 2024 | |
| <i>Postdoctoral Researcher</i> | <i>Montreal, QC, Canada</i> |
| · Postdoctoral Researcher working on stringed instrument measurement, modeling, and synthesis methods. | |
| CCRMA, Stanford University | 2022 – 2024 |
| <i>Lecturer</i> | <i>Stanford, CA, USA</i> |
| · Lecturer for a combined undergraduate and graduate musical acoustics class as well as digital signal processing and audio tutorial. Advisor and instructor for a group study and independent projects on audio effects, musical acoustics, and physical modeling. | |
| CCRMA, Stanford University | September 2017 – June 2023 |
| <i>Teaching and Research Assistant</i> | <i>Stanford, CA, USA</i> |

- Academic research, co-teaching lectures, labs, and assisting students.

Facebook Reality Labs Research

June 2021 – September 2021

Haptics and Sound Synthesis Research Intern

Remote

- Research methods and algorithms for simultaneous haptics and sound synthesis for virtual and augmented reality applications.

Pickup Processing LLC

June 2019 – Present

Signal Processing Consultant

Stanford, USA

- Digital signal processing for acoustic guitar sound reinforcement.

Yamaha Corporation

July 2017- September 2017

Audio Technology Intern

Hamamatsu, Japan

- Audio effects and synthesis algorithm development and programming.

Sound Recording Department, McGill University

May 2016 – August 2016

Audio Technology Researcher

Montreal, QC, Canada

- Room acoustics measurements and virtual acoustics.

Computational Acoustic Modeling Laboratory, McGill University

May 2015 – August 2015

Musical Acoustics Researcher

Montreal, QC, Canada

- Measurements of acoustic and electronic musical instruments.

Marvin Duchow Music Library, McGill University

May 2015 – December 2016

Audio Archive Assistant

Montreal, QC, Canada

- Recorded audio preservation and cataloging.

TEACHING

MIT Assistant Professor

21M.369/569: Musical Acoustics, Synthesis, and Audio Effects, Spring 2025.

6.3000/21M.584: Signal Processing, Fall 2025.

Stanford University Lecturer

Music 158/258d: Musical Acoustics, Winter 2023, Winter 2024.

Music 424L: Signal Processing Techniques for Digital Audio Effects Group Study, Winter 2024.

Music 220d: Advise Student Instrument Building Projects, Winter 2024.

Music 320d: Tutorial on Audio Signal Processing for Musicians, Fall 2022,
Winter 2023, Spring 2023.

Stanford University Teaching Assistant:

Music 320b: Introduction to Audio Signal Processing Part II: Digital Filters, Winter 2022.

Music 424: Signal Processing Techniques for Digital Audio Effects, Spring 2020.

Music 420a: Signal Processing Models in Musical Acoustics, Winter 2020.

Music 23: Elements of Music III, Autumn 2019.

Music 220c: Research Seminar in Computer-Generated Music , Spring 2019.

Music 420a: Signal Processing Models in Musical Acoustics, Winter 2019.

Music 192a: Foundations of Sound Recording Technology, Autumn 2018.

CCRMA Summer Workshops:

Digital Audio Effects Workshop. Co-taught with Elliot Canfield-Dafilou,
Summer 2018 and 2019.

AWARDS, GRANTS, AND HONOURS

MIT Center for Art, Science & Technology

Cross Disciplinary Class Development Fund, *Musical Acoustics, Synthesis, and Audio Effects*, 2025.

MIT Human Insight Collaborative

SHASS+ Connectivity, *Material and Acoustic Studies of Historic Musical Instruments*, shared with Prof. Antoine Allanore, \$193,262, 2024.

Making@Stanford

Making Materials grant to support Music 158/258d, 2023, 2024.

National Sciences and Engineering Research Council of Canada (NSERC).

Postdoctoral Fellowship (Mechanical Engineering), 2023.

Student Paper Award Competition, First Prize in Musical Acoustics.

182nd Meeting of the Acoustical Society of America, May 2022, Denver, CO.

Stanford School of Humanities and Sciences Graduate Research Opportunity Grant, 2021.

Student Paper Award Competition, Second Prize in Musical Acoustics.

178th Meeting of the Acoustical Society of America, December 2019, San Diego, CA.

Stanford Arts Institute Fellowship, 2016.

Student Paper Award Competition, Second Prize in Musical Acoustics.

171st Meeting of the Acoustical Society of America, May 2016, Salt Lake City, UT.

National Sciences and Engineering Research Council of Canada (NSERC).

Undergraduate Student Research Award, 2015 and 2016.

PUBLICATIONS

Dissertation

M. Rau, “Vibration and acoustic measurements of guitars with applications to luthiery, synthesis, and audio effects,” Ph.D. Thesis, Stanford University, 2023.

Journal Articles

- [1] **M. Rau**, J. S. Abel, D. James, and J. O. Smith III, “Electric-to-acoustic pickup processing for string instruments: An experimental study of the guitar with a hexaphonic pickup,” *The Journal of the Acoustical Society of America*, vol. 150, no. 1, pp. 385–397, 2021.

Conference Papers

- [1] **M. Rau** and G. Scavone, “Vibration measurements comparing the contrabass and octobass,” *International Symposium on Musical and Room Acoustics (ISMRA)*, New Orleans, USA, May 24–27, 2025.
- [2] T. Yudasaka, **M. Rau**, and G. Scavone, “Measurement and analysis of electric guitar neck admittance for digital waveguide models,” *International Symposium on Musical and Room Acoustics (ISMRA)*, New Orleans, USA, May 24–27, 2025.
- [3] E K. Canfield-Dafilou, S. Yusuf, and **M. Rau**, “Acoustics of sympathetic strings in a sarangi,” *International Symposium on Musical and Room Acoustics (ISMRA)*, New Orleans, USA, May 24–27, 2025.
- [4] **M. Rau**, J. O. Smith, and J. S. Abel, “A comparison of modal parameter extraction methods when applied to measurements of stringed instruments,” *Proceedings of the Forum Acusticum*, Turin, Italy, 2023.
- [5] T. Zhang, M. Sheinin, D. Yao Chan, **M. Rau**, M. O’Toole, and S. Narasimhan, “Estimating physical interactions using transient surface wave imaging,” *Proceedings of the IEEE/CVF Conference*

on Computer Vision and Pattern Recognition, 2023.

- [6] S. Clarke, R. Gao, M. Wang, **M. Rau**, J. Xu, J.H. Wang, D. James, and J. Wu, “RealImpact: A dataset of impact sound fields for real objects,” the Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, 2023.
- [7] S. Clarke, N. Heravi, **M. Rau**, R. Gao, J. Wu, D. James, and J. Bohg, “DiffImpact: Differentiable rendering and identification of impact sounds,” in 5th Annual Conference on Robot Learning, 2021.
- [8] J. Chowdhury, E. K. Canfield-Dafilou, and **M. Rau**, “Water bottle synthesis with modal signal processing,” in 23rd Int. Conf. Digital Audio Effects (DAFx-20), Virtual, Sep. 9–11, 2020.
- [9] **M. Rau**, O. Das, and E. Canfield-Dafilou, “Improved carillon synthesis,” in 22nd Int. Conf. Digital Audio Effects (DAFx-19), Birmingham, England, Sep. 2–6, 2019.
- [10] **M. Rau** and J. O. Smith III, “Measurement and modeling of a resonator guitar,” International Symposium on Musical Acoustics (ISMA), Detmold, Germany, September 13–17, 2019.
- [11] **M. Rau** and R. Hoover, “Measurements of acoustic guitar top plates during the voicing process,” in 26th International Congress on Sound and Vibration, July 7– 11, 2019.
- [12] **M. Rau**, J. S. Abel, and J. O. Smith III, “Contact sensor processing for acoustic instrument recording using a modal architecture,” in 21st Int. Conf. Digital Audio Effects (DAFx-18), Aveiro, Portugal, pp. 304–311, Sep. 4–8, 2018.
- [13] **M. Rau** and O. Das, “An “infinite” sustain effect designed for live guitar performance,” in Audio Engineering Society Convention 143. Audio Engineering Society, 2017.
- [14] P. Murgai, **M. Rau**, and J.-M. Jot, “Blind estimation of the reverberation fingerprint of unknown acoustic environments,” in Audio Engineering Society Convention 143. Audio Engineering Society, 2017.
- [15] **M. Rau**, E. Maestre, J. O. Smith, and G. Scavone, “An exploration of guitar neck admittance measurements taken at different string stopping locations,” International Symposium on Musical Acoustics (ISMA), pp. 73–76, Montreal, Canada, June 18–22, 2017.
- [16] **M. Rau** and W. Woszczyk, “An evaluation of two microphone techniques for bleed reduction using independent component analysis,” in Audio Engineering Society Convention 141. Audio Engineering Society, 2016.

Invited Conference Talks

- . 187th Meeting of the Acoustical Society of America, November 2024, Virtual.
- . 26th International Congress on Sound and Vibration, July 2019, Montreal, QC, Canada.
- . 176th Meeting of the Acoustical Society of America, November 2018, Victoria, BC, Canada.

Conference Talks

- [1] B. Sabatini, **M. Rau** and A. Aldins, “The sound and material profiling of “Svilpaunieki” via acoustic measurements and X-ray computed tomography,” in 17th European Meeting on Ancient Ceramics (EMAC 2025), Bilbao, Spain, September 10-12, 2025.
- [2] **M. Rau** and G. Scavone, “Measuring body vibrations of stringed instruments,” in 187th Meeting of the Acoustical Society of America, Virtual, November 18-22, 2024.

- [3] **M. Rau** and G. Scavone, “A comparison of various steel-string acoustic guitars’ modal response with relation to typical playing styles,” in 186th Meeting of the Acoustical Society of America, Ottawa, Canada, May 13-17, 2024.
- [4] C. Darabundit and **M. Rau**, “Modeling and correction of piezoelectric string instrument pickups,” in 183rd Meeting of the Acoustical Society of America, Nashville, TN, Dec 5–9, 2022.
- [5] **M. Rau**, R. Hoover, R. Barto, and J. O. Smith, “A self-contained and automated tonewood measurement device,” Vienna Talk on Musical Acoustics, Vienna, Austria, September 11–14, 2022.
- [6] **M. Rau**, J. O. Smith, and D. L. James, “Augmenting a single-point laser Doppler vibrometer to perform scanning measurements,” in 182nd Meeting of the Acoustical Society of America, Denver, CO, May 23–27, 2022, published abstract.
- [7] **M. Rau**, “Measurements and analysis of acoustic guitars during various stages of their construction,” in 180th Meeting of the Acoustical Society of America, Virtual, June 8–10, 2021.
- [8] **M. Rau**, J. S. Abel, J. O. Smith, and D. L. James, “String instrument acoustic transfer processing,” in 179th Meeting of the Acoustical Society of America, Virtual, December 7–11, 2020.
- [9] **M. Rau** and J. O. Smith III, “A comparison of nonlinear modal synthesis using a time-varying linear approximation and direct computation,” in 178th Meeting of the Acoustical Society of America, San Diego, CA, December 2–6, 2019.
- [10] **M. Rau**, J. O. Smith, and J. S. Abel, “String synthesis using individually modeled termination scattering filters,” in 177th Meeting of the Acoustical Society of America, Victoria, Canada, Nov. 5–9, 2018, presentation by invitation.
- [11] **M. Rau** and G. Scavone, “Investigating the effect of body geometry on the acoustics of electric guitars,” in 171st Meeting of the Acoustical Society of America, Salt Lake City, UT, May 23–27, 2016.

PATENT APPLICATIONS

- [1] **M. Rau**, J. S. Abel, D. James, and J. O. Smith III, “Electric to acoustic string instrument pickup processing”, Application No. 63/122727, Dec. 8, 2020, Provisional patent.

ACADEMIC AND PROFESSIONAL SERVICE

- . Journal of the Audio Engineering Society guest editor, 2025-2026.
- . International Conference on Digital Audio Effects (DAFx26) organizer, 2025-2026.
- . International Symposium on Musical and Room Acoustics organizing committee, 2024-2025.
- . Acoustical Society of America Technical Program Organizer, 2024-2025.
- . Acoustical Society of American student representative for the Musical Acoustics technical committee, 2019-2022.
- . Reviewer for the Journal of the Acoustical Society of America (JASA), Acta Acustica, International Conference on Digital Audio Effects (DAFx), Journal of the Audio Engineering Society (JAES), Sound and Music Computing Conference (SMC), Linux Audio Conference (LAC), International Computer Music Conference (ICMC), and the Forum Acusticum.
- . Run the Graduate Audio Signal Processing reading/research group at CCRMA, 2018-2023.
- . Mentor for the Stanford Peer Mentoring in Music program, 2020-2023.

MEMBERSHIPS

- . Acoustical Society of America.
- . Guild of American Luthiers.

TECHNICAL SKILLS

Programming Languages: MATLAB, Python, C++.

Acoustics: Vibration Testing, Laser Doppler Vibrometry, Room Acoustics Measurements, Musical Instrument Analysis and Design, Numerical Methods.

Electrical Engineering: Digital Signal Processing, Physical Modeling, Circuit Modeling, Electronics/Circuit Design, Microprocessors.

Audio Engineering: Sound Recording, Protocols, Logic, Reaper, Studio Equipment Testing.

Making: 3D printing, Laser Cutting, Woodworking.

Computer Music: ChuckK, Max, Pd.

Instruments: Guitar, Contrabass, French Horn.