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Education

2014-21 | **Ph.D. in Computer-based music theory and acoustics**, Stanford University

Advisors: Dr. Julius O. Smith and Dr. Chris Chafe, Dr. Edward W. Large

Thesis title: Mathematical models of rhythm synchronization and anticipation

2009-14 | **B.A. in Biology, minor in chemistry**, University of North Texas

2009-14 | **B.M. in Music theory**, University of North Texas

2009-14 | **B.A. in German language**, University of North Texas

Professional Experience

2021- | **Postdoctoral scholar in human-centered artificial intelligence**, New York University

- Created multimodal machine learning models for 3D scene understanding.
- Developed systems that use spatial cues to detect, localize and track objects in the real world.
- Contributed to open-source python projects, including `librosa`, `soundata`, `mirdata`, and `micarraylib`.

2020-21 | **Signal processing engineer**, internship, Tesla Inc, Palo Alto, CA

- Designed signal processing algorithms for the embedded audio system of the 2021 Model S.
- Wrote testing pipelines to identify signal distortion in A2DP and PCM streaming.
- Designed signal processing layouts with the AudioWeaver software for dedicated audio hardware.

2018-19 | **Deep learning researcher**, internship, Apple Inc, Cupertino, CA

- Optimized the transformer neural architecture to carry out automatic speech recognition (ASR).
- Collected human data with novel sensors designed for natural voice interaction with Siri.
- Designed deep neural network architectures that integrate speech and the novel sensor signals.

2017-18 | **Signal processing and machine learning engineer**, internship, Poly, Santa Cruz, CA

- Developed neural networks and curated datasets for biometric authentication of users with audio headsets.
- Optimized the size of the neural network to be small enough to run in an embedded system.

Publications

Refereed Journal Articles

- Castelo S, Rulff J, McGowan E, Steers B, Wu G, Chen S, **Roman IR**, Lopez R, Brewer E, Zhao C, Qian J, Cho K, He H, Sun Q, Vo H, Bello J, Krone M, Silva C. ARGUS: Visualization of AI-Assisted Task Guidance in AR. *Transactions in Visualization and Computer Graphics*. 2023.
- **Roman IR**, Roman AS, Kim JC, Large EW. Hebbian learning with elasticity explains how the spontaneous motor tempo affects music performance synchronization. *PLOS Computational Biology*. 2023 Jun 7;19(6):e1011154.
- Large EW, **Roman IR**, Kim JC, Cannon J, Pazdera JK, Trainor LJ, Rinzel J, Bose A. Dynamic models for musical rhythm perception and coordination. *Frontiers in Computational Neuroscience*. 2023 May 17;17:1151895.
- Liang BS, Liang AS, **Roman IR**, Weiss T, Duinkharjav B, Bello JP, Sun Q. Reconstructing room scales with a single sound for augmented reality displays. *Journal of Information Display*. 2023 Jan 2;24(1):1-2

- **Roman IR**, Washburn A, Large EW, Chafe C, Fujioka T. Delayed feedback embedded in perception-action coordination cycles results in anticipation behavior during synchronized rhythmic action: A dynamical systems approach. *PLoS Computational Biology*. 2019 Oct 31;15(10):e1007371.
- Washburn A, **Roman IR**, Huberth M, Gang N, Dauer T, Reid W, Nanou C, Wright M, Fujioka T. Musical role asymmetries in piano duet performance influence alpha-band neural oscillation and Behavioral synchronization. *Frontiers in Neuroscience*. 2019 Oct 15;13:1088.
- Huberth M, Dauer T, Nanou C, **Roman IR**, Gang N, Reid W, Wright M, Fujioka T. Performance monitoring of self and other in a turn-taking piano duet: A dual-EEG study. *Social Neuroscience*. 2019 Jul 4;14(4):449-61.
- Jiménez JE, Crego RD, Soto GE, **Roman IR**, Rozzi R, Vergara PM. Potential impact of the alien American mink (*Neovison vison*) on Magellanic woodpeckers (*Campephilus magellanicus*) in Navarino Island, Southern Chile. *Biological Invasions*. 2014 Apr;16(4):961-6.

Refereed Articles in Conference Proceedings

- Kushwaha SS, **Roman IR**, Fuentes M, Bello JP. Sound source distance estimation in diverse and dynamic acoustic conditions. In *Proceedings of the IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA)*, 2023.
- **Roman IR**, Faronbi D, Burger-Weiser I, Adu-Gilmore L. F0 analysis of Ghanaian pop singing reveals progressive alignment with equal temperament over the past three decades: a case study. In *Proceedings of the Sound and Music Computing Conference (SMC)*, 2023.
- Faronbi D, **Roman IR**, Bello JP. Exploring Approaches to Multi-Task Automatic Synthesizer Programming. In *Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2023.
- Kushwaha SS, **Roman IR**, Bello JP. Analyzing the effect of equal-angle spatial discretization on sound event localization and detection. In *Proceedings of the Workshop on Detection and Classification of Acoustic Scenes and Events (DCASE)*, 2022.
- **Roman IR**, Bello JP. Micarraylib: software for reproducible aggregation, standardization, and signal processing of microphone array datasets. In *Proceedings of the Workshop on Detection and Classification of Acoustic Scenes and Events (DCASE)*, 2021.

Article Preprints

- Fuentes M, Salamon J, Zinemanas P, Rocamora M, Paja G, **Roman IR**, Miron M, Serra X, Bello JP. Soundata: a python library for reproducible use of audio datasets. arXiv preprint arXiv:2109.12690. 2021 Sep 26.

Other Non-Refereed Publications

- Walls KL, **Roman IR**, Steers B, Georgieva E. Total variation in popular rap vocals from 2009–2023: extension of the analysis by Georgieva, Ripollés & McFee. ismir2023program.ismir.net
- Pedroza HE, Meza G, **Roman IR**. EGFxSet: electric guitar tones processed through real effects of distortion, modulation, delay and reverb. ismir2022program.ismir.net
- O'Brien T, **Roman IR**. A RNN for musical structure processing and expectation. cs224d.stanford.edu
- **Roman IR**. Assessing neuroplasticity with convolutional and recurrent neural networks. vision.stanford.edu

Open-Source Contributions

Software

- `librosa`, re-wrote the API to efficiently handle multi-channel audio, github.com/librosa
- `mirdata`, wrote code to load and use the EGFxSet dataset in audio research, github.com/mirdata
- `micarraylib`, founded the project and wrote the first version in its entirety, github.com/micarraylib
- `soundata`, wrote code to process spatial audio and microphone array datasets, github.com/soundata
- `musicinformationretrieval`, maintained the website and github repo, musicinformationretrieval.com

Data

- EGFxSet: electric guitar tones processed through real effects, zenodo.com/egfxset

Conference Presentations with Refereed Abstracts

Podium

- **Roman IR**, Large EW. Neuronal dynamics of strong anticipation in musical action. In *Abstracts of the SIAM Conference on Applications of Dynamical Systems*, 2023
- **Roman IR**, Rabinovitch E, Golumbic EZ, Large EW. A dynamic model of neural oscillation can synchronize with natural speech. In *Abstracts of the 2022 Advances and Perspectives in Auditory Neuroscience meeting*, 2022
- Roman, AS, **Roman, IR**. Individual musician's spontaneous performance rates affect interpersonal synchrony in joint musical performance: a dynamical systems model. In *Abstracts of the biennial meeting of the Society for Music Perception and Cognition*, 2019.
- **Roman IR**, Washburn A, Large E, Chafe C, Fujioka T. Delayed feedback embedded in perception-action coordination cycles results in anticipation behavior. In *Abstracts of the International Conference on Music Perception and Cognition*, 2018.
- **Roman IR**, Fujioka T. Music syntactic processing is influenced by integration of local and global harmonic structures: an ERP study. In *Abstracts of the Cognitive Neuroscience Society meeting*, 2016.

Poster

- **Roman IR**, Rabinovitch E, Golumbic EZ, Large EW. A dynamic model of neural oscillation can synchronize with natural speech. In *Program No. 241.02. San Diego, CA: Society for Neuroscience*, 2022
- **Roman IR**, Fujioka T. Music syntactic processing is determined by the architecture of a recurrent neural network. In *Abstracts of the Neurosciences and Music Conference*, 2017.
- **Roman IR**, Huberth M, Gang N, Dauer T, Reid W, Nanou C, Wright M, Fujioka T. A dual piano performance EEG study: the effect of the partner's animacy and melodic content on alpha-band oscillations. In *Abstracts of the Cognitive Neuroscience Society meeting*, 2017.
- Huberth M, Dauer T, **Roman IR**, Nanou C, Gang N, Reid W, Wright M, Fujioka T. Involvement or irrelevance: representation of the self vs. other in joint piano performance recorded by dual-EEG. In *Abstracts of the Cognitive Neuroscience Society meeting*, 2017.
- **Roman IR**, Imam J, Stearns T. Characterization of five human p53 mutants using the budding yeast (*Saccharomyces cerevisiae*) as a model. In *Abstracts of the Annual Biomedical Research Conference for Minority Students*, 2013.
- **Roman IR**, Jiménez JE, Vergara P, Rozzi R. Magellanic woodpecker (*Campephilus magellanicus*) behavior when approached by humans in the context of ecotourism. In *Abstracts of the Ecological Society of America meeting*, 2013.

Invited Lectures and Seminars

- 2023 | Multimodal sensing to recognize steps in medical procedures. Defense Advanced Research Projects Agency, Perceptual Task Guidance PI Meeting at Wright State University. May 23rd, Dayton, OH
- 2023 | Mathematical models of music anticipation and synchronization. Maastricht University. Mar 20th, Maastricht, Netherlands
- 2022 | Deep learning for music. Universidad de Nuevo León. Dec 9th, Nuevo León, Mexico
- 2022 | Action and object recognition for TIM: a transparent, interpretable, and multimodal personal assistant. Defense Advanced Research Projects Agency, Perceptual Task Guidance PI Meeting at the Massachusetts Institute of Technology. Nov 8th, Cambridge, MA
- 2021 | A transparent, interpretable, and multimodal personal assistant. Defense Advanced Research Projects Agency, Perceptual Task Guidance Kickoff Meeting. Nov 17th, Washington, DC
- 2021 | Hebbian learning with elasticity explains music performance synchronization and speech envelope processing. New York University Center for Neural Science. Oct 11th, New York City, NY
- 2020 | Deep learning applied to audio. Universidad Politécnica de Madrid. Nov 13th, Madrid, Spain
- 2020 | Mathematical models of music anticipation and synchronization. New York University Center for Neural Science. Feb 22nd, New York City, NY
- 2019 | Delayed feedback embedded in perception-action coordination cycles results in anticipation behavior during synchronized rhythmic action: a dynamical systems approach. Stanford University Center for Mind, Brain, and Computation. May 20th, Stanford, CA

Honors and Awards

- 2023 | Honorable mention for best paper, IEEE VIS: Visualization & Visual Analytics
- 2019 | Excellence in advocacy award, Stanford University Diversity and Advocacy Committee
- 2019 | Outstanding artificial intelligence project for Siri speech, Apple Inc
- 2016 | Honorable mention for best paper, Stanford University Deep Learning for Genomics and Biomedicine
- 2013 | Best poster presentation, Annual Biomedical Research Conference for Minority Students
- 2013 | Honorable mention for oral presentation, Stanford Summer Research Program
- 2013 | Nationally competitive awards public recognition, University of North Texas Honors Day

Grants, Fellowships, and Scholarships

2023	National Science Foundation, REU Supplement	\$15,000
2023	SIAM Conference on Applications of Dynamical Systems, Travel Scholarship	\$650
2023	Cold Spring Harbor, Science Forward: Inclusive Excellence Symposium, Travel Scholarship	\$250
2021	National Science Foundation, REU Supplement	\$45,000
2021	Defense Advanced Research Projects Agency, Perceptually Enabled Task Guidance (proposal co-authored with PI: Claudio Silva, grant HR001121S0015-PTG-FP-041)	\$5,129,870
2019	Stanford University, Human-Centered Artificial Intelligence Research Fellowship	\$70,000
2015	Stanford University, Mind, Brain and Computation Graduate Research Traineeship	\$4,500
2015	National Institute of Mental Health, Cognitive Neuroscience Summer Institute Scholarship	~\$2,500
2014	Stanford University, Graduate Fellowship	\$308,000
2014	Howard Hughes Medical Institute, Exceptional Research Opportunities Capstone	~\$20,000
2013	Howard Hughes Medical Institute, Exceptional Research Opportunities Fellowship	~\$20,000
2012	Howard Hughes Medical Institute, Undergraduate Research Fellowship	~\$20,000

Student Research Advisees

Current

- 2023- | Hegel Pedroza, Ph.D. candidate, National Autonomous University of Mexico
- 2022- | Ameyaltzin Castillo, Ph.D. candidate, National Autonomous University of Mexico
- 2022- | Daniel Faronbi, Ph.D. candidate, New York University
- 2023- | Wallace Abreu, Master student, Federal University of Rio de Janeiro

2023- | Clément Sicard, Master student, ETH Zurich
 2023- | Filippo Maria Pedini, Master student, Politecnico di Milano
 2018- | Adrian S. Roman, Master student, University of Southern California
 2022- | Chuyang Chen, Undergrad, New York University

Past

2023 | Nalicha Antoine, High-School, Achievement First Brooklyn High School
 2023 | Lauren Pryor, Undergrad, California Institute of Technology
 2022-23 | Saksham Singh, Master student, New York University (now Ph.D. at UT Dallas)
 2022 | Bridget Meier, High-School, Staten Island Technical High School
 2022 | Aidan Singh, Undergrad, New York University (now Master student at Cornell)
 2021 | Aliaa Mahgoub, High-School, Brooklyn Technical High School, (now Undergrad at Yale)

Courses Taught

Graduate level

2023 | CSCI-GA 3813, Advanced Laboratory in Computer Science, New York University
 2022 | Deep Learning for Music Information Retrieval, National Autonomous University of Mexico
 2022 | CSCI-GA 3813, Advanced Laboratory in Computer Science, New York University
 2018 | MUSIC 280, Music Department Teaching Assistant Training, Stanford University
 2017 | EE 367A, Signal Processing Models in Musical Acoustics, Stanford University
 2017 | MUSIC 280, Music Department Teaching Assistant Training, Stanford University
 2017 | MUSIC 320B, Intro to Audio Signal Processing Part II: Digital Filters, Stanford University
 2016 | MUSIC 320A, Intro to Audio Signal Processing Part I: Spectrum Analysis, Stanford University
 2016 | EE 367D, Signal Processing Techniques for Digital Audio Effects, Stanford University
 2016 | MUSIC 320B, Intro to Audio Signal Processing Part II: Digital Filters, Stanford University
 2015 | MUSIC 320A, Intro to Audio Signal Processing Part I: Spectrum Analysis, Stanford University

Undergraduate level

2014 | BIOL 4022, Microbiology Laboratory, University of North Texas
 2013 | BIOL 1710, Principles of Biology I (recitation lecturer), University of North Texas
 2012 | BIOL 3452, Genetics Laboratory, University of North Texas

Week-long tutorials taught

2017-24 | Deep Learning for Music Information Retrieval, Stanford University (once a year)
 2023-24 | Signal Processing and Machine listening with PyTorch, Stanford University (once a year)
 2020 | AI for Audio using Neural Networks, Mexican Center for Music and Sonic Arts
 2020 | Artificial Intelligence, Stanford University Summer Pre-Collegiate Institute
 2018 | Deep Learning Algorithms, Higher Technological Institute of Southern Guanajuato
 2016 | Mathematics for Spectral Analysis and Digital Filters, Mexican Center for Music and Sonic Arts
 2016 | Artificial Intelligence, Stanford University Summer Pre-Collegiate Institute

Online (on demand)

- Generative Music AI Course, Collaboration with Universitat Pompeu Fabra (UPF), [The Sound of AI](#).
- Deep Learning for Music Information Retrieval: Generative Models, [dl4genaudio.github.io](https://github.com/dl4genaudio)
- Artificial Intelligence for Audio Using Neural Networks, cmmas.com

Service

Peer Review

- 2023 | Article reviewer, eLife
- 2021-23 | Article reviewer, International Society for Music Information Retrieval
- 2023 | Article reviewer, Music & Science
- 2023 | Article reviewer, IEEE International Conference on Acoustics, Speech, and Signal Processing
- 2023 | Article reviewer, IEEE International Workshop on Machine Learning for Signal Processing
- 2023 | Article reviewer, Journal of Attention, Perception, & Psychophysics
- 2022 | Article reviewer, Cognitive Systems Research Journal
- 2021-22 | Grant reviewer, National Research Project Competition, Chile's National Science Foundation

Academic

- 2022-24 | Volunteer professor, National Autonomous University of Mexico
- 2023 | Meeting chair, Workshop on Neuroscience and Neural Networks, National College of Mexico
- 2022 | Meeting chair, IEEE Mexico LatAm BISH Bash
- 2021-22 | Policy council officer, Northside Center for Child Development
- 2019-20 | ASSU executive director of graduate student affordability, Stanford University
- 2017-19 | Working group for diversity and inclusion, Stanford University Department of Music
- 2017-19 | Seminar coordinator, Stanford University Center for Mind, Brain, and Computation
- 2012-13 | Student ambassador, University of North Texas World Languages and Literatures

Other

- 2013 | Bilingual tour guide, UNESCO Cape Horn Biosphere Reserve, Puerto Williams, Chile

Diversity and Inclusion

- 2022-24 | Mentor, Women in Music Information Retrieval (WiMIR)
 - Each year introduced a student and/or aspiring researcher to the field of Music Information Retrieval (MIR).
 - Met individually with the student to discuss how to navigate career options in industry and academia.
 - Helped the student writing research proposals and gaining hands-on skills to carry out MIR research.
- 2016-24 | Application reviewer, Diversity in Music Technology Summer Scholarship, Stanford University
 - Prepared and publicized a summer tuition scholarship application to study music technology at Stanford.
 - This scholarship has supported students from backgrounds/countries underrepresented in STEM, and allies.
- 2021-23 | Research mentor, Applied Research Innovations in Science and Engineering, New York University
 - Mentored high-school students carrying out summer research at the Music and Audio Research Lab.
 - Helped students prepare a research presentation, delivered at a symposium celebrating minorities in STEM.
- 2023 | Presentation, Science Forward: Towards Inclusive Excellence Symposium, Cold Spring Harbor Lab
 - Presented the poster titled "Highlighting representation in multi-modal machine learning research".
 - Created a spotlight around BIPOC researchers by inviting them to present at high-impact venues.
 - Published their presentations (with their consent) on my YouTube channel.
- 2021 | Recruiter, Undergrad Research Experience, Music and Audio Research Lab, New York University
 - Publicized REU positions in our lab at minority-serving engineering programs across the United States.
 - Produced a pool of talented applicants with strong representation from minority groups in STEM.
- 2016 | Program leader, Stanford Summer Research Program, Stanford Medical School
 - Mentored a group of diverse undergraduate students carrying out summer research.
 - Guided students to prepare high-quality oral and poster presentations for a research symposium.

- Provided students with feedback on their personal statements for Ph.D. program applications.
- 2015 | Program leader, Stanford Biosciences ADVANCE Summer Institute, Stanford Medical School
- Planned and conducted a journal club series with a diverse group of new Ph.D. students.

Languages

- Spanish: Native
- English: Fluent
- German: Advanced

Press

- 2019 | Delayed neural communication may underlie anticipatory behaviors, EurekaAlert!, Oct 31st
- 2019 | Stanford's Human-Centered AI Institute awards 30 seed grants, The Stanford Daily, May 1st
- 2016 | High school students wrestle with perennial questions and make connections between art practice and other disciplines, Stanford University News, August 9th
- 2013 | UNT undergraduate student earns Howard Hughes grant, The North Texan, June 5th

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