Emilian Postolache

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Research Interests

Deep Generative Models, Compositional Music Generation, Source Separation, Efficient Machine Translation

Education

Sapienza University of Rome — Rome, Italy
Ph.D. in Computer Science; Advisor: Prof. Emanuele Rodolà — 2020 - 2024

Sapienza University of Rome — Rome, Italy
M.Sc. in Artificial Intelligence and Robotics; Final grade: 110 with honors / 110 — 2018 - 2020

Sapienza University of Rome — Rome, Italy
B.Sc. in Computer Science; Final grade: 110 with honors / 110 — 2014 - 2018

Experience

Ca' Foscari University of Venice — Venice, Italy
Research Fellow — March 2024 - Ongoing
- Research in generative modeling applied to signal processing.

Sony CSL — Tokyo, Japan
AI Researcher — November 2023 - February 2024
- Worked on the task of EEG to music decoding using latent diffusion models.

Dolby Laboratories — Barcelona, Spain
AI Researcher — June 2022 - September 2022
- Introduced a novel method for universal sound separation, reaching state-of-the-art results. Improved my planning skills, optimized parallel experiment execution to make the best use of computational resources, and developed modular code that allowed me and the team to perform experiments efficiently.

Sapienza University of Rome — Rome, Italy
Junior Research Fellow — June 2019 - May 2020
- Research activity in geometry processing.

Babelscape — Rome, Italy
Software Developer — June 2018 - September 2018
- Ported BabelNet, a very large multilingual semantic network, from Java 8 to Python 3.

Research Visits

Queen Mary University of London — London, United Kingdom
Academic Visitor — May 2023 - September 2023
- Visited the Center For Digital Music (C4DM) at Queen Mary University of London, under the supervision of Dr. Emmanouil Benetos. Worked on compositional diffusion models for music, singing voice separation, and foley sound synthesis.

Main Works

- **COCOLA: Coherence-Oriented Contrastive Learning of Musical Audio Representations**: Proposed the first contrastive model operating at the level of sub-constituent of musical tracks, able to evaluate accompaniment generation models objectively. **Preprint**.

- **Multi-Source Diffusion Models for Simultaneous Music Generation and Separation**: Proposed a diffusion-based generative model capable of both waveform music synthesis and source separation. Introduced source imputation, where a subset of the sources are generated given the others (accompaniments). Utilizing a novel Dirac sampler, the method exhibits competitive separation performance on the Slakh2100 dataset compared to state-of-the-art regressors. **Accepted at ICLR-2024 with oral presentation (top 1.2%)**.

- **Generalized Multi-Source Inference for Text Conditioned Music Diffusion Models**: Proposed a generalization of Multi-Source Diffusion Models (MSDM) via text-conditioned diffusion models. I show how the task of total and partial generation of MSDM can be solved with an inference procedure in which one performs separation while generating the sources. Source separation can be performed in a zero-shot way via the independent Dirac separator. **Accepted at ICASSP-2024**.

- **SyncFusion: Multimodal Onset-synchronized Video-to-Audio Foley Synthesis**: Proposed with M. Comunità and R.F. Gramaccioni a novel system for automating audio synthesis synchronized with a video, easing the workload of sound designers. It uses a diffusion model conditioned on action onsets extracted from video and text labels to generate the audio. We improve both synchronization metrics and sound quality with respect to the state-of-the-art and feature a great degree of controllability. **Accepted at ICASSP-2024**.
- **Zero-Shot Duet Singing Voices Separation with Diffusion Models**: Applied with C.Y. Yu the Dirac-based source separator with diffusion models on the task of duet singing voices separation. We show that performing diffusion in an autoregressive manner improves the separation metrics considerably. **Accepted at the Sound Demixing Workshop 2023**.
- **Accelerating Transformer Inference for Translation via Parallel Decoding**: Proposed with A. Santilli parallel decoding methods for machine translation that offer a speed-up with respect to greedy sampling up to 38% without affecting translation quality (having mathematical guarantees) and up to $2\times$ when scaling the available resources. **Accepted at ACL-2023**.
- **Adversarial Permutation Invariant Training for Universal Sound Separation**: Proposed a novel I-replacement context-based adversarial loss and multiple discriminator training for universal sound separation (separating mixes containing any kind of sound). Obtained a non-negligible improvement of 1 dB over the state-of-the-art SI-SNRi in the reverberant FUSS dataset. Adversarial PIT effectively reduces spectral holes, ubiquitous in mask-based separation models. **Accepted at ICASSP-2023 and granted patents ES-P202230890 (Oct 17, 2022), US-63/440568 (Jan 23, 2023), EP-23/075668 (Sep 18, 2023)**.
- **Latent Autoregressive Source Separation**: Introduced a source separation method employing autoregressive models over vector-quantized latent spaces. Competitive results with existing generative approaches in separation quality while offering significant speedups in inference time and scalability to higher dimensional data. **Accepted at AAAI-2023**.
- **A parametric analysis of discrete Hamiltonian functional maps**: Analysis of asymptotic properties of the spectrum of a discrete family of Hamiltonian operators parameterized by the energy level on a region. State-of-the-art results on the task of partial shape correspondence at the time. **Accepted at SGP-2020**.

Professional Activities / Academic Service

- **Conference Organizing Committee Member**
  - Web Chair: Smart Tools and Applications in Graphics (**STAG**), 2021

- **International Program Committee Member**
  - International Conference on 3D Vision (**3DV**), 2021
  - Conference on Neural Information Processing Systems (**NeurIPS**), 2023
  - Unifying Representations in Neural Models Workshop (**UniReps**), 2023

- **External Reviewer (not in the PC)**
  - Conference on Empirical Methods in Natural Language Processing (**EMNLP**), 2022
  - International Conference on Learning Representations (**ICLR**), 2024
  - IEEE International Conference on Acoustics, Speech, and Signal Processing (**ICASSP**), 2024
  - International Society for Music Information Retrieval Conference (**ISMIR**), 2024

- **Conference Volunteering**
  - International Conference on Learning Representations (**ICLR**), 2024

- **Reviewer for International Journals**
  - IEEE Transactions on Visualization and Computer Graphics (**TVCG**)

Grants and Awards

- **AWS Cloud Credit for Research**
  Amazon *February 2024*
  - Winner, with my team, of 50.000$ worth of Amazon AWS Credit for developing research related to compositional music generation.

- **ICASSP-2024 Travel Grant**
  IEEE Signal Processing Society *February 2024*
  - Winner of a 500$ travel grant awarded by the IEEE Signal Processing Society.

- **AAAI-2023 Student Scholarship**
  Association for the Advancement of Artificial Intelligence *December 2022*
  - Winner of a 500$ scholarship awarded by the AAAI organization.

- **Imminent Grant**
  Translated *April 2022*
  - Winner, with my team, of a 20.000€ grant awarded by Translated for the project "Incremental Parallel Inference for Machine Translation".

- **Galileo Program**
  Université Franco Italienne *January 2022*
  - Winner, with my team, of a 7.000€ research grant awarded for the joint project "Multimodal Artificial Intelligence for 3D shape analysis, modelling and applications".

Invited Talks

- **Tech Talk: Multi-Source Diffusion Models for Simultaneous Music Generation and Separation**

  PI School   *21 March 2023*
    - Presented my work together with a tutorial on diffusion models for music at the PI School of Artificial Intelligence.

- **Adversarial Permutation Invariant Training for Universal Sound Separation**

  Ca' Foscari University of Venice   *3 November 2022*
    - Presented my work at the Department of Environmental Sciences, Informatics and Statistics. Event organized by Prof. Luca Cosmo.

Teaching Activities

- Assisted Prof. M. Felisatti in the "Linear Algebra" course of the B.Sc. program "Applied Computer Science and Artificial Intelligence" (2021-2022) at Sapienza University of Rome.

- Assisted Prof. E. Rodolà in the "Metodi Numerici per l'Informatica" course of the B.Sc. program "Informatica" (2021-2022, 2022-2023) at Sapienza University of Rome.

Languages

Romanian (native), Italian (native), English (fluent), Spanish (basic)