

# Shih-Lun Wu

Student, **M.Sc. in Language Technologies (MLT)**, School of Computer Science

**Carnegie Mellon University (CMU)**, Pittsburgh, PA, United States

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## EDUCATION

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**Master of Science (M.Sc.)** | Carnegie Mellon University 08.2022 ~ 05.2024 (expected)

Language Technologies major

- Cumulative QPA -- **4.17/4.33**
- Research areas: **Music & Audio Processing, Generative Models, Multimodal Learning**
- Advisors: Dr. Chris Donahue, Dr. Shinji Watanabe

**Bachelor of Science (B.Sc.)** | National Taiwan University 09.2017 ~ 06.2021

Computer Science major · Economics minor

- Cumulative GPA -- Overall: **4.28/4.30**, Major: **4.28/4.30**, Rank: **1/176**
- Bachelor's thesis: "**Bridging Transformers and Latent Variable Models for User-controllable Conditional Music Generation.**" Committee members: Dr. Yi-Hsuan Yang, Dr. Yun-Nung Chen, Dr. Lin-shan Lee [[pdf](#)] [[defense slides](#)]

## HONORS & RECOGNITION

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- **Citation count** (Google Scholar, as of 12/16/2023): **225+** total, **150+** first-author | **GitHub stars: 400+**

**Siebel Scholar, Class of 2024** | The Siebel Foundation 09.2023

- Awarded to ~85 graduate students worldwide for outstanding research & leadership (**\$35K** prize money)

**Winner (Research Org), Intern Project Showcase** | Adobe Inc. 08.2023

- Won with the Music ControlNet and related music generation projects, against **200+** Adobe research interns

**1<sup>st</sup> Prize, Automated Audio Captioning Challenge** | DCASE 2023 06.2023

- Won by leveraging advanced encoder architecture & LLM supervision, surpassing runner-up by **1.2** points (**4%**)

**1<sup>st</sup> Prize (Ssu-Nien Fu's Award), Best Bachelor's Thesis** | National Taiwan University 06.2021

- Awarded to **6** out of **3500+** students in the graduating class for exceptional undergrad research

## SELECTED PUBLICATIONS

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[8] **Shih-Lun Wu**, Chris Donahue, Shinji Watanabe, and Nicholas J. Bryan. "Music ControlNet: Multiple Time-varying Controls for Music Generation." Under review at *IEEE/ACM Transactions on Audio, Speech, & Language Processing (TASLP)*. [[pdf](#)] [[tl;dr](#)] [[project website](#)]

[7] **Shih-Lun Wu**, Xuankai Chang, Gordon Wichern, Jee-weon Jung, François Germain, Jonathan Le Roux, and Shinji Watanabe. "Improving Audio Captioning Models with Fine-grained Audio Features, Text Embedding Supervision, and LLM Mix-up Augmentation." *Int. Conf. on Acoustics, Speech, & Signal Processing (ICASSP)* 2024. [[pdf](#)] [[DCASE challenge results](#)]

[6] **Shih-Lun Wu**, Yi-Hui Chou, and Liangze Li. "Listener Model for the PhotoBook Referential Game with CLIP Scores as Implicit Reference Chain." *Annual Meeting of the Assoc. for Computational Linguistics (ACL)* 2023. [[pdf](#)] [[code](#)]

[5] **Shih-Lun Wu** and Yi-Hsuan Yang. "Compose & Embellish: Well-structured Piano Performance Generation via A Two-Stage Approach." *Int. Conf. on Acoustics, Speech, & Signal Processing (ICASSP)* 2023. (**Oral paper**) [[pdf](#)] [[code](#)]

[4] **Shih-Lun Wu** and Yi-Hsuan Yang. "MuseMorphose: Full-song and Fine-grained Music Style Transfer with One Transformer VAE." *IEEE/ACM Transactions on Audio, Speech, & Language Processing (TASLP)* 2023. [[pdf](#)] [[code](#)] [[project website](#)]

[3] Antoine Liutkus, Ondřej Cífka, **Shih-Lun Wu**, Umut Simsekli, Yi-Hsuan Yang, and Gaël Richard. "Relative Positional Encoding for Transformers with Linear Complexity." *International Conference on Machine Learning (ICML)* 2021. (**Long talk**, acceptance rate: **3.0%**) [[pdf](#)] [[code](#)] [[presentation video](#)] [[project website](#)]

[2] **Shih-Lun Wu** and Yi-Hsuan Yang. "The Jazz Transformer on the Front Line: Exploring the Shortcomings of AI-Composed Music through Quantitative Measures." *International Society for Music Information Retrieval Conference (ISMIR)* 2020. [[pdf](#)] [[code](#)] [[poster](#)] [[presentation video](#)]

[1] **Shih-Lun Wu\***, Ching-Yuan Bai\*, Kai-Chieh Chang, Yi-Ting Shieh, Chao Huang, Chung-Wei Lin, Eunsuk Kang and Qi Zhu. "Efficient System Verification with Multiple Weakly-hard Constraints for Runtime Monitoring." *International Conference on Runtime Verification (RV)* 2020. (\*: equal contribution) [[pdf](#)] [[publisher page](#)]

## RESEARCH EXPERIENCE

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**Research Scientist/Engineer Intern** | Adobe Research 05.2023 ~ 12.2023

**Audio AI Lab.** Supervisors: Dr. Nick Bryan, Dr. Gautham Mysore

- Invented Music ControlNet, enabling precise melody, dynamics, rhythm controls for diffusion text-to-music models
- Demonstrated compositionality of proposed controls, and out-of-domain generalizability to user-specified controls
- Beat Meta's MusicGen by 49% on melody control, using 35x fewer params & 11x less training data (publication [8])

**Graduate Research Assistant** | Carnegie Mellon University 09.2022 ~

**Watanabe's Audio & Voice Lab (WAVLab), Language Tech Institute.** Advisor: Dr. Shinji Watanabe

- Achieved new SoTA on audio captioning task with ChatGPT mix-ups and LLM embedding supervision (publ. [7])
- Won ICASSP-23 Grand Challenge on spoken language understanding, utilizing Whisper model backbone [[tech rep](#)]
- Integrated OpenAI's Whisper model into the lab's 7000+ star ESPnet speech processing toolkit [[GitHub PR](#)]

**Research Engineer** | Taiwan AI Labs 08.2021 ~ 03.2022

**Research Intern** | Taiwan AI Labs 07.2020 ~ 07.2021

**AI Music Team.** Supervisor: Dr. Yi-Hsuan Yang

- Made a 3-stage model to generate well-structured music with recurring & developing content (some results in [5])
- Bridged Transformers and VAEs for fine-grained style transfer of arbitrarily long musical pieces, allowing users to exert bar-level controls such as harmonic and rhythmic intensities (publ. [4])
- Collaborated with researchers @ INRIA / Télécom Paris on positional encodings for O(n) Transformers (publ. [3])
- Developed a set of widely-used quantitative metrics to assess the quality of machine-generated music (publ. [2])

**Undergraduate Research Assistant** | National Taiwan University 02.2019 ~ 06.2020

**Cyber-Physical Systems Lab, Dept. of CSIE.** Advisor: Dr. Chung-Wei Lin

- Formulated the formal verification problem under multiple weakly-hard constraints on environmental faults
- Discovered and proved the mathematical properties between pairs of weakly-hard constraints
- Devised a lowest-cost-first heuristic using the properties, accelerating verification algorithm by up to 12x (publ. [1])

## OTHER WORK EXPERIENCE

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**Software Engineering Intern** | Asus Inc. 07.2019 ~ 08.2019

**Cloud Infrastructure Team, Asus Intelligent Cloud Services (AICS) Center**

- Developed a Kubernetes + Python (Flask) template for launching containerized, cloud-based ML solutions
- Integrated Azure Key Vault, Mutual TLS auth & Azure App Insights to the template to streamline model deployment

## OTHER SELECTED PROJECTS

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**MuseOptimus: Interactive AI Composition Webapp** | React · Flask · PyTorch 01.2021

- Realized an immersive user interface for the music generation model developed by me @ Taiwan AI Labs
- Implemented interactive features, including dynamic note display, song rating, and song recommendation
- Scored the highest among 100+ final projects in NTU's Web Programming course (by Prof. Ric Huang) [[slides](#)]

## EXTRACURRICULAR ACTIVITIES & SERVICE

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**Pianist, Violist, & Director of General Affairs** 09.2018 ~ 06.2021

**Symphony Orchestra, National Taiwan University**

- Participated actively in concerts [[playlist](#)] and handled procurement, musical scores, and transportation affairs

**Peer Reviewer**

- Conferences: **ICMLA** (2020), **ISMIR** (2021, 2022, 2023), **ICASSP** (2024)
- Journals: **TISMIR** (2021), **ACM Computing Surveys** (2023)

**Teaching Assistant**

- **Algorithms Design and Analysis** (NTU, Fall 2019)

## SKILLS & QUALIFICATIONS

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- Programming Languages & Infrastructure: Python · C/C++ · JavaScript · ReactJS · LaTeX · Linux · Kubernetes
- Machine Learning Frameworks: PyTorch · Keras · Tensorflow · HuggingFace · PyTorch Lightning
- Selected Coursework: **Straight A+'s** in the following courses (NTU & CMU)
  - CS fundamentals: DS & Algo, Algo Design & Analysis, Formal Language & Automata, Linear Algebra
  - ML-/DL-related: ML Techniques, Advanced NLP, Speech Recognition & Understanding, Multimodal ML