Luiz Felipe Vecchietti

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Research Interests

My research aims to develop generative AI and data science algorithms for applications in diverse domains such as computational biology, robotics, and demographic research. For this, I am particularly interested in developing flexible algorithms that can be applied to diverse data modalities and frameworks. These include novel **reinforcement learning** algorithms, **graph neural networks**, and **diffusion-based** models. My general interests include applied artificial intelligence, data science, deep reinforcement learning, and foundation models.

Academic Positions

Max Planck Institute for Security and Privacy (MPI-SP) *Bochum, Germany, Nov. 2024 - Present*

Senior Researcher - Data Science for Humanity Group.

Institute for Basic Science (IBS) *Daejeon, South Korea, Oct. 2021 - Sep. 2024*

Senior Researcher - Data Science Group.

Mechanical Engineering Research Institute, KAIST *Daejeon, South Korea, Mar. 2021 - Sep. 2021*

Postdoctoral Researcher.

Education

Korea Advanced Institute of Science and Technology (KAIST) *Daejeon, South Korea, Aug. 2017 - Feb. 2021*

Ph.D. in Green Transportation. Advisor: Dongsoo Har.

Thesis topic: Performance Enhancement in Multigoal Reinforcement Learning using Hindsight Experience Replay.

COPPE - Federal University of Rio de Janeiro (UFRJ) *Rio de Janeiro, Brazil, Mar. 2015 - Apr. 2017*

M.S. in Electrical Engineering. Advisor: Fernando Gil Vianna Resende Junior.

Thesis topic: Comparison between rule-based and data-driven Natural Language Processing algorithms for Brazilian Portuguese Speech Synthesis.

Federal University of Rio de Janeiro (UFRJ) *Rio de Janeiro, Brazil, Feb. 2009 - Dec. 2014*

B.S. in Electronics and Computer Engineering.

Korea Advanced Institute of Science and Technology (KAIST) *Daejeon, South Korea, Feb. 2013 - Feb. 2014*

Exchange Student in Electrical Engineering (Science without Borders Program).

Selected Publications

[1] **L. F. Vecchietti**, B. N. Wijaya, et al., "**Artificial intelligence-driven computational methods for antibody design and optimization**," mAbs, 2025, doi: 10.1080/19420862.2025.2528902.

[2] M. Lee, **L. F. Vecchietti** *(co-first author)*, H. Jung, H. J. Ro, M. Cha, and H. M. Kim, "**Robust Optimization in Protein Fitness Landscapes Using Reinforcement Learning in Latent Space**," in International Conference on Machine Learning (ICML) 2024 *(Spotlight Poster)*.

[3] M. Seo, **L. F. Vecchietti**, S. Lee and D. Har, "**Rewards Prediction-Based Credit Assignment for Reinforcement Learning With Sparse Binary Rewards**," in IEEE Access, vol. 7, pp. 118776-118791, 2019, doi: 10.1109/ACCESS.2019.2936863.

[4] T. B. Ribeiro, **L. F. Vecchietti**, et al., "**Overabundance of abelisaurid teeth in the Acu Formation (Albian-Cenomanian), Potiguar Basin, Northeastern Brazil: morphometric, cladistic and machine learning approaches**," Journal of Vertebrate Paleontology (2025).

[5] S. Mishra, P. K. Rajendran, **L. F. Vecchietti**, D. Har, "**Sensing accident-prone features in urban scenes for proactive driving and accident prevention**", 2023, IEEE Transactions on Intelligent Transportation Systems.

[6] **L. F. Vecchietti**, M. Seo and D. Har, "**Sampling Rate Decay in Hindsight Experience Replay for Robot Control**," in IEEE Transactions on Cybernetics, 2020, doi: 10.1109/TCYB.2020.2990722.

[7] **L. F. Vecchietti**, T. Kim, K. Choi, J. Hong and D. Har, "**Batch Prioritization in Multigoal Reinforcement Learning**," in IEEE Access, vol. 8, pp. 137449-137461, 2020, doi: 10.1109/ACCESS.2020.3012204.

[8] C. Hong, I. Jeong, **L. F. Vecchietti**, D. Har and J. -H. Kim, "**AI World Cup: Robot Soccer-Based Competitions**," in IEEE Transactions on Games, 2021, doi: 10.1109/TG.2021.3065410.

[9] T. Kim, **L. F. Vecchietti**, K. Choi, S. Sariel and D. Har, "**Two-stage training algorithm for AI robot soccer**", in PeerJ Computer Science, 7:e718, 2021, https://doi.org/10.7717/peerj-cs.718.

[10] S. Lee, **L. F. Vecchietti**, H. Jin, J. Hong and D. Har, "**Power Management by LSTM Network for Nanogrids**," in IEEE Access, vol. 8, pp. 24081-24097, 2020, doi: 10.1109/ACCESS.2020.2969460.

[11] S. Lee, H. Jin, **L. F. Vecchietti**, J. Hong and D. Har, "**Short-Term Predictive Power Management of PV-Powered Nanogrids**," in IEEE Access, vol. 8, pp. 147839-147857, 2020, doi: 10.1109/ACCESS.2020.3015243.

[12] T. Kim, **L. F. Vecchietti**, K. Choi, S. Lee and D. Har, "**Machine Learning for Advanced Wireless Sensor Networks: A Review**," in IEEE Sensors Journal, vol. 21, no. 11, pp. 12379-12397, 1 June1, 2021, doi: 10.1109/JSEN.2020.3035846.

[13] S. Kim, I. Kim, **L. F. Vecchietti** and D. Har, "**Pose Estimation Utilizing a Gated Recurrent Unit Network for Visual Localization**", in Applied Sciences, 10, no. 24: 8876, 2020, https://doi.org/10.3390/app10248876.

[14] S. Lee, D. Har, **L. F. Vecchietti**, J. Hong, H. -J. Lim, "**Optimal Link Scheduling Based on Attributes of Nodes in 6TiSCH Wireless Networks**", in The Journal of Korean Institute of Information Technology, vol. 18, no. 1, pp.77-92, 2020, https://doi.org/10.14801/jkiit.2020.18.1.77.

[15] S. Lee, H. Jin, **L. F. Vecchietti**, J. Hong, K-B. Park, PN. Son and D. Har, "**Cooperative decentralized peer-to-peer electricity trading of nanogrid clusters based on predictions of load demand and PV power generation using a gated recurrent unit model**", in IET Renewable Power Generation, vol. 15, pp. 3505-3523, 2021, https://doi.org/10.1049/rpg2.12195.

Preprints

[1] L. Vecgaile, A. Spata, **L. F. Vecchietti**, E. Zagheni, "**Predicting Individual Life Trajectories: Addressing Uncertainty in Social Employment Transitions**," SocArXiv, 2025.

[2] J. Yun, S. Yang, J. H. Kwon, **L. F. Vecchietti**, M. Cha, J. E. Oh, H. M. Kim, "**Enhancing the protein fitness of interferon-lambda through computational design and glyco-engineering for prophylactic nasal drugs against respiratory viruses**," bioRxiv (2025): 2025-04.

[3] **L. F. Vecchietti**, M. Lee, B. Hangeldiyev, H. Jung, H. Park, T-K. Kim, M. Cha, H. M. Kim, "**Recent advances in interpretable machine learning using structure-based protein representations**," arXiv:2409.17726, 2024.

[4] S. Lee, H. Jin, **L. F. Vecchietti**, J. Hong, K. Park and D. Har, "**Power Management of Nanogrid Cluster with P2P Electricity Trading Based on Future Trends of Load Demand and PV Power Production**", 2020, arXiv preprint arXiv:2009.00863.

Workshops, Domestic Conferences

[1] J. Kim, J. Kwon, **L. F. Vecchietti**, A. Oh and M. Cha, "**Exploring Persona-dependent LLM Alignment for the Moral Machine Experiment**," arXiv preprint arXiv:2504.10886 (2025), presented at the ICLR 2025 BiAlign Workshop.

[2] B. N. Wijaya, **L. F. Vecchietti**, M. Cha, H. M. Kim, "**Evaluating Antibody Structure Reconstruction with an SE(3)-Equivariant Graph Neural Network**", in Proceedings of the Korea Software Congress (KSC), 2023.

[3] M. Lee, **L. F. Vecchietti**, H. Jung, M. Cha, H. M. Kim, "**Protein Sequence Design in a Latent Space via**

Model-based Reinforcement Learning", 2022, presented at the NeurIPS 2022 Machine Learning in Structural Biology Workshop.

[4] M. Lee, A. Rzayev, H. Jung, **L. F. Vecchietti**, M. Cha, H. M. Kim, "**Structure-based representation for protein functionality prediction using machine learning**", in Proceedings of the Korea Computer Congress (KCC), 2022.

[5] P. K. Rajendran, S. Mishra, **L. F. Vecchietti**, D. Har, "**RelMobNet: End-to-end relative camera pose estimation using a robust two-stage training**", 2022, arXiv preprint arXiv:2202.12838, presented at the ECCV 2022 IWDSC Workshop.

[6] B. Hangeldiyev, A. Rzayev, A. Armanuly, **L. F. Vecchietti**, M. Cha, H. M. Kim, "**Antibody Sequence Design With Graph-Based Deep Learning Methods**", in Proceedings of the Korea Software Congress (KSC), 2022.

Work Experiences

Hyundai Motor Company, Namyang Research and Development Center *Namyang, South Korea, Jul. 2013*

Intern. Advisor: Dong-pil Yoon.

Honors and Awards

Science without Borders Program *Feb. 2013 - Feb. 2014*

Brazilian government 1 year scholarship for undergraduate students with outstanding academic achievements.

KAIST Scholarship *Aug. 2017 - Feb. 2021*

PhD Scholarship.

Academic Services

Reviewer

Journals: IEEE Transactions on Cybernetics, IEEE Sensors, IEEE Transactions on Games, Frontiers in AI and Robotics

Conferences: AAAI ICWSM 2022, NeurIPS 2024, ICLR 2025, WSDM 2025, AISTATS 2025, ICML 2025, NeurIPS 2025, AAAI 2026, ICLR 2026

Workshops: ICML LatinX 2021, ICLR Reincarnating RL 2023, NeurIPS MLSB 2023, ICML ML4LMS 2023, NeurIPS MLSB 2024, NeurIPS MLSB 2025

Invited Presentations

Center for Neuroscience-inspired AI - KAIST *October 2025*

Invited to present the lecture titled "*From self-organized networks to deep reinforcement learning: perspectives on AI research.*"

Ruhr University Bochum, Germany *July 2025*

Invited to present the lecture titled "*LLMs outside Natural Language Processing applications.*"

WebImmunization Seminar, University of Oslo, Norway *December 2024*

Invited to present the talk titled "*Integrating Data Science and AI methods in multidisciplinary research to make discoveries with social impact.*"

Cradle Bio, Zurich, Switzerland *November 2024*

Invited to present the talk titled "*Robust Optimization in Protein Fitness Landscapes Using Reinforcement Learning in Latent Space.*"

Graduate School of AI, Gwangju Institute of Science and Technology (GIST) *July 2023*

Invited to present the talk titled "*Developing and applying deep learning methods for protein design.*"

Max Planck Institute for Security and Privacy *May 2023*

Invited to present the talk titled "*Developing and applying deep learning methods to facilitate new scientific discoveries.*"

IBS Winter School on AI-Boosted Basic Science - Institute for Basic Science *Dec. 2022*

Invited to present the talk titled "*Target-conditioned protein and antibody design for drug discovery.*"

School of AI Convergence - Chonnam National University *Nov. 2021*

Invited to present the work titled "*Identifying the key actions that lead an agent to accomplish a task in model-based deep reinforcement learning.*"

Cho Chun Shik Graduate School of Green Transportation - KAIST *Oct. 2021*

Invited to present the work titled "*Performance enhancement in multigoal model-based deep reinforcement learning.*"

Institute for Basic Science (IBS) *Apr. 2021*

Invited to present the work titled "*Identifying the key actions that lead an agent to accomplish a task in model-based deep reinforcement learning.*"

Open-Source Systems

Dino Toothier (lead developer) [Code]

App using Machine Learning models to classify Dinosaur teeth.

AI Soccer Robot Simulator (lead developer) [Code]

Simulator to train multi-agent AI algorithms for AI robot soccer.