Luiz Felipe Vecchietti

lfelipesv@ibs.re.kr · +82-10-4964-0418
https://lfelipesv.github.io
42 Eoeun-ro 51beon-gil 203, Eoeun-dong, Yuseong-gu, Daejeon, South Korea, 34139
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Research Interests

My research aims to develop **Generative AI** methods for **basic science** applications, especially drug discovery and climate change. For this, I am particularly interested in developing novel **reinforcement learning** algorithms, **graph neural networks**, and **diffusion-based** models. Currently, I am working towards Generative AI for protein and antibody design applied to drug discovery. My general interests include artificial intelligence, deep reinforcement learning, and applied deep learning. From these, I am particularly interested in improving exploration and credit assignment in single-agent and multi-agent reinforcement learning. I also have previous research experiences in speech synthesis, natural language processings (using recurrent neural networks and transformers), and robotic applications using continuous control.

Academic Positions

Data Science Group, Institute for Basic Science *Daejeon, South Korea, Oct. 2021 - Present*

Senior Researcher.

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 Papers

[1] 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.

[2] **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.

[3] **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.

[4] 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.

[5] 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.

[6] 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.

[7] 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

[8] 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.

[9] 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.

[10] 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.

[11] 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.

[12] 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.

[13] 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.

[14] 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.

[15] 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.

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

[17] 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.

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.

Academic Services

Reviewer

IEEE Transactions on Cybernetics

IEEE Sensors

IEEE Transactions on Games

Frontiers of AI and Robotics

ICML LatinX Workshop *2021*

AAAI ICWSM 2022 *2022*

ICLR Reincarnating RL Workshop 2023 *2023*

NeurIPS Machine Learning in Structural Biology Workshop 2023 *2023*

Invited Presentations

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.*"