Juhyung Lee

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Research Interests

- On-Device AI/LLM

- Generative AI Solutions for Wireless Systems

Experience

- **Nokia** — Sunnyvale, CA, USA
  Principal Researcher, AI/ML — *Aug. 2024 - Present*

  - **Developed an on-device LLM PoC** (`Llama3`, `Phi4`) for cross-layer (Application $\leftrightarrow$ PHY/MAC) optimization; applied fixed-point quantization (`GPTQ`, `AWQ`) and achieved real-time inference on `MacBook Pro`. [1] [Github] [Demo]
  - **Built and led an LLM-based RAG assistant** for IEEE 802.11 standard documents
  - Active in Wi-Fi standardization (IEEE 802.11 TGbn and AIML TIG)

- **University of Southern California** — Los Angeles, CA, USA
  Postdoctoral Researcher, Wireless Devices and Systems Group (Head: [Prof. Andreas Molisch]) — *Apr. 2022 - Aug. 2024*

  - **Developed a compression/quantization for AI-to-AI comm.**; Tested on 5G-NR PHY setup [Github]
  - Post-trained a LLM as a neural source coder, integrated into Link-Level simulator (`Nvidia Sionna`) [2]
  - Developed a fast ($\approx$ 1ms) and accurate (RMSE $\approx$ –14dB) **Digital Network Twin (DT)** [3] [Github]
  - Leveraged the twin for mobility management, localization, and autonomous base-station deployment [4] [Github]

- **Samsung Research America** — Dallas, USA
  Senior AI/Wireless Research Engineer — *Dec. 2023 - Jan. 2024 (Seasonal)*

  - **Developed a lightweight generative model** for mMIMO CSI feedback compression [5] [Github]

- **Korea University** — Seoul, Korea
  Research Professor, Research Institute for Information & Communication — *Sep. 2021 - Feb. 2023*

  - Designed RL-based PHY/MAC protocols for LEO satellite networks in system-level simulations (`3GPP TR-38.821`)

Skills

- **Languages&Frameworks**: Python, C/C++, Swift, Matlab; PyTorch, TensorFlow, CoreML; DeepSpeed/FSDP, Triton

- **AI/ML Tech.**: LLM/VLM (`Llama3`, `QWEN3`); Model Adaptation (SFT, LoRA, RLHF & DPO, RAG); RL (`PPO`); GenAI (`VQ-VAE`, `Diffusion`); Efficient AI (`GPTQ`, `AWQ`, Distillation)

- **Wireless&System Sim.**: MATLAB-`5G Toolbox`, Nvidia-`Sionna`, Apple-`CoreWLAN`, WirelessInSite

Education

- **Korea University** — Seoul, Korea
  Ph.D. in Electrical and Computer Eng. (Awarded by Research Excellence) — *Mar. 2016 – Aug. 2021*

  - **EdgeAI-Enabled RAN Optimization:** Developed RL algorithm for 5G/6G high-mobility networks—coverting initial access, handover, radio resource scheduling, and beam management [6, 7]
  - **Radio-over-FSO (RoFSO):** Built a hybrid 802.11 RF+ laser link with USRP and custom optical transceivers; demonstrated ~20Gbps over a 100m outdoor path—the first RoFSO proofs for Wi-Fi backhaul [8, 9] [Demo]

- **Korea University** — Seoul, Korea
  B. Eng. in Electrical and Electronic Eng. (Awarded by National Sci. & Tech. Scholarship) — *Mar. 2011 – Feb. 2016*

Projects

- **On-Device LLM-based Context-Aware Handover (Wi-Fi Roaming)** [Github] [Demo-1] [Demo-2]
  - Developed context-aware handover on `Macbook Pro` using on-device LLM inference (`Llama3, Phi4`); Employed Chain-of-Thought prompting, post-training (`SFT, DPO, ORPO`), and quantization (`GPTQ, AWQ`) to leverage location/time context [1]

- **LLM-Based Neural Source Coding (5G Link-Level Simulation)** [Github]
  - Integrated a pre-trained language model (transformer-based `BART`) with 5G-NR link-level simulator (`NVIDIA Sionna`), using a vector-quantized variational autoencoder (VQ-VAE) for source compression.
  - Demonstrated $\sim 50\%$ data compression, retaining high robustness under 3GPP CDL-{A$\sim$E} channel models.[10]

- **Generative Model for Channel Feedback Compression (5G mMIMO)** [Github]
  - Designed a low-complexity Generative Model (*e.g.,* `Diffusion, VQ-VAE`) for mMIMO CSI compression [5]
  - Achieved $\sim 12\%$ of original feedback data ($\sim 8\times$ compression) while retaining accuracy (NMSE ~ -15 [dB])

- **Large-Scale Channel Prediction (*aka.* Digital Network Twins)** [Github]
  - **Achieved 1st place** in *IEEE ICASSP Radio Map Prediction Grand Challenge* [11], designing an ML-driven wireless digital twin for site-specific pathloss mapping.
  - Created a channel measurement dataset via ray-tracing simulations (`WirelessInsite, Sionna-RT`) across real-world locations (USC, UCLA, Boston), and demonstrated ~ 31 [dB] RMSE gain compared to `3GPP TR-38.901-UMi`

Honors and Awards

- **Invited Industry Panelist**, **ICML** "ML4Wireless", July. 2025
- **1$^{\mathrm{st}}$ Place**, *IEEE ICASSP Signal Processing Grand Challenges*, Jun. 2023 [11]
- **Best Paper**, *IEEE ICTC*, Oct. 2022 [12]
- **Best Paper**, *IEEE ICTC*, Oct. 2021 [13]
- **Grand Prize**, *Graduate Research Excellence Award*, Korea University, Feb. 2021
- Travel Grant, *IEEE GLOBECOM*, Dec. 2020;
- Bronze Prize, *IEEE Seoul Section Student Paper Award*, Dec. 2020
- Best Paper Award, *Korea Institute of Commun., and Info. Sciences*, Feb. 2020
- Full Tuition Scholarship (B. Eng.), *National Science & Technology Scholarship*, Korea, 2011

Patents

- [USA #2 - pending] **J.-H. Lee** and Y.-C. Ko, "Deep reinforcement learning-based random access method for low earth orbit satellite network and terminal for the operation", US20230189353A1 (06/15/2023)
- [USA #1 - pending] J.-M. Kim, **J.-H. Lee**, and Y.-C. Ko, "Apparatus based on wireless optical communication", US20230083544A1 (03/16/2022)
- [Korea #3] B.-H. Lee, **J.-H. Lee**, and Y.-C. Ko, "Minimum transmission rate maximization using power control and association in ground base station-to-UAV communication", 10-2508442 (03/06/2023)
- [Korea #2] J.-M. Kim, **J.-H. Lee**, and Y.-C. Ko, "Apparatus based on wireless optical communication", 10-2506809 (03/02/2023)
- [Korea #1] **J.-H. Lee**, J. Lee, "Method and apparatus for uploading or downloading file based on tag," 10-2014-0128406 (01/26/2016)

Professional References

- [Prof. Andrea F. Molisch] : Professor (IEEE & AAAS Fellow), University of Southern California, molisch@usc.edu
- **Dr. Hao Chen** : Manager, Samsung Research America, hao.chen1@samsung.com
- **Prof. Young-Chai Ko** : Professor, Korea University, koyc@korea.ac.kr

SELECTED PUBLICATIONS [LINK FOR FULL-LIST]

[1] J.-H. Lee, Y. Lu, and K. Doppler, "On-device LLM for context-aware Wi-Fi roaming," *International Conference on Machine Learning (ICML)*, 2025. [paper] [code] [Demo-1] [Demo-2].

[2] J.-H. Lee*, D.-H. Lee, J. Lee, and J. Pujara, "Integrating pre-trained language model with physical layer communications," *IEEE Trans. Wireless Commun. (TWC)*, 2024. [paper] [code].

[3] J.-H. Lee* and A. F. Molisch, "A scalable and generalizable pathloss map prediction," *IEEE Trans. Wireless Commun. (TWC)*, 2024. [paper] [code].

[4] J.-H. Lee and A. F. Molisch, "AutoBS: Autonomous base station deployment with reinforcement learning and digital network twins," *International Conference on Machine Learning (ICML)*, 2025. [paper] [code].

[5] J.-H. Lee, J. Lee, and A. F. Molisch, "Generative vs. predictive models in massive MIMO channel prediction," *Asilomar Conf. on Signals, Systems, and Computers*, 2024. [paper] [code].

[6] J.-H. Lee*, H. Seo, J. Park, M. Bennis, and Y.-C. Ko, "Learning emergent random access protocol for LEO satellite networks," *IEEE Trans. Wireless Commun. (TWC)*, 2023. [paper].

[7] J.-H. Lee*, A. F. Molisch, and et al., "Handover protocol learning for LEO satellite networks: Access delay and collision minimization," *IEEE Trans. Wireless Commun. (TWC)*, 2024. [paper].

[8] J.-M. Kim, J.-H. Lee*, and et al., "Experimental demonstration of RoFSO transmission combining WLAN standard and WDM-FSO over 100m distance," in *IEEE Conf. on Comput. Commun. Workshop (INFOCOM-Demo)*, May 2022.

[9] J.-M. Kim, J.-H. Lee*, and Y.-C. Ko, "WLAN standard-based Non-Coherent FSO transmission over 100m indoor and outdoor environments," in *IEEE Conf. on Comput. Commun. Workshop (INFOCOM-Demo)*, May 2021.

[10] J.-H. Lee*, D.-H. Lee, E. Sheen, T. Choi, and J. Pujara, "Seq2seq-sc: End-to-end semantic communication systems with pre-trained language model," in *Asilomar Conf. on Signals, Systems, and Computers*, 2023. [paper] [code].

[11] J.-H. Lee*, A. F. Molisch, and et al., "PMNet: Large-scale channel prediction system for radio map prediction challenge," in *IEEE International Conf. on Acoustics, Speech and Signal Processing (ICASSP)*, 2023. [**1st-Rank in ML Competition**] [code].

[12] J.-H. Lee*, A. F. Molisch, and et al., "Reinforcement learning empowered massive IoT access in LEO-based non-terrestrial networks," in *Proc. IEEE Int. Conf. on Inf. and Commun. Techn. Conv.*, 2022. [**Best Paper Award**].

[13] J.-H. Lee* and Y.-C. Ko, "Optimization for LEO satellite-ground integrated networks via deep reinforcement learning," in *Proc. IEEE Int. Conf. on Inf. and Commun. Techn. Conv.*, 2021. [**Best Paper Award**].