

Juhyung Lee

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Los Angeles, CA, USA

RESEARCH INTERESTS

- AI/GenAI Solutions for Wireless Communication Systems
- On-Device AI/LLM Communication

EXPERIENCE

- **University of Southern California** Los Angeles, CA, USA
Postdoctoral Researcher, Wireless Devices and Systems Group (Head: [Prof. Andreas Molisch](#)) Apr. 2022 - Present
 - **On-Device AI/LLM Communication** [\[Github\]](#)
 - Fine-tuned a pre-trained LLM (BART) as a neural lossy source coder in end-to-end Link-Level Simulation (LLS), integrating with 5G-NR PHY layer functions [\[1, 2\]](#)
 - Developed a compression & quantization method for AI-to-AI comm.; Tested in NVIDIA Sionna with 5G-NR setup
 - **Computer Vision-based Site-Specific Channel Modeling for RAN Optimization** [\[Github\]](#)
 - Developed an fast (~ 1 [msec]) and accurate (RMSE ~ -14 [dB]) Digital Twin Network simulation [\[3, 4\]](#)
 - Designed Radio Access Network (*e.g.*, O-RAN) optimization methods for *i*) Localization & Sensing [\[5\]](#), *ii*) Beamforming, and *iii*) Automatic AP (*e.g.*, O-RU, WiFi) deployment
 - Tested/Compared with UMi (3GPP TR-38.901) and site-specific RT (WirelessInsite, NVIDIA-Sionna) channels
- **Samsung Research America** Dallas, USA
AI/Wireless Senior Research Engineer Dec. 2023 - Jan. 2024 (Seasonal)
 - **Generative Model for Channel Feedback Compression in NR-mMIMO System** [\[Github\]](#)
 - Developed a low-complexity generative model-based channel prediction for massive MIMO systems
 - Designed a channel feedback (*e.g.*, DMRS, SRS) compression scheme (3GPP TR-38.843)
- **Korea University** Seoul, Korea
Research Professor, Research Institute for Information & Communication Sep. 2021 - Feb. 2023
 - **Reinforcement Learning-based PHY/MAC Protocol Design for LEO Satellite Networks**
 - Designed 3GPP-compatible mobility management protocols, *e.g.*, handover [\[6\]](#) & RACH initial access [\[7, 8\]](#)
 - Tested the designed PHY/MAC access protocols in end-to-end System-Level Simulation (3GPP TR-38.821)

SKILLS

- **Programming:** Python, C/C++, CUDA C++, MATLAB, Verilog, PyTorch, Tensorflow
- **ML Methodologies:** LLM (BART, LLaMA3, QLoRA), Generative (Diffusion, GAN, VAE), Computer Vision (ViT, DeepLabV3+, CNN), Time Series (Transformer, RNN), Reinforcement Learn. (PPO, A3C, DQN)
- **Tool & Library:** Link-Level & System-Level Simul. (MATLAB-5G, NVIDIA-Sionna), Modeling (Simulink, Quartus2), GIS (OpenStreetMap), Ray-Tracing (WirelessInSite, SionnaRT)
- **HW:** USRP, FPGA (Altera)

EDUCATION

- **Korea University** Seoul, Korea
Ph.D. in Electrical and Computer Eng. (Awarded by Research Excellence) Mar. 2016 – Aug. 2021
 - **Radio Access Network Optimization:** Developed DRL-based radio resource scheduling [\[9, 10, 11\]](#), initial access [\[7\]](#), handover [\[6\]](#), and beam management [\[12\]](#) for high-mobility networks
 - **[Demo] Radio-over-FSO (RoFSO):** Developed a RoFSO system integrating 802.11 RF USRP and laser-based optical transceivers; Demonstrated ~ 20 [Gbps] transmission over with ~ 100 [m] outdoor [\[13, 14\]](#)
- **Korea University** Seoul, Korea
B. Eng. in Electrical and Electronic Eng. (Awarded by National Sci. & Tech. Scholarship) Mar. 2011 – Feb. 2016

PROJECTS

- **A Scalable and Generalizable Large-Scale Channel Prediction** [\[Github\]](#)
 - Built a channel measurement dataset using ray-tracing simulations (**WirelessInsite**, **Sionna-RT**) on real maps (*e.g.*, USC, UCLA, and Boston area)
 - Implemented a supervised-learning framework, using Computer Vision techniques, to predict radio maps in mmWave/THz Communications [3, 15]
 - **1st-rank** in ML competition (*IEEE ICASSP Radio-Map Prediction Challenge* [4]), achieving the highest accuracy (RMSE ~ -14 [dB])
 - Developed a transfer learning-based few-shot learning method to adapt models to new, unseen network scenarios/environments
 - Achieved ~ 31 [dB] RMSE gain compared to 3GPP-UMi channel model
- **LLM-based Context-Aware Handover (Mobility Management)**
 - Developed a context-aware handover method for WiFi and cellular networks with LLM (*e.g.*, **LLaMA3**); Fine-tuned with historical data on signal strength, user speed, and location.
 - Engineered prompts for LLM-based handover decisions and evaluated **LLaMA3** predictions against legacy handover methods, achieving 85 % prediction accuracy using Zero-Shot Learning (without any training).
- **Generative Model for Channel Feedback Compression** [\[Github\]](#)
 - Designed a novel low complexity Generative Model (*e.g.*, Diffusion, VQ-VAE)-based channel feedback compression
 - Demonstrated high channel feedback compression efficiency ($\sim \frac{1}{8}$), retaining up to NMSE ~ -15 [dB]

HONORS AND AWARDS

- 1st-Rank, *IEEE ICASSP Signal Processing Grand Challenges*, Jun. 2023 [4]
- Best Paper Award, *IEEE ICTC*, Oct. 2022 [16]
- Best Paper Award, *IEEE ICTC*, Oct. 2021 [17]
- 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*, D.-H. Lee, J. Lee, and J. Pujara, "Integrating pre-trained language model with physical layer communications," *arXiv preprint arXiv:2402.11656*, 2024. [\[paper\]](#) [\[code\]](#).
- [2] 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*, pp. 1–4, 2023. [\[paper\]](#) [\[code\]](#).
- [3] J.-H. Lee* and A. F. Molisch, "A scalable and generalizable pathloss map prediction," *arXiv preprint arXiv:2312.03950*, 2024. [\[paper\]](#) [\[code\]](#).
- [4] 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)*, Jun. 2023. **[1st-Rank in ML Competition]** [\[code\]](#).
- [5] O. G. Serbetci, J.-H. Lee*, D. Burghal, and A. F. Molisch, "Simple and effective augmentation methods for CSI based indoor localization," in *Proc. IEEE Global Commun. Conf. (GLOBECOM)*, pp. 1–6, 2023.
- [6] 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.*, 2024. [\[paper\]](#).
- [7] 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.*, vol. 22, no. 1, pp. 257–269, 2023. [\[paper\]](#).
- [8] J.-H. Lee*, H. Seo, J. Park, M. Bennis, Y.-C. Ko, and J. Kim, "Random access protocol learning in LEO satellite networks via reinforcement learning," in *Proc. IEEE Vehicular Technology Conf. (VTC)*, pp. 1–5, 2022. **[Invited Paper]**.
- [9] J.-H. Lee*, J. Park, M. Bennis, and Y.-C. Ko, "Integrating LEO satellites and multi-UAV reinforcement learning for hybrid FSO/RF non-terrestrial networks," *IEEE Trans. Veh. Technol.*, pp. 1–16, 2022.
- [10] J.-H. Lee*, J. Park, M. Bennis, and Y.-C. Ko, "Integrating LEO satellite and UAV relaying via reinforcement learning for non-terrestrial networks," in *Proc. IEEE Global Commun. Conf. (GLOBECOM)*, (Taipei, Taiwan), pp. 1–6, 2020. **[Travel Grant]**.
- [11] J.-H. Lee*, K.-H. Park, Y.-C. Ko, and M.-S. Alouini, "Spectral-efficient network design for high-altitude platform station networks with mixed rf/fso system," *IEEE Trans. Wireless Commun.*, vol. 21, no. 9, pp. 7072–7087, 2022.
- [12] Y. Lee, J.-H. Lee*, and Y.-C. Ko, "Beamforming optimization for IRS-assisted mmWave V2I communication systems via reinforcement learning," *IEEE Access*, Jun. 2022.
- [13] 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. **[Demo]**.
- [14] 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. **Demo**.
- [15] J.-H. Lee*, A. F. Molisch, and et al., "PMNet: Robust pathloss map prediction via supervised learning," in *Proc. IEEE Global Commun. Conf. (GLOBECOM)*, pp. 1–6, 2023.
- [16] 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.*, Oct. 2022. **[Best Paper Award]**.
- [17] 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.*, Oct. 2021. **[Best Paper Award]**.