Hyungsuk Lee

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Research Interests

Quantum computing: quantum machine learning; quantum error correction and decoding (qLDPC and surface codes).

Education

2022–2028 **B.S.**, Computer Science and Engineering, Dongguk University, Seoul. Expected Feb. 2028. Mandatory military service in the Republic of Korea Army, Jan. 2024–Jul. 2025; discharged as Sergeant on completion of service.

Research Experience

2026– **Quantum computing**, independent research
Computing resources and feedback from the CSDC Lab, Dongguk University.

- *Quantum machine learning.* Studied how allocating attack records across types affects a QCNN intrusion detector on NSL-KDD, CICIDS2017, and TON_IoT, over five ansätze and 50–5,000 training records. Type-balanced sampling raised type-averaged AUC but lowered recall at a 1% false-positive rate on NSL-KDD and CICIDS2017; the loss came from moving records away from frequent attack types [U1].
  Code: github.com/ansis03/qcnn-intrusion-detection-benchmark
- *Quantum error correction.* Simulated real-time sliding-window decoding for gauging measurements on bivariate bicycle (qLDPC) codes under circuit-level noise, with Relay-BP and Tesseract decoders. Manuscript in preparation.
- *Neural decoders.* Studied how three training-data choices (which shots to sample, how many, and which targets they carry) affect a 3D-CNN surface-code decoder at distances 3, 5, and 7 under circuit-level noise. Manuscript in preparation.

2025– **Context-aware anomaly detection**, undergraduate research assistant
CSDC Lab, Dongguk University. Advisor: Prof. Junho Jeong.
Code: github.com/ansis03/context-aware-anomaly-detection

- Built a pipeline that turns data from six low-density ambient sensors (door, PIR, radar, respiration, heart rate, and illuminance) into the daily routines of single-person households, with per-person thresholds that tell apart states that look alike in raw data, such as long absence vs. long sleep [C1].
- Detected anomalous days with K-Means dynamic thresholds and Isolation Forest [C2], and extended this to a per-context Isolation Forest that scores each day against the person's own routine, evaluated on real-world data from 20 households [J1].
- The system, including a retraining pipeline based on the contrastive augmentation of CTAD (Contrastive Time-series Anomaly Detection), was registered as a computer program with the Korea Copyright Commission (Reg. No. C-2026-049828, Oct. 2026; developed with J. Jeong and I. Wang; copyright held by Dongguk University Industry-Academic Cooperation Foundation).

Publications

Under Review

U1. **H. Lee**, I. Wang, J. Jeong. "How Sampling Affects QCNN Intrusion Detection." Submitted to ICAIIC 2027.

Journal Articles

J1. **H. Lee**, Haneum Lee, I. Wang, J. Jeong. "Smart Home Anomaly Detection using K-Means Dynamic Threshold and Isolation Forest based on Multi-Sensor Data." *Journal of Korean Institute of Intelligent Systems*, 36(5):411–419, Oct. 2026. In Korean; extended version of C2. doi:10.5391/JKIIS.2026.36.5.411

Conference Papers

C1. **H. Lee**, I. Wang, J. Jeong. "Daily Life Pattern Extraction in Single Person Households." In *Proc. 2026 18th International Conference on Knowledge and Smart Technology (KST)*, Pattaya, Thailand, pp. 350–355, IEEE, Jan. 2026. doi:10.1109/KST67832.2026.11431865

C2. **H. Lee**[*], Y. Kim[*], I. Wang, J. Jeong. "Smart Home Anomaly Detection using K-Means Dynamic Threshold and Isolation Forest based on Multi-Sensor Data." In *Proc. KIIS Autumn Conference 2025*, 35(2):286–287, Nov. 2025. In Korean. [*]Equal contribution.

Honors & Awards

2025 Outstanding Paper Award, KIIS Autumn Conference, for C2

2023 Silver Prize, Kookmin University Intellectual Property Camp

2023 Excellence Award, Robot Autonomous Driving Technology Project, Dongguk University, for a team project on LiDAR-based SLAM mapping and autonomous driving

Projects

2026 **WIT (Webtoon Illustrious Tool)**, team lead, AI and backend
Open Source Software Project (CSC4004), Dongguk University, spring 2026.
Code: github.com/ansis03/wit

- Led a four-person team that built a web app for generating and editing AI-assisted webtoon panels with consistent characters and layout.
- Owned the AI pipeline: style and per-character LoRA fine-tuning, an LLM step that turns a scenario into per-shot generation settings, and BiRefNet background removal that outputs characters as separate layers.

Technical Skills

Quantum	Stim, PennyLane
ML / Data	PyTorch, scikit-learn, NumPy, SciPy, pandas
Languages	Python, Java
Other	Spring Boot, MySQL, Git, LaTeX