

# Insup Lee

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## Summary

I am an AI & Security Researcher based in Abu Dhabi, UAE, working on generative models for cybersecurity and drones. Previously, I spent five years as a researcher at the Agency for Defense Development (ADD), conducting research in AI-driven cybersecurity. I am also a Ph.D. candidate in Cybersecurity at Korea University, where I earned my B.E. in Cyber Defense. My research interests lie at the **intersection of AI and cybersecurity**, focusing on generative models, AI-driven security, adversarial machine learning, and secure communications.

## Research Interests

- **AI + Security:** AI for cybersecurity, adversarial ML, NLP for threat intelligence, LLM for vulnerability detection
- **Generative Models:** diffusion models with transformers, GANs, robustness via data augmentation
- **Network and Wireless Security:** drones, robust communications, anomaly detection, network IDS, etc.

## Education

**Ph.D. Candidate in Cybersecurity**, Korea University – Seoul, Republic of Korea Sep 2019 – Present

- Completed all required coursework and passed Ph.D. qualifying examination
- Researched generative models to enhance robustness in communication systems

**B.E. in Cyber Defense**, Korea University – Seoul, Republic of Korea Mar 2014 – Feb 2018

- Studied computer science, cybersecurity, cryptography, and secure coding

## Employment History

**Research Intern**, Indiana University – Bloomington, Indiana, USA Mar 2025 – Jun 2025

- Researched quantification methods for ML security in autonomous vehicle systems

**Security Engineer**, Ministry of National Defense – Republic of Korea Aug 2023 – May 2025

- Collaborated with international colleagues and led AI-based security projects in the UAE
- Executed cyber defense operations and developed automation tools at the Cyber Operations Command

**Researcher**, [Agency for Defense Development \(ADD\)](#) – Seoul, Republic of Korea Jul 2018 – Jul 2023

- ADD is a South Korean government agency dedicated to defense R&D, including cybersecurity and AI
- Carried out three AI-driven cybersecurity projects, conducting research and in-house software development
  - (1) "Detection of Nation-Sponsored Cyber Attacks Using NLP Technologies" (Apr 2021 – Jul 2023)
  - (2) "Generative Models for Cybersecurity Data Augmentation" (Jun 2019 – Oct 2020)
  - (3) "IPADS: Integrated Proactive and Adaptive Defense Systems" (Aug 2018 – May 2019)
- Published six international papers [C1, C2, J2, J3, J4, J6], four patents, and 12 domestic papers

## Technical Skills

- Frameworks/Tools: PyTorch, Keras, TensorFlow, scikit-learn, pandas, Git, Streamlit
- Programming Languages: Python, C, JavaScript, SQL
- Languages: English, Korean

## Research Projects

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### **Large Language Models for Enterprise-Scale Cyber Threat Intelligence** Mar 2025 - Present

- Keywords: CTI, LLMs, semantic embeddings, data extraction, MITRE ATT&CK TTPs
- Frameworks/Tools: PyTorch
- Publications: one paper is under review

### **Diffusion Models for Enhanced Drone Communications** Mar 2024 - Present

- Keywords: drone communications, UAV video signal processing, diffusion models, vision transformers
- Frameworks/Tools: PyTorch, GNU Radio, SigDigger, SDRangel
- Publications: two papers are under review

### **Detection of State-Sponsored Cyber Attacks via NLP Techniques** Apr 2021 - Jul 2023

- Keywords: cyber threat intelligence, NLP, data augmentation, embedding, SOAR, MITRE ATT&CK
- Frameworks/Tools: PyTorch, scikit-learn, FastAPI, Git, PostgreSQL
- Publications: [J2], [J3], [J4], [J6]

### **Generative Adversarial Networks for Robust Modulation Classification** May 2020 - Dec 2022

- Keywords: wireless communications, GANs, adversarial attacks, I/Q data augmentation, adversarial robustness
- Frameworks/Tools: PyTorch, IBM ART
- Publications: [J1], [J5]

### **Generative Models for Cybersecurity Data Augmentation** Jun 2019 - Oct 2020

- Keywords: host IDS, sequence data, CycleGAN, SeqGAN, Seq2Seq, ADFA-LD
- Frameworks/Tools: TensorFlow, Node.js, Git
- Publications: [C1], [C2]

### **Network Intrusion Detection Systems Using Incremental Learning** Sep 2019 - Apr 2020

- Keywords: network IDS, machine learning, encrypted traffic classification, incremental learning
- Frameworks/Tools: scikit-learn
- Publications: [C3]

### **IPADS: Integrated Proactive and Adaptive Defense Systems** Aug 2018 - May 2019

- Keywords: anomaly detection, network IDS, in-vehicle network, MilCAN, CIC-IDS2017
- Frameworks/Tools: scikit-learn

## Other Experience

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### **AI Cyber Challenge (AixCC)**, DARPA and ARPA-H, USA Apr 2024 – Aug 2024

- Participated in the semifinal round as a member of Team KORIA, submitting our cyber reasoning system that leverages LLMs for automated detection and patching of software vulnerabilities

### **SW Outsourcing Development**, KCMVP-Certified Cryptographic Module Jun 2017 – May 2018

- Implemented a cryptographic module with 25,000 LoC in C while following secure coding conventions
- Covered the ARIA block cipher (modes: ECB, CBC, CTR), hash functions (SHA-256, SHA-512), and HMAC-based DRBG for Windows (.dll) and Linux (.so), respectively

## Awards and Honors

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- Ambassador's Commendation for excellence in defense cooperation, Embassy of the Republic of Korea to the United Arab Emirates Mar 2025

- The 3rd Prize, Military Cybersecurity Experts Hackathon, Ministry of Science and ICT, Republic of Korea Dec 2023
- Full Tuition Scholarship, Ministry of National Defense, Republic of Korea Mar 2014 – Feb 2018

## Publications

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### Under Review

- [Multi-Step LLM Pipeline for Enhancing TTP Extraction in Cyber Threat Intelligence](#)  
Hyoungrok Kim, Donghyeon Lee, [Insup Lee](#), Soohan Lee, and Sangjin Lee
- [Enhancing Modulation Classification via Diffusion Transformers for Drone Video Signal Processing](#)  
[Insup Lee](#), Khalifa Alteneiji, and Mohammed Alghfeli

### Journal Articles

- J6 [MuCamp: Generating Cyber Campaign Variants via TTP Synonym Replacement for Group Attribution](#)  
[Insup Lee](#) and Changhee Choi  
*IEEE Transactions on Information and Forensics Security (TIFS)*, 2025  
(SCI 2024 I/F Top 7.8% in Computer Science, Theory & Methods)
- J5 [UniQGAN: Towards Improved Modulation Classification With Adversarial Robustness Using Scalable Generator Design](#)  
[Insup Lee](#) and Wonjun Lee  
*IEEE Transactions on Dependable and Secure Computing (TDSC)*, 2024  
(SCI 2023 I/F Top 4.9% in Computer Science, Software Engineering)
- J4 [Camp2Vec: Embedding Cyber Campaign With ATT&CK Framework for Attack Group Analysis](#)  
[Insup Lee](#) and Changhee Choi  
*ICT Express*, 2023  
(SCI 2023 I/F Top 23.0% in Computer Science, Information Systems)
- J3 [Exploiting TTP Co-occurrence via GloVe-Based Embedding With ATT&CK Framework](#)  
Chanho Shin, [Insup Lee](#), and Changhee Choi  
*IEEE Access*, 2023  
(SCI 2023 I/F Top 34.4% in Engineering, Electrical & Electronic)
- J2 [BAN: Predicting APT Attack Based on Bayesian Network With MITRE ATT&CK Framework](#)  
Youngjun Kim, [Insup Lee](#), Hyuk Kwon, Gyeongsik Lee, and Jiwon Yoon  
*IEEE Access*, 2023  
(SCI 2023 I/F Top 34.4% in Engineering, Electrical & Electronic)
- J1 [UniQGAN: Unified Generative Adversarial Networks for Augmented Modulation Classification](#)  
[Insup Lee](#) and Wonjun Lee  
*IEEE Communications Letters*, 2022  
(SCI 2023 I/F Top 33.2% in Telecommunications)

### Conference Proceedings

- C3 [Encrypted Malware Traffic Detection Using Incremental Learning](#)  
[Insup Lee](#), Heejun Roh, and Wonjun Lee  
*IEEE International Conference on Computer Communications (INFOCOM) - Poster Session*, 2020
- C2 [Anomaly Dataset Augmentation Using Sequence Generative Models](#)  
Sunguk Shin, [Insup Lee](#), and Changhee Choi  
*IEEE International Conference on Machine Learning and Applications (ICMLA)*, 2019
- C1 [Opcode Sequence Amplifier Using Sequence Generative Adversarial Networks](#)  
Changhee Choi, Sunguk Shin, and [Insup Lee](#)  
*International Conference on ICT Convergence (ICTC)*, 2019

### Patents

- Changhee Choi and [Insup Lee](#), "Method for Augmentating Cyber Attack Campaign Data to Identify Attack Group, and Security," Korea Patent Application Number. 10-2024-0176082, December 2, 2024.

- Changhee Choi, Insup Lee, Chanho Shin, and Sungho Lee, "Information Identification Method and Electronic Apparatus Thereof," Korea Patent Application Number. 10-2024-0006106, January 15, 2024.
- Changhee Choi, Chanho Shin, Sunguk Shin, Seongyeon Seo, and Insup Lee, "Method for Training Attack Prediction Model and Device Therefor," U.S. Patent Application Number. 18/126,005; U.S. Patent Number. US20230308462A1, September 28, 2023.
- Changhee Choi, Sunguk Shin, and Insup Lee, "Appratus, Method, Computer-readable Storage Medium and Computer Program for Generating Operation Code," Korea Patent Application Number. 10-2019-0141865, November 07, 2019; Korea Patent Number. 10-2246797, April 30, 2021.

### Domestic Journals and Conferences (Korean)

- Kangmun Kim and Insup Lee, "User Behavior Embedding via TF-IDF-BVC for Web Shell Detection," *Journal of The Korea Institute of Information Security & Cryptology (JKIISC)*, Vol. 34, No. 6, pp. 1231-1238, Dec. 2024.
- Insup Lee, Chanho Shin, and Changhee Choi, "Mutating Cyber Camapaign With TTP Word Replacement," in *Proc. of the KIMST Annual Conference*, Jun. 2023.
- Chanho Shin, Insup Lee, and Changhee Choi, "Towards GloVe-Based TTP Embedding With ATT&CK Framework," in *Proc. of the KIMST Annual Conference*, Jun. 2023.
- Changhee Choi, Insup Lee, Chanho Shin, and Sungho Lee, "Cyber Threat Campaign Analysis Based on PEGASUS and RoBERTa Model," in *Proc. of the KIMST Annual Conference*, Jun. 2023.
- Insup Lee, Chanho Shin, Sunguk Shin, Seongyeon Seo, and Changhee Choi, "Analyzing Cyberattack Campaign Similarity via TTP Sequence Embedding," in *Proc. of the KIMST Annual Conference*, Jun. 2022.
- Sunguk Shin, Insup Lee, Chanho Shin, Seongyeon Seo, and Changhee Choi, "Cyber Campaign Analysis With TTP Embedding Using TF-IDF," in *Proc. of the KIMST Annual Conference*, Jun. 2022.
- Chanho Shin, Sunguk Shin, Insup Lee, Seongyeon Seo, and Changhee Choi, "Classifying TTP Based on CIA Labeling," in *Proc. of the KIMST Annual Conference*, Jun. 2022.
- Changhee Choi, Chanho Shin, Sunguk Shin, Seongyeon Seo, and Insup Lee, "Cyber Attack Group Classification Using Siamese LSTM," in *Proc. of the KIMST Annual Conference*, Jun. 2022.
- Chanho Shin, Sunguk Shin, Seongyeon Seo, Insup Lee, and Changhee Choi, "Embedding and Training RNN to Estimating the Goal of Cyber Attack," in *Proc. of the KIMST Fall Conference*, Nov. 2021.
- Sunguk Shin, Chanho Shin, Seongyeon Seo, Insup Lee, and Changhee Choi, "The Proposed Approach for Country Prediction With TTP-based Cyber Data Using GCN," in *Proc. of the KIMST Fall Conference*, Nov. 2021.
- Changhee Choi, Chanho Shin, Sunguk Shin, Seongyeon Seo, and Insup Lee, "Deep Learning for Estimating Next Action of Cyber Attack," in *Proc. of the KIMST Fall Conference*, Nov. 2021.
- Yongbin Park, Sunguk Shin, and Insup Lee, "A Study on Evaluation Method of NIDS Datasets in Closed Military Network," *Journal of Internet Computing and Services (JICS)*, Vol. 21, No. 2, pp. 121-130, Apr. 2020.
- Insup Lee, Jinguok Kim, and Jeongchan Park, "Analysis of Weight Setting in Incremental Learning to Improve Real-Time Intrusion Detection," in *Proc. of the KIMST Annual Conference*, Jun. 2019.

### Mentoring Experience

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| • <b>Hyunjun Park</b> (Navy Lieutenant at Ministry of National Defense)<br>DDoS detection via transfer learning (paper submitted to JICS)                           | Nov 2024 – Feb 2025 |
| • <b>Kangmun Kim</b> (First Lieutenant at Cyber Operations Command)<br>Web shell detection via user behavior embedding ( <a href="#">paper</a> published at JKIISC) | Jan 2024 – Sep 2024 |

### Professional Service

#### Reviewer

- IEEE Transactions on Dependable and Secure Computing (TDSC), 2025
- IEEE International Conference on Computer Communications (INFOCOM), 2023-2024
- IEEE Communications Letters, 2022
- ICT Express, 2025