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Insup Lee

AI & Security Researcher at Abu Dhabi, UAE

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Summary

I am a cyber officer of ROK Army, currently working in **Abu Dhabi**, UAE. Previously, I spent five years as a researcher at Agency for Defense Development (ADD), where I collaborated on research with Dr. Changhee Choi. My primary research interest lies at the **intersection of AI and cybersecurity**, especially addressing diverse issues with generative models. I am scheduled to be discharged from military service in May 2025.

Research Interests

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

Employment

Cyber Officer, Ministry of National Defense – Republic of Korea — Aug 2023 – present

- Collaborated with international team members while working in the UAE
- Developed programs for network defense operations at the Cyber Operations Command

Researcher, Agency for Defense Development – Seoul, Republic of Korea — Jul 2018 – Jul 2023

- Actively contributed to three research projects centered on AI-driven cybersecurity
  (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 five international papers [C1, C2, J2, J3, J4], four patents, and 12 domestic papers

Education

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

- Completed all required coursework for the doctoral program (overall GPA: 4.33/4.50)

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

- Studied computer science, cybersecurity, cryptography, and AI

Research Projects

Diffusion Models for UAVs — Mar 2024 - Present

- Keywords: diffusion models, vision transformers, drone communications, adversarial robustness
- Frameworks/Tools: PyTorch, GNU Radio
- Publications: two papers are under review

Detection of Nation-Sponsored Cyber Attacks Using NLP Technologies — 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] & one paper is under review

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

Awards and Honors

- 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

Other Experience

AI Cyber Challenge (AIxCC), DARPA and ARPA-H, USA — Apr 2024 – Aug 2024

- Submitted our cyber reasoning system (CRS) to achieve automated program repair (APR), leveraging LLMs for automatic detection and patching of software vulnerabilities
- Participated in the AIxCC semifinal round as a member of Team KORIA

SW Outsourcing Development, KCMVP-Certified Cryptographic Module — Jun 2017 – Mar 2018

- ARIA block cipher (mode: ECB/CBC/CTR), Hash (SHA256/SHA512) and HMAC-based DRBG for Windows (.dll) and Linux (.so), implemented by 25,000 LoC with C
- Tested by national security research institute (NSR) and certified by national intelligence service (NIS)

Technical Skills

- Frameworks/Tools: PyTorch, Keras, TensorFlow, scikit-learn, pandas, Git, Metasploit
- Programming Languages: Python, C/C++, JavaScript, SQL, HTML, CSS, PHP

Publications

Under Review

- (Blind review)
  Insup Lee
  submitted to *ACM Conference on Computer and Communications Security* (**CCS**), 2025
- MuCamp: Generating Cyber Campaign Variants via TTP Synonym Replacement for Group Attribution
  Insup Lee and Changhee Choi
  revised to *IEEE Transactions on Information Forensics and Security* (**TIFS**)

Journal Articles

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 5.30% in CS, Software Engineering Category)

J4 Camp2Vec: Embedding Cyber Campaign With ATT&CK Framework for Attack Group Analysis
Insup Lee and Changhee Choi
ICT Express, 2023

J3 Exploiting TTP Co-occurence via GloVe-Based Embedding With ATT&CK Framework
Chanho Shin, Insup Lee, and Changhee Choi
IEEE Access, 2023

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

J1 UniQGAN: Unified Generative Adversarial Networks for Augmented Modulation Classification
Insup Lee and Wonjun Lee
IEEE Communications Letters, 2022

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, Jingook 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

- **Hyunjun Park** (Navy Lieutenant at Ministry of National Defense) Nov 2024 – Feb 2025
  DDoS detection via transfer learning
- **Kangmun Kim** (First Lieutenant at Cyber Operations Command) Feb 2024 – Sep 2024
  Web shell detection via user behavior embedding (paper published at JKIISC)