

# Seungwan Seo

Ph.D., in Industrial Engineering

## Contact Information

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### Robot Learning Research Scientist

CarbonSix  
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## Experience

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### Robot Learning Research Scientist

April 2026 -- Present

CarbonSix

- Develop VLA/foundation models for SigmaKit, from training to deployment
- Build, curate, and augment robot datasets
- Improve sim-to-real transfer for robust real-world robot performance

### Lead Vision Algorithm Engineer

May 2024 -- April 2026

GENGENAI

- Led the research and development of large-scale synthetic image generation pipelines for training and evaluating vision models
- Designed data generation frameworks for non-optical sensors (e.g., SAR and infrared), addressing extreme data scarcity scenarios
- Managed the end-to-end technical execution of client-driven synthetic data projects, from problem formulation to pipeline development

### Senior Researcher

February 2023 -- May 2024

AI Vision Cell, Hana Institute of Technology

- Conducted applied research on document understanding and OCR-based classification under real-world noisy conditions
- Developed generative models for virtual human synthesis, including facial expression and lip-motion generation from limited data
- Delivered a real-time virtual human prototype and demonstrated its feasibility at Korea Fintech Week 2023

## Education

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### Korea University

Ph.D. in Industrial Management

Seoul

2017 - 2023

### Seoul Tech

Bachelor of Science in Information Technology and Management

Seoul

2011 - 2017

## Selected Projects (Industry)

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@ CARBONSIX

2026.04 – CURRENT

### Off-Trajectory Action Recovery

2025.04 -- Present

CarbonSix, Research

- Built an on-the-fly warping and hole-filling pipeline for robot novel-view synthesis
- Achieved a 12 p.p. gain in off-trajectory action recovery with no performance drop under nominal conditions

@ GENGENAI

2024.05 – 2026.04

### **High-altitude Narrow-FOV Synthetic Image Generation**

2025.05 -- 2026.04

Korea Aerospace Industries (Client)

- Generated synthetic imagery simulating observations from altitudes up to 9,000 m (30,000 ft) under extremely narrow field-of-view constraints
- Generated full scenes containing TEL and SAM assets using conditional T2I models, with precise control over viewing geometry and object scale
- Enabled configurable camera tilt (pitch) angles ranging from 15° to 90° to support diverse observation scenarios
- Modeled diverse environmental conditions (e.g., snow, rain, fog) to support data generation across varied weather scenarios

### **Drone-view Synthetic Data Generation via Conditional T2I Models**

2025.01 -- 2025.05

Korea Aerospace Industries (Client)

- Generated drone-view image datasets using conditional text-to-image models, leveraging open datasets such as VisDrone
- Synthesized drone-view scenes with precise spatial control over the placement and type of TEL assets
- Achieved a 7 p.p. improvement in object detection performance (mAP@50) on real drone-captured test images when training exclusively on synthetic data, compared to models trained on open datasets
- Reduced generation latency by replacing inpainting-based pipelines with condition-controlled T2I generation
- Trained detection models capable of identifying TEL decoys with up to 90% detection accuracy (mAP@50)

### **Satellite-view Synthetic Image Generation for TEL Detection**

2024.10 -- 2024.12

Korea Aerospace Industries (Client)

- Generated nadir-view (top-down) satellite imagery with controllable placement of specific TEL variants
- Designed scene-consistent synthetic data pipelines to replicate realistic satellite observation conditions
- Produced fully labeled datasets optimized for object detection under limited availability of real satellite imagery

### **Core Research on Synthetic Data Generation for Autonomous Driving**

2024.05 - 2024.10

GENGENAI, Foundational Research

- Developed scene-aware inpainting techniques to insert vehicles, cyclists, and pedestrians at controllable locations within autonomous driving scenes
- Mitigated severe class imbalance in object detection datasets by selectively synthesizing under-represented object categories
- Validated the effectiveness of the synthetic data through a 16% improvement in object detection performance (mAP@50) compared to training on real-world datasets alone

@HANA INSTITUTE OF TECHNOLOGY

2023.02 – 2024.05

### **Virtual Human Generation from Limited Visual Data**

2023.04 - 2024.05

Hana Institute of Technology, Foundational Research

- Developed generative pipelines for virtual human synthesis using diffusion and StyleGAN-based models
- Generated identity-consistent virtual humans from limited visual inputs, including single-image scenarios
- Implemented facial attribute manipulation and lip motion generation conditioned on user-provided scripts
- Built an end-to-end system for producing talking-head videos, enabling scalable content generation for VTM applications

### **OCR-based Document Classification for Financial Applications**

2023.02 - 2023.05

Hana Bank

- Designed an OCR-based document understanding system for foreign exchange and financial documents
- Addressed classification challenges arising from handwritten text, noisy scans, and heterogeneous document layouts
- Classified document types into fine-grained categories and extracted key phrases to support downstream financial processing

## Selected Projects (Doctoral Research)

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- Synthetic Data Generation for Unseen Ocean Environments** 2019.09 - 2020.05  
Daewoo Shipbuilding & Marine Engineering
- Generated synthetic ocean imagery using GANs to improve classification performance on unseen data
- Ocean Wave Property Prediction from Imagery** 2020.12 - 2021.10  
Daewoo Shipbuilding & Marine Engineering
- Developed deep learning-based models to predict wave height, direction, and period from ocean wave images
- DeepFake Video Detection** 2019.03 - 2021.02  
National Research Foundation of Korea
- Developed DeepFake detection models using classification and anomaly detection techniques
- Sentence Similarity Estimation via Image Association** 2018.06 - 2019.02  
NCSoft
- Designed multimodal models to estimate sentence similarity through image-based associative representations
- System Anomaly Detection Using Deep Learning** 2018.03 - 2019.03  
Agency for Defense Development
- Detected abnormal system states using RNN-based autoencoder models

## Publications

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- Exploring the Differences in Adversarial Robustness Between ViT- and CNN-Based Models Using Novel Metrics** 2023.10  
Seungwan Seo, Jaehyuk Heo, Pilsung Kang\*  
Computer Vision and Image Understanding, IF: 4.886, Q1 Journal  
[Original paper link](#)
- Evaluating and improving adversarial robustness of CNNs on image classification** 2023.02  
Seungwan Seo  
Korea University  
[Original paper link](#)
- Cost-free Adversarial Defense: Distance-based optimization for model robustness without adversarial training** 2023.01  
Seungwan Seo, Yunseung Lee, Pilsung Kang\*  
Computer Vision and Image Understanding, IF: 4.886, Q1 Journal  
[Original paper link](#)
- Intrusion Detection based on Sequential Information preserving Log Embedding Methods and Anomaly Detection Algorithms** 2021.04  
Czangyeob Kim, Myeongjun Jang, Seungwan Seo, Kyeongchan Park, Pilsung Kang\*  
IEEE Access, IF: 4.34, Q1 Journal  
[Original paper link](#)
- Unusual customer response identification and visualization based on text mining and anomaly detection** 2020.04  
Seungwan Seo, Deokseong Seo, Myeongjun Jang, Jaeyun Jeong, Pilsung Kang\*  
Expert Systems with Applications, Volume 144, April 2020, 113111, IF: 9.60, Q1 Journal  
[Original paper link](#)
- Comparative Study of Deep Learning-Based Sentiment Classification** 2020.01  
Seungwan Seo, Czangyeob Kim, Haedong Kim, Kyoung Hyun Mo, Pilsung Kang\*  
IEEE Access, Volume 8, January 2020, Pages 6861 - 6875, IF: 4.34, Q1 Journal  
[Original paper link](#)

- Recurrent neural network-based semantic variational autoencoder for Sequence-to-sequence learning** 2019.07  
 Myeongjun Jang, **Seungwan Seo**, Pilsung Kang\*  
 Information Sciences, Volume 490, July 2019, Pages 59-73, IF: 6.795, Q1 Journal  
[Original paper link](#)
- Sentiment classification with word localization based on weakly supervised learning with a convolutional neural network** 2018.07  
 Gichang Lee, Jaeyun Jeong, **Seungwan Seo**, CzangYeob Kim, Pilsung Kang\*  
 Knowledge-Based Systems Volume 152, 15 July 2018, Pages 70-82, IF: 8.038, Q1 Journal  
[Original paper link](#)

## Conference

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- An Active Reference Reset Method Adapting Distribution Shift for Robust System Anomaly Detection** 2022.10  
**Seungwan Seo**, Heejeong Choi, Pilsung Kang\*  
 2022 13th International Conference on Information and Communication Technology Convergence (ICTC)  
[Original paper link](#)
- Cost-free Adversarial Defense: Distance-based optimization for model robustness without adversarial training** 2021.06  
 Korean Institute of Industrial Engineers (Spring), Jeju Cention Center, Jeju  
**Seungwan Seo**, Yunseng Lee, Pilsung Kang\*
- Intrusion detection based on sequential information preserving log embedding methods and anomaly detection algorithms** 2019.11  
 INFORMS Annual Meeting, Seattle, WA  
**Seungwan Seo**, Pilsung Kang\*
- Measuring Sentence Similarity based on Image Association and Siamese Network** 2019.11  
 Korean Institute of Industrial Engineers (Fall), Seoul National University, Seoul  
**Seungwan Seo**, Minsung Jeong, Heejeong Choi, Pilsung Kang\*
- Identifying and visualizing uncommon customer response on machine learning** 2018.11  
 INFORMS Annual Meeting, Phoenix, Arizona  
**Seungwan Seo**, Pilsung Kang\*
- Comparative Study of Deep Learning-Based Sentiment Classification** 2018.04  
 Korean Institute of Industrial Engineers (Spring), Hyundai Hotel, Gyeongju  
**Seungwan Seo**, Czangyeob Kim, Haedong Kim, Kyoungyun Mo, Pilsung Kang\*
- Unusual customer response identification and visualization based on text mining and anomaly detection** 2018.04  
 Korean Institute of Industrial Engineers (Spring), Hyundai Hotel, Gyeongju  
**Seungwan Seo**, Deokseong Seo, Myeongjun Jang, Jaeyun Jeong, Pilsung Kang\*
- Distance Decomposition for Variable Importance of Distance-based Novelty Detection** 2018.04  
 Korean Institute of Industrial Engineers (Spring), Hyundai Hotel, Gyeongju  
**Seungwan Seo**, Myeongjun Jang, Czangyeob Kim, Pilsung Kang\*

**Recurrent Neural Network-based Semantic Variational Autoencoder for Sequence to Sequence Learning** 2018.04  
Korean Institute of Industrial Engineers (Spring), Hyundai Hotel, Gyeongju  
Seungwan Seo, Myeongjun Jang, Pilsung Kang\*

**Sentiment classification with word localization based on weakly supervised learning with a convolutional neural network** 2017.11  
Korean Institute of Industrial Engineers (Fall), KAIST, Daejeon  
Seungwan Seo, Gichang Lee, Jaeyun Jeong, Czangyeob Kim, Pilsung Kang\*

## Teaching Experiences

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**Deep Learning Course** 2022.05  
LG Innotek  
Full-time Lecture

**Python Syntax Course** 2022.05  
LG Innotek  
Full-time Lecture

**Python for Deep Learning Course** Online course  
Fastcampus  
Full-time Lecture

**Python Syntax Course** 2021.07  
LG Innotek  
Full-time Lecture

**Python for Machine Learning and Deep Learning Course** 2020.11  
SK Hynix  
Full-time Lecture

**Python for Machine Learning and Deep Learning Course** 2020.03  
SK Hynix  
Full-time Lecture

**Machine Learning with Python** 2019.09  
Korea Credit Bureau  
Full-time Lecture

**Machine Learning with Python** 2019.08  
Korea Credit Bureau  
Full-time Lecture

**Python for Machine Learning and Deep Learning Course** 2019.07  
Samsung Electronics  
Full-time Lecture

**Python for Machine Learning and Deep Learning Course** 2019.07  
Samsung Electronics  
Full-time Lecture

**Python for Deep Learning for Text Domain** 2019.02  
SeoulTech  
Seminar

**Python for Machine Learning and Deep Learning Course** 2019.02  
Samsung Electronics  
Full-time Lecture

**Python Syntax Course** 2019.01  
Samsung Electronics  
Full-time Lecture