SANGYUP LEE

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EDUCATION

Georgia Institute of Technology — **Atlanta, Georgia**

Pursuing a Ph.D., Industrial and Systems Engineering — *Aug. 2024 – Present*

- *Full Corporate Sponsorship Recipient for PhD Program, SK hynix Inc.*
- Advisor: Professor Xiao Liu, Co-Advisor: Professor Shi Jianjun
- Current Research Area: 3D Stacking Optimization, Geometric Modeling for Chips on Wafer, Machine Learning, AI based Warpage Control Methods…

Yonsei University — **Seoul, Korea**

M.S., Industrial and Information Engineering (GPA: 4.28 / 4.5) — *Sep. 2016 – Aug. 2018*

- Advisor: Professor Bongju Jeong
- Thesis: "Expert Knowledge-based Order Quantity Decision Model using Reinforcement Learning"
- Teaching Assistant, "Operation Research" (Fall 2017)
- Brain Korea 21+ Scholarships (Spring-Fall 2017)

Ajou University — **Suwon, Korea**

B.S., Industrial Engineering (GPA: 3.82 / 4.5, Ranking: 7 / 50) — *Mar. 2008 – Aug. 2016*

- Internships: AWSI Inc. Seongnam, Korea (07/2014-08/2014), Kensington Vanguard Inc. New York, NY (10/2011-12/2011)
- Military Service: *Honorary Discharge as a Sergeant,* Republic of Korea Army (04/2009-02/2011)

PROFESSIONAL EXPERIENCE

SK hynix Inc. — **Icheon, Korea**

Metrology & Inspection Engineer, Wafer Level Packaging Technology Dept. — *Jul. 2018 – Jul. 2024*

- Research and apply data algorithms to improve image quality and data analysis in a semiconductor mass production system, especially within the HBM (High Bandwidth Memory) and 3DS (3D-Stack chip) manufacturing processes.
- Architect and distribute the first platform that uses ML (Machine Learning)-based image classification and object detection models in memory semiconductor fabrication fields.
- Develop and operate solutions and application recipes such as 2D-3D vision, SAT (Scanning Acoustic Tomography), wafer infrared inspections, x-ray composition analyzers, and film thickness meters.
- Fabricate and integrate the world's first high-speed chip-level warpage measurement technology to create an optimization model combining an individual chip's electrical characteristics and physical shapes.
- Optimize the machine preventive maintenance cycle, control the spare part inventory, oversee machine renovation budgets, promote cost reduction items, and develop/apply a real-time remaining life prediction model for key equipment components.

Data Science Committee Member, Package and Test Division — *Feb. 2022 – Jul. 2024*

- Construct a semiconductor process data analysis platform, design data flow, and improve built-in mass analysis algorithms.
- Provide consulting on data analysis and methods for AI, ML, and optimization-related projects.
- Create questions and review submissions of data analysis competitions; evaluate the outstanding AI/ML projects submitted.
- Invent and implement built-in solution algorithms to track the cause of product defects.

IT Business Committee Lead, Data Science Team, Package and Test Division — *Mar. 2020 – Jan. 2021*

- Reviewed ~300 URDs (User Requirement Documents) requested for 10+ Enterprise Resource Planning systems including the Manufacturing Execution System (MES), quality analysis, defect image inquiry, productivity management, and more.
- Determined, approved, and promoted the URD feasibility of all in-house IT solution developments for MES used in Korea and China-based production systems as the PKG-WLPKG processing IT consultative director.

PROJECT EXPERIENCE

Development of New MI Machines for Advanced 3D Package Technology — **Icheon, Korea**

World's First Mass Chip Warpage Measuring Instrument (ATI Inc.) — *Jun. 2023 – Jul. 2024*

Joint Development of High-speed Scanning Acoustic Tomography Machine (Fortive, Sonix Inc.) — *Jun. 2023 – Jul. 2024*

Joint Development of Data Processing Algorithm of 3D-Measurement Machine (ATI Inc.) — *Jun. 2021 – Dec. 2022*

World's First AI-based Void Detecting Scanning Acoustic Tomography Machine (Nordson TI Inc.) *Jun. 2019 – Dec. 2022*
Joint Development of High-speed Scanning Acoustic Tomography Machine (Kovis Technology Inc.) *Mar. 2024 – Jul. 2024*

Development of AI-based Defect Image Classification Service **Icheon, Korea**
HyVIS (SK hynix Intelligent Visual Inspection) Platform *Jun. 2022 – Jul. 2023*
P&T Machine Learning Technology Diffusion *Jun. 2022 – Mar. 2023*
IVIA (Intelligent Visual Inspection Analytics) Platform *Jun. 2020 – Dec. 2021*
AIV (Auto Image Verification) Platform *Jun. 2019 – Dec. 2020*
- News Link (Korean): https://www.edaily.co.kr/news/read?newsId=01111926635705024&mediaCodeNo=257 (Hyvis)

Development of Mass Data Auto-Mining System **Icheon, Korea**
METIS Platform Development *May 2023 – Jul. 2024*
- Develop a unified data analytics platform; integrate data-lake and develop anomaly detection and auto-mining algorithms.

Development of Abnormal Pattern Detecting System **Icheon, Korea**
SLDD (Sequential and Localized Defect Detection) System Development *May 2023 – Jul. 2024*
- Establish a system to detect repetitive defect patterns caused by anomalies in various processes and machines in SK hynix.

Development of TSV (Through-Silicon Via) 3D Package Products **Icheon, Korea**
Advanced Technology for Next Gen. HBM/3DS *Jun. 2021 – Jul. 2024*
World's First HBM3 Product (DRAM used in AI and graphic cards) *Jun. 2019 – Jun. 2022*
World's First HBM2E Product (DRAM used in graphic cards) *Jun. 2018 – Jun. 2020*
- Devise an MI solution using physics and data algorithms for new HBM products; design a mass-production process.
- Upgrade the MR-MUF (Mass Reflow-Mold Underfill) technology for higher production yield and HBM market dominance; develop an MI solution capable of screening chip center void, a side effect of MR-MUF, to be more production-ready.

Automated Semiconductor Manufacturing Facility Setup **Icheon, Korea**
Member, New Fab. (Factory) Setup for HBM Mass Production *Jun. 2021 – Jul. 2024*
- Install ~100 various semiconductor MI machines worth USD 000 million in total with a junior engineer.

AWARDS AND RECOGNITIONS

Supex Award, SK Group *Jun. 2024*
- The highest honor of SK group

SK hynix Grand Award, SK hynix *Jun. 2024*
- The highest honor of SK hynix
- Contribution to HBM manufacturing technology for achieving the No. 1 market share.

Full Corporate Sponsorship Recipient for PhD Program, SK hynix Inc. *2024-2028*

Grand Prize, Spartan Project Competition, SK hynix *Oct. 2024*
- Project Subtopic 1: Developed the new measurement techniques for two key quality variables of Stacked Chips (HBM).
- Project Subtopic 2: Yield difference causes analysis between factories producing the same product.
- Project Subtopic 3: Developed the automatic defect classification solution based on ML using On-the-Fly captured images.

ESG Prize, WLP Technology Division, SK hynix (awarded 3 times) *Nov. 2022 & Jun. 2023 & Nov. 2023*
- Developed and applied a water flow route and interlock system for automatic SAT machines to prevent safety incidents.

Excellence Award, AI DT Excellence Competition, SK hynix *Nov. 2022*
- Eliminated inspection and measurement in the HBM process based on statistical justification.
- Transitioned from 100% inspection to sampling inspection using virtual metrology.
- Replaced human tasks in Engineers and Operators with algorithm-based automation.

First Place, 2022 In-house Excellence Project, SK hynix *Nov. 2022*
- Applied ML, AI, and Optimization-based methods to increase manufacturing line capacity and yield without additional costs; contributed to raising the revenue to ~USD 90 million between 2022-2023.

Appreciation Plaque, Nordson Inc., Westlake, OH *Oct. 2021*

- Proposed methods to optimize queues and eliminate hidden throughput losses by devising an advanced ultrasonic inspector.
- Proposed a cost-effective method to refine data processing in Nordson equipment's program with a local software supplier.
- Designed and led the S/W data processing and development, contributing to the revenue generation of ~USD 77 million.

Excellence Project Award, P&T Smart Workplace, SK hynix *Aug. 2021*

- Formulated an algorithm for transforming the wafer-level inspection results of acoustic bulk wafer tomography machines into die-level results data and applied it on-site.
- Created a model for classifying defective and good dies; integrated the results into quality analysis systems.

Excellence Paper Prize, *WLP Technology Division,* SK hynix (awarded 2 times) *Oct. 2021, Nov. 2023*

- Title 1: "Machine Learning-based Defect Image Classification Methods using Net-defect Image Extraction Algorithm for Compression, Integration, and Advancement"
- Title 2: "Research on the Effective Quantification Methods of Qualitative Factors Using Data Algorithms: Minimizing Human Judgement based on Engineer Experience and Knowledge in the HBM Process"

Grand Prize, The Third Hackathon Project Competition, SK hynix *Jul. 2020*

- Title: "ML-based Sub-component (Dry Pump) Lifetime Prediction Model and Inventory Control Optimization Model using MILP (Mixed Integer Linear Programming)"
- Devised a remaining lifespan prediction model for dry pumps via ensemble learning using historical and specification data.
- Built a model to optimize dry pump inventory control based on predicted remaining lifespan and constraints using MILP.
- News Link (Korean): https://news.skhynix.co.kr/post/hackathon-season-3-site (Team: Optimal Solutions & Decision Science)

Excellence Award, P&T Digital Transformation, SK hynix *Jun. 2020*

- Devised and implemented 3D coordinate transformation to overcome gravity-caused wafer tilt in measuring wafer warpage.

Best AI & Best Engineer Prize, WLP Division, SK hynix (awarded 3 times) *2019-2023*

Bronze Award, P&T Data Analysis Competition, SK hynix *Dec. 2019*

- Developed a two-phase model to predict defective chips and wafer test process outcomes based on association rule mining and random forest model, using a high-volume historical dataset.

Year-end Excellent Project Award, P&T, SK hynix *Dec. 2019*

- Developed and implemented onsite a supervised learning-based automatic defect detection and classification model for auto visual inspection in CPB (Cu Pillar Bump) manufacturing.

First Place, "Imagination Town" Excellent Project, SK hynix *Nov. 2019*

- Built a supervised learning-based automatic defect image classification model for visual inspection in TSV manufacturing.

PUBLICATIONS

Lee, S.Y. (1st and Corresponding author) al. "Industry's First In-line Chip Warpage Measurement Methods for HBM Manufacturing Using UV-Induced Delamination and a Flux-Based Support Layer." Journal of Semiconductor Technology and Science, Accepted, 2025.

Yoon, S.H.**, Lee, S.Y.** (Corresponding author) "Enhancing HBM3E KGSD (Known Good Stacked Dies) Quality Competitiveness Through the Implementation of Gray AI-Based Technology," *The 32nd Korean Conference on Semiconductors,* Jeongseon, Korea, 2025.

Lee, S.Y.**, Lee, S.Y.** (Corresponding author)**,** Whoang, I.T., Kim, J.H., Lee, M.Y, Lee, Y.H., "The Industry 1st Study on ln-line Mass Measurement Methods for Chip-Level Warpage to Yield Improvement of HBM," *The 32nd Korean Conference on Semiconductors,* Jeongseon, Korea, 2025.

Park, H.N.R.**, Lee, S.Y.** (Corresponding author) "Development of new High-speed Inline SAT (Scanning Acoustic Tomography) Machine Focusing on Improvement HBM Capability & Application of AI Solutions," *The 32nd Korean Conference on Semiconductors,* Jeongseon, Korea, 2025.

Lee, S.Y. "Research on the Effective Quantification Methods of Qualitative Factors Using Data Algorithms: Minimizing Human Judgement based on Engineer Experience and Knowledge in the HBM Process," *The 11th SK hynix Academic Paper Conference,* Icheon, Korea, 2023.

Lee, S.Y. "A Study on Improving Process Technology Integrating Data and Machine Learning in the Advanced Package Process," *The 31st Korean Conference on Semiconductors,* Gyeongju, Korea, 2024.
Yoon S.H., **Lee, S.Y.** "Machine Learning-based MI Image Classification for A.I Semiconductor Production," *The 31st Korean Conference on Semiconductors,* Gyeongju, Korea, 2024.

Lee, S.Y. "Research on the Effective Quantification Methods of Qualitative Factors Using Data Algorithms: Minimizing Human Judgement based on Engineer Experience and Knowledge in the HBM Process," *The 11th SK hynix Academic Paper Conference,* Icheon, Korea, 2023.

Song, H.R., **Lee, S.Y.** "Wafer Warpage Measurement Method using 3D Coordinate Transformation for Gravity Correction," *The 8th SK hynix Academic Paper Conference,* Icheon, Korea, 2020.

Lee, S.Y. "Machine Learning Based Defect Image Classification Methods using Net-Defect Image Extraction Algorithm for Compression, Integration and Advancement," *The 8th SK hynix Academic Paper Conference,* Icheon, Korea, 2020.

Lee, S.Y., Jeong, B.H., Jeong, B.J. "Intelligent Inventory Management System considering Supply and Demand Uncertainty," *Proceedings of the KIIE-KORMS-KSS Joint Conference,* Yeosu, pp. 5911-5930, Korea, 2017.

Lee, S.Y., Jeong, B.J. "Order Quantity Decision Model using Reinforcement Learning in Non-Stationary Demand & Uncertainty of Supply Environments." *Proceedings of the KIIE Annual Fall Conference,* pp. 1673-1687, Daejeon, Korea, 2017.

RESEARCH EXPERIENCE

Advanced Data Analytics TF, SK hynix WLP Technology *Jun. 2020 – Jul. 2024*

- Predict equipment and parts' remaining lifespan; establish reactive inventory management strategies based on the results.
- Examine quantitative scoring methods to qualitatively assess processing quality from SAT inspection and scope images.
- Analyze optimal chip stacking combination for chip warpage and warpage control techniques using CVD (Chemical Vapor Deposition), MI, and stacking processes.
- Prepare research on a model that optimizes chip stacking combination using chip-unit datasets for industrial application.

P&T Data Science Research TF, SK hynix *Jun. 2019 – Jul. 2024*

- Assess the application of MILP and meta-heuristic methods to determine equipment suppliers, models, and quantities.
- Identify the optimal places to install vibration isolation tables and substructure architecture on semiconductor plant layouts.
- Gauge semiconductor process data using association rule mining and supervised/unsupervised learning to track equipment and processes causing defects.

Intelligent Manufacturing System Lab, Yonsei University **Seoul, Korea**
Research Assistant (Advisor: Prof. Bongju Jeong) *Sep. 2016 – Aug. 2018*

- "Prediction of Smart Energy Demand for Balanced National Power Energy Supply" (11/2016-10/2019) and "Energy Chain Supply for the Optimal National Energy Decision-making" (07/2016-10/2016), funded by the Ministry of Science and ICT.

- Lab Projects:
  - Development of Smart Factory Evaluation Index using the 3C (Collaboration, Connectivity, and Customization) Model
  - Drone Delivery using Drone Flocking for Cost Reduction
  - Optimal CODP (Custom Order Decoupling Point) Determination in the Supply Chain
  - Dynamic Dispatching Rule using Reinforcement Learning
  - Simulation on Gait Speed according to the Ship Deviation Angle and Density Zones in Maritime Disaster Scenarios

MENTORING/LECTURING EXPERIENCE

SK hynix University **Icheon, Korea**
On-the-Job Training Instructor, WLP Technology *Jun. 2020 – Jul. 2024*
Lecturer, Practical Data Analysis Course: WLP, Data Technology 1 & 2 *2021*
Lecturer, Machine Learning and Optimization Team Seminar (6 times) *2020*

ASAC (Allied SW Academy Companies) Project **Seoul, Korea**

Project Mentor and Lecturer *Jun. 2021 – Jul. 2024*

- Project Title: Repetitive Defect Detection Model in Semiconductor Manufacturing
- Expanded the project results; developed and distributed an in-house service system throughout SK hynix for industrial use.
- Hosted by SK Planet Inc. and sponsored by the Ministry of Employment and Labor and the Korean Chamber of Commerce.
- You Tube Link (Korean): https://www.youtube.com/watch?v=6WSPXrCfTUE
- News Link (Korean): https://www.dailian.co.kr/news/view/1156858

SK hynix P&T Insight Seminar **Icheon, Korea**

Speaker, In-house Live Broadcast *Sep. 2023*

- Title: "Advancement of AI and ML-based MI Technology"
- Discussed the application of intelligent technology using the 3C model (Customization, Connectivity, and Collaboration).

SK hynix P&T MI Summit **Icheon, Korea**

Presenter and Panelist, In-house Live Broadcast *Oct. 2021*

- Title: "Application of Data Technology in Metrology and Inspection Technology"

In-house Interview: "The Role of Industrial Engineering Majors in SK hynix" **Icheon, Korea**

"Advice and Tips for Recent College Graduate Jobseekers with Industrial Engineering Majors" *Nov. 2020*

- News Link (Korean): https://news.skhynix.co.kr/post/industrial-engineering-major

TECHNICAL SKILLS

Programming: R, Python, MATLAB, JMP…
Tools: Arena (process simulations), RPA (Robotic Process Automation Tool)
Micro-Fabrication MI Equipment: <1um, X-ray, CT, Scanning Acoustic Tomography, Triangulation, Interferometer, 3D Laser Scanning, Reflectometry, Ellipsometer-based Metrology.