

SEULKI HAN - CURRICULUM VITAE

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EDUCATION

Ph.D., University of Connecticut, Chemical and Biomolecular Engineering Aug 2019 - Current
Advisor: Dr. George M. Bollas

M.S., Incheon National University, Energy and Chemical Engineering Mar 2015 - Feb 2017
Advisor: Dr. Jiyong Kim
Thesis: Multi-scale optimization for the design and operation of complex renewable energy systems

B.S., Incheon National University, Energy and Chemical Engineering Mar 2011 - Feb 2015

RESEARCH INTERESTS

- Hybrid model (physics-informed machine learning), data-driven model, Explainable AI
- Optimization, Mixed-integer programming, Non-linear programming
- Predictive analytics, Prognostics and health management (PHM)
- Digital tiwn, Industry 4.0, Smart manufacturing
- Energy systems, Sustainability
- Renewable energy, Carbon-neutrality
- Process synthesis, Techno-economic analysis, Life-cycle analysis

SKILLS

Software	Microsoft Office
Programming	MATLAB, Python, Tensor Flow, Numpy
Software/Algebraic modeling language	ALAMO, GPTIPS, GAMS
Mathematical Programming/Optimization	Linear programming, Integer programming, Nonlinear programming
Machine learning/AI	Classification, Regression, Clustering, Dimensionality reduction, Feature engineering, Genetic programming, Neural networks,
Data analytics	Data analysis, Data visualization, Data augmentation, Data mining
Energy system analysis computer model	SAM, iHOGA, HOMER

RESEARCH EXPERIENCE

University of Connecticut Aug 2019 - Current
Graduate Research Assistant *Storrs, CT, USA*

- Processed and analyzed sensor data collected from the machining process, and conducted feature engineering to extract a health indicator that best represents tool wear.
- Developed various machine learning and deep learning models for fault classification and tool wear diagnostics in precision machining
- Evaluated the impact of multi-signal fusion, multi-domain feature fusion, and data dimensionality on improving accuracy in tool condition monitoring.
- Developed a physics-informed surrogate model using genetic programming to generalize machining processes with diverse characteristics.

- Achieved an average of 95% accuracy in RUL (Remaining Useful Life) predictions for different machining processes using the developed generic model.

Incheon National University

Undergraduate & Graduate Research Assistant

Nov 2014 - Feb 2017

Incheon, Korea

- Developed an optimization-based decision-making model to design and operate an integrated renewable energy system, aimed at minimizing total costs
- Estimated future energy demand for electricity, hydrogen, and liquid fuels in Korea, considering CO₂ regulatory policies, oil price conditions, and projections of the penetration rates of electric vehicles and fuel cell vehicles
- Assessed the influence of meteorological changes, energy storage strategies, and demand structure on the renewable energy supply infrastructure
- Developed a multi-period mixed-integer programming (MIP) model to maximize the net present value (NPV) over a 36-year time horizon for planning and designing a renewable energy-based energy supply system in Korea
- Demonstrated wind turbines, bio-power, and electrolysis technologies were the most cost-effective for electricity and hydrogen production in Korea.
- Observed energy demand structure and varying storage strategies significantly influenced the overall economics of the system

WORK EXPERIENCE

Innovation Center for Chemical Engineering

Researcher Assistant

Mar 2017 - Jun 2019

Incheon, Korea

I) Carbon Utilization

- Develop an optimization-based framework to systematically analyze and assess carbon utilization strategies for energy productions (hydrogen, methane, methanol, and Fischer-Tropsch fuels) from coke oven gas
- Developed process model of involved technologies using process simulator (ASPAN) to estimate technical and economic parameters
- Developed mixed-integer programming (MIP) models to assess carbon utilization strategies with four criteria: minimizing production cost, minimizing energy consumption, maximizing production quantity, and maximizing profit
- Evaluated the optimal strategies comparatively for the production of different types of energy chemicals to satisfy different technical and economic objectives
- Acquired a patent for the methodology developed for a carbon utilization strategy

II) Water-Food-Energy Nexus

- Developed mixed-integer programming (MIP) models for the design and management of a bioethanol supply chain under the water-energy-food-land (WEFL) nexus to minimize the total annual cost while meeting energy, water, and food demands, within the constraints of limited resources and land availability
- Generated two scenarios - a cost optimization scenario and a nexus optimization scenario - and compared quantitatively nexus-centric and non-nexus supply chains for bioethanol in Jeju Island, Korea
- Identified the optimal process configuration for bioethanol production and supply network under the WEFL nexus framework simultaneously
- Demonstrated 2% land usage, 30% water consumption, and 64% primary energy usage can be reduced in a nexus-centric approach

TEACHING EXPERIENCE

University of Connecticut
Graduate Teaching Assistant

Aug 2019 - May 2020
Storrs, CT, USA

- Fluid Mechanics / a semester as teaching assistant for this course
- Advanced Process Control / a semester as teaching assistant for this course

Incheon National University
Graduate Teaching Assistant

Aug 2016 - Dec 2016
Incheon, Korea

- Chemical Reaction Engineering / a semester as teaching assistant for this course

PROJECTS

- **Manufacturing diagnostics, prognostics and health management**, Air Force Research Laboratory, Materials and Manufacturing Directorate (AFRL/RXMS), USA (May 2020 - Current)
- **Energy Management Systems for Subtractive and Additive Precision Manufacturing**, CESMII-The Smart Manufacturing Institute, USA (Aug 2019 - May 2020)
- **Optimization-based decision-making model for residue gas utilization**, Korea Research Institute of Chemical Technology (KRICT), Ministry of Science and ICT (MSIT), Korea (Jan 2018 - Jun 2019)
- **Process development and techno-economic evaluation of waste and captured carbon utilization** Mar 2017 - Dec 2017
- **Development of a decision support model for design of multi-scaling based energy systems**, National Research Foundation of Korea (NRF), Ministry of Science and ICT (MSIT), Korea (Nov 2014 - Apr 2017)

PUBLICATIONS

- **Han, S.**, Awasthi, U., and Bollas, G. M. Physics-informed symbolic regression for PHM: recursive model for predictive maintenance in manufacturing. (In preparation)
- **Han, S.**, Pattipati, K. R., and Bollas, G. M. Surrogate model-based tool wear prognostics and remaining useful life prediction in precision machining. (In preparation)
- **Han, S.**, Mishra, D., Pattipati, K. R., and Bollas, G. M. (2024). Symbolic regression-based hybrid models for a manufacturing process. 10th 2024 International Conference on Control, Decision and Information Technologies, CoDIT 2024 (Submitted)
- Mishra, D., **Han, S.**, Pattipati, K. R., and Bollas, G. M. (2023). Explainable Symbolic Regression Model for Tool Wear Diagnosis. 9th 2023 International Conference on Control, Decision and Information Technologies, CoDIT 2023, 2139–2144.
- **Han, S.**, Yang, Q., Pattipati, K. R., and Bollas, G. M. (2022). Sensor selection and tool wear prediction with data-driven models for precision machining. *Journal of Advanced Manufacturing and Processing*, 4(4).
- **Han, S.**, Mannan, N., Stein, D. C., Pattipati, K. R., and Bollas, G. M. (2021). Classification and regression models of audio and vibration signals for machine state monitoring in precision machining systems. *Journal of Manufacturing Systems*, 61, 45–53.
- You, C.¹, **Han, S.**¹, and Kim, J. (2021). Integrative design of the optimal biorefinery and bioethanol supply chain under the water-energy-food-land (WEFL) nexus framework. *Energy*, 228, 120574. (¹Contributed equally)
- **Han, S.**, and Kim, J. (2019). A multi-period MILP model for the investment and design planning of a national-level complex renewable energy supply system. *Renewable Energy*, 141, 736–750.
- **Han, S.**, Kim, S., Kim, Y. T., Kwak, G., and Kim, J. (2019). Optimization-based assessment framework for carbon utilization strategies: Energy production from coke oven gas. *Energy Conversion and Management*, 187, 1–14.

- Cho, S., Won, W., **Han, S.**, Kim, S., Youa, C., and Kim, J. (2018). An optimization-based design and analysis of a biomass derived hydrogen energy system. *Computer Aided Chemical Engineering*, 44, 1573–1578.
- **Han, S.**, and Kim, J. (2017). Optimization-based integration and analysis of a complex renewable energy system for the transportation sector. *Chemical Engineering Research and Design*, 128, 1–14.
- **Han, S.**, and Kim, J. (2017). An optimization model to design and analysis of renewable energy supply strategies for residential sector. *Renewable Energy*, 112, 222–234.
- **Han, S.**, Won, W., and Kim, J. (2017). Scenario-based approach for design and comparatively analysis of conventional and renewable energy systems. *Energy*, 129, 86–100.

PRESENTATIONS

- **Han, S.**, Mishra, D., Pattipati, K. R., and Bollas, G. M. (2024). Symbolic regression-based hybrid models for a manufacturing process, 10th International Conference on Control, Decision and Information Technologies (CoDIT), Valletta, Malta.
- Mishra, D., **Han, S.**, Pattipati, K. R., and Bollas, G. M. (2023). Explainable Symbolic Regression Model for Tool Wear Diagnosis, 9th International Conference on Control, Decision and Information Technologies (CoDIT), Rome, Italy.
- **Han, S.** and Bollas, G. M. (2021). Regression Model for Tool Wear Monitoring in Precision Machining, AIChE, Boston, MA, USA.
- **Han, S.**, Maloney, T., and Bollas, G. M. (2020). Machine Learning Approach for Tool Condition Monitoring in Manufacturing Systems, AIChE, Virtual Meeting, USA.
- **Han, S.** and Kim, J. (2019). An optimization model for design and analysis of land-water-energy-food nexus in a bioethanol supply chain, KIChE, Jeju.
- **Han, S.**, Kim, S., Kim, Y. T., Kwak, G., and Kim, J. (2018). MILP model for assessment and analysis of carbon utilization strategies: Application to residue gas utilization, KIChE, Daegu, Korea.
- **Han, S.** and Kim, J. (2016). MILP model for technology integration and investment planning of a complex renewable energy system, KIChE, Busan, Korea.
- **Han, S.** and Kim, J. (2015). An optimization-based investment planning for a complex renewable energy systems, KIChE, Ilsan, Korea.
- **Han, S.** and Kim, J. (2015). Optimization-based analysis of a complex energy superstructure, International Conference on Chemical and Polymer Engineering (ICCPE'15), Barcelona, Spain.
- **Han, S.** and Kim, J. (2015). Optimization-based analysis of a complex energy system using renewable energy sources, KIChE Jeju, Korea.
- **Han, S.** and Kim, J. (2014). Design and life-cycle- cost analysis of scenario-based energy supply system for transportation sector, KIChE, Daejeon, Korea.

PEER REVIEWING

- Reviewed for Journal: *Computers and Chemical Engineering*
- Reviewed for Conference: International Conference on Control, Decision and Information Technologies (CoDIT)

PATENTS

- Han, S. (2021). Republic of Korea. Patent Number 10-2203502. “Method and server for establishing optimization-based carbon utilization strategy”

HONORS & AWARDS

• Pratt & Whitney Advanced Systems Engineering Fellowship	2024
• Pratt & Whitney Advanced Systems Engineering Travel Fellowship	2024
• Predoctoral Travel Award, University of Connecticut	2024
• Best Oral Presentation Award, KIChE conference	2019
• Graduate Academic Scholarship, Incheon National University	2016
• Graduate Academic Scholarship, Incheon National University	2015
• Undergraduate Academic Scholarship, Incheon National University	2014
• Undergraduate Academic Scholarship, Incheon National University	2013
• Undergraduate Academic Scholarship, Incheon National University	2012

CERTIFICATIONS

DeepLearning.AI TensorFlow Developer	2024
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PROFESSIONAL MEMBERSHIPS

American Institue of Chemical Engineers (AIChE)	
IEEE	