

# SEULKI HAN - CURRICULUM VITAE

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## EDUCATION

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

**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

## SKILLS

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

## RESEARCH INTERESTS

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- 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

## TEACHING EXPERIENCE

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**University of Connecticut** Aug 2019 - May 2020  
Graduate Teaching Assistant *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** Aug 2016 - Dec 2016  
Graduate Teaching Assistant *Incheon, Korea*

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

## RESEARCH EXPERIENCE

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**University of Connecticut**  
Graduate Research Assistant

Aug 2019 - Current  
*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 CO<sub>2</sub> 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

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**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

## PEER REVIEWING

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

## PATENTS

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

## PUBLICATIONS

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- **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.<sup>1</sup>, **Han, S.**<sup>1</sup>, 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. (<sup>1</sup>Contributed 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

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- **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.

## HONORS & AWARDS

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|-------------------------------------------------------------------|------|
| • 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**

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DeepLearning.AI TensorFlow Developer 2024

**PROFESSIONAL MEMBERSHIPS**

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American Institue of Chemical Engineers (AIChE)  
IEEE