Kang, SungKu
Assistant Professor, College of Engineering (Mechanical Engineering Program), Korea Aerospace University
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RESEARCH INTERESTS

Design automation via the integration of machine learning, especially reinforcement learning, and domain knowledge (e.g., design rules) with special interests in personalization and sustainability.

EXPERIENCE

Assistant Professor Mar 2024 – Present
Department of Mechanical and Aircraft System Engineering, Korea Aerospace University
-Research focus: Design automation via integrating domain knowledge and data in aerospace applications

Postdoctoral Research Associate Jul 2020 – Feb 2024
Department of Civil and Environmental Engineering, Northeastern University
Advisor: Dr. Michael Kane and Dr. Jennifer Dy
Research projects involving design automation of construction and infrastructure
-Occupant-centric building control based on the sensor/behavior data collected from the actual homes
-Design automation of stone masonry structures using reinforcement learning (RL) inspired by Tetris AI
-Control Co-Design of floating offshore turbine blades via machine learning control and RL

Postdoctoral Research Associate Aug 2018 – June 2020
Department of Industrial and Systems Engineering, Virginia Tech
Advisor: Dr. Ran Jin
Research projects at the intersection of data science and domain knowledge modeling
-Data-driven design space exploration for personalized recommendation of microbial fuel cell anode design
-NLP-based executable export rule extraction from textual regulation for turbine blade design

Graduate Research Internship Summer 2015
Model-based Manufacturing Laboratory, General Electric Global Research Center
Research project: Collaborative management of design rules via natural language-based user interface

EDUCATION

University of Illinois at Urbana-Champaign (UIUC) Dec 2017
Doctor of Philosophy in Mechanical Engineering (GPA: 3.83 / 4.0)
- Research advisor: Dr. Debasish Dutta and Dr. Lalit Patil
- Research area: Semantic technologies and Natural Language Processing (NLP) for design and manufacturing

Seoul National University (SNU) Feb 2012
Bachelor of Science in Mechanical and Aerospace Engineering (Cum Laude, GPA: 3.64 / 4.30)
- Thesis advisor: Dr. Kyu-Jin Cho / Academic advisor: Dr. Joon Sik Lee
- Minor in Electrical Engineering

GRANTS

Awarded Grants

1. PI, "Design Automation of Multi-Environmental Unmanned Mobility for Space Utilization: A Domain Knowledge-Data Integration Approach" for New Basic Research Projects (Outstanding Young Scientist Grants), ₩600M, funded by National Research Foundation of Korea, Mar 2025 – Feb 2028
2. PI, "Development of Virtual Sensor Technology for Efficient and Robust Real-Time Structural Monitoring", ₩240M, funded by Korea Research Institute of Standards and Science, Jan 2025 – Dec 2027

3. Co-PI, "4C2B: Century-scale Carbon-sequestration in Cross-laminated timber Composite Bolted-steel Buildings" for Harnessing Emissions into Structures Taking Input from the Atmosphere (HESTIA), $3.5M, funded by Advanced Research Projects Agency–Energy, U.S. Department of Energy, Nov 2022 – Nov 2025 (PI: Dr. Jerome Hajjar)
4. Co-PI, "PARIS: Precise Air-sealing Robot for Inaccessible Spaces" for the American-Made Buildings Prize: Envelope Retrofit Opportunities for Building Optimization Technologies (Phase 1), $200K, Funded by U.S. Department of Energy, Aug 2021 – Mar 2022 (PI: Dr. Taskin Padir)
5. Co-PI (50%), "Frequent subgraph mining to identify potential violations of export regulations from additively manufactured parts," $20K, Funded by Northrop-Grumman Corporation, Jan – Aug 2020 (PI: Dr. Ran Jin)
6. Co-PI (50%), "Association rule learning from legal text to predict potential trade law violation from additively manufactured parts: Case study," $20K, Funded by Northrop-Grumman Corporation, Jan – Dec 2019 (PI: Dr. Ran Jin)

PUBLICATIONS

Refereed Journal Papers (Published and Accepted)

1. **S. Kang**, J. G. Dy, and M. B. Kane, "Stone masonry design automation via reinforcement learning," *Artificial Intelligence for Engineering Design, Analysis and Manufacturing (AI EDAM)*, vol. 37, p. e17, 2023
2. X. Chen, Y. Zeng, **S. Kang**, and R. Jin, "INN: An interpretable neural network for AI incubation in manufacturing," *ACM Transactions on Intelligent Systems and Technology*, vol. 13, no. 5, pp. 1–23, 2022
3. J. Yoon, H. J. Kwon, **S. Kang**, E. Brack, and J. Han, "Portable seawater desalination system for generating drinkable water in remote locations," *Environmental Science & Technology*, vol. 56, no. 10, pp. 6733–6743, 2022
4. J. Velino, **S. Kang**, and M. B. Kane, "Machine learning control for floating offshore wind turbine individual blade pitch control," *Journal of Computing in Civil Engineering*, vol. 36, no. 6, p. 04022034, 2022
5. **S. Kang**, R. Jin, X. Deng, and R. S. Kenett, "Challenges of modeling and analysis in cybermanufacturing: a review from a machine learning and computation perspective," *Journal of Intelligent Manufacturing*, 2021
6. **S. Kang**, X. Deng, and R. Jin, "A cost-efficient data-driven approach to design space exploration for personalized geometric design in additive manufacturing," *Journal of Computing and Information Science in Engineering*, vol. 21, no. 6, p. 061008, 2021
7. **S. Kang**, L. Patil, A. Rangarajan, A. Moitra, T. Jia, D. Robinson, F. Ameri, and D. Dutta, "Extraction of formal manufacturing rules from unstructured english text," *Computer-Aided Design*, vol. 134, p. 102990, 2021
8. L. Wang, X. Chen, **S. Kang**, X. Deng, and R. Jin, "Meta-modeling of high-fidelity fea simulation for efficient product and process design in additive manufacturing," *Additive Manufacturing*, vol. 35, p. 101211, 2020
9. **S. Kang**, L. Patil, M. E. Graham, and D. Dutta, "Semantic tagging framework for contextually augmented features," *Computer-Aided Design and Applications*, vol. 17, no. 1, pp. 1–15, 2020
10. **S. Kang**, L. Patil, A. Rangarajan, A. Moitra, T. Jia, D. Robinson, and D. Dutta, "Automated feedback generation for formal manufacturing rule extraction," *Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, vol. 33, no. 3, pp. 289–301, 2019
11. **S. Kang**, L. Patil, A. Rangarajan, A. Moitra, D. Robinson, T. Jia, and D. Dutta, "Ontology-based ambiguity resolution of manufacturing text for formal rule extraction," *Journal of Computing and Information Science in Engineering*, vol. 19, no. 2, p. 021003, 2019
12. **S. Kang**, H. In, and K.-J. Cho, "Design of a passive brake mechanism for tendon driven devices," *International Journal of Precision Engineering and Manufacturing*, vol. 13, no. 8, pp. 1487–1490, 2012

Journal Papers in Preparation

1. **S. Kang**, M. B. Kane, "Advanced Manufacturing of Locally-Sourced Cross-Laminated Timber: Proof-of-Concept," *Submitted*
2. **S. Kang**, "Sustainable Structural Design Automation via Reinforcement Learning: Case Study of Stone Masonry," *Submitted*

3. **S. Kang**, J. J. Velazquez, M. B. Kane, "Building Operations Emulator: Integrating Interactive Building Performance Simulation into Building Operators Training," *In Revision*
4. **S. Kang**, K. Sharma, M. Pathak, E. Casavant, K. Bassett, M. Pavel, D. Fannon, and M. B. Kane, "Thermostat Interactions and Human Discomfort: Uncovering Spatiotemporal Variabilities in a Longitudinal Study of Residential Buildings," *In Revision*

Conference Proceedings (Published and Accepted)

1. **S. Kang**, J. J. Velazquez, and M. B. Kane, "Building operations emulator: Integrating interactive building performance simulation into building operators training," in *SimBuild 2024 Conference*, IBPSA-USA, 2024
2. **S. Kang**, V. Taylor, M. Okwei, B. Schultz, and R. Jin, "Rule extraction to identify export regulation compliance of AM parts," in *Proceedings of the 2020 IISE Annual Conference*, pp. 507–512, 2020
3. **S. Kang**, L. Patil, A. Rangarajan, A. Moitra, T. Jia, D. Robinson, and D. Dutta, "Extraction of manufacturing rules from unstructured text using a semantic framework," in *Proceedings of the ASME 2015 IDETC/CIE*, p. V01BT02A033, 2015
4. H. In, **S. Kang**, and K.-J. Cho, "Capstan brake: Passive brake for tendon-driven mechanism," in *2012 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pp. 2301–2306, IEEE, 2012

COMPANY REPORTS / PATENTS

1. M. B. Kane and **S. Kang**, "Building Operations Emulator," U.S. Patent Application, *Pending*
2. R. Jin, S. Sarin, and **S. Kang**, "Smart manufacturing roadmap for optical fiber manufacturing," Feb 2020
3. K. Cho, **S. Kang**, and H. In., "Passive brake apparatus for cable driving apparatus," Korean Patent Application No. KR101357817B1, 2012

CONFERENCE PRESENTATIONS

1. S. Kang, **S. Kang** "Investigation of Vehicle Dynamics Due to Brake Force Distribution in Non-ABS Vehicles," *Presented at 2025 Spring Conference of the KSME IT Intelligence Convergence Division*, May 2025, Gongju, Republic of Korea
2. **S. Kang**, M. B. Kane "Advanced Manufacturing of Locally-Sourced Cross-Laminated Timber: Proof-of-Concept," *Presented at ICMDT2025, The 10th International Conference on Manufacturing, Machine Design and Tribology*, Apr 2025, Himeji, Japan
3. **S. Kang** "Design Automation by Integrating Data and Knowledge," *Presented at KSME Annual Meeting 2024 (KSME Promising Scientist Session)*, Dec 2024, Jeju, Republic of Korea
4. **S. Kang**, J. J. Velazquez, M. B. Kane, "Building Operations Emulator: Integrating Interactive Building Performance Simulation into Building Operators Training," *Presented at SimBuild 2024, Eleventh National Conference of IBPSA-USA*, May 2024, Singapore
5. K. Bassett, M. B. Kane, D. Fannon, M. Pavel, **S. Kang**, M. Pathak, E. Casavant, K. Sharma, "Patterns of Residential Thermal Comfort and Human-Building Interactions: Findings from a Novel Data Set," *Presented at international Symposium on Occupant Behavior Research 2022 (OB-22 Symposium)*, September 2022, Singapore
6. **S. Kang** and M. B. Kane, "Topology optimization of tetris masonry via physics-guided deep Q-learning," *Presented at 2021 Engineering Mechanics Institute Conference and Probabilistic Mechanics & Reliability Conference (EMI/PMC)*, May 2021, Virtual
7. **S. Kang**, R. Jin, A. Patel, and D. Orrell, "Identification of export regulation compliance of AM parts via surrogate modeling of design features," *Presented at Institute of Industrial & Systems Engineer (IISE) Annual Conference & Expo 2021*, May 2021, Virtual
8. **S. Kang**, R. Jin, and X. Deng, "Feasible region identification in personalized design for additive manufacturing via surrogate modeling of design rules," *Presented at 2019 Institute for Operations Research and the Management Sciences (INFORMS) Annual Meeting*, Oct 2019, Seattle WA
9. **S. Kang**, X. Deng, and R. Jin, "Feasible design region identification in additive manufacturing via surrogate modelling of design rules," *Presented at 2019 The Fifth International Conference on the Interface between Statistics and Engineering (ICISE)*, June 2019, Seoul Republic of South Korea

10. **S. Kang**, L. Patil, A. Rangarajan, A. Moitra, T. Jia, D. Robinson, and D. Dutta, "Extraction of manufacturing rules from unstructured text using a semantic framework," *Presented at ASME 2015 IDETC/CIE*, Aug 2015, Boston MA

SERVICES

- Committee Member for Collaboration, Society for Computational Design and Engineering
- Committee Member for Business, KSME Production and Design Engineering division
- Committee Member for Industry-Academia Collaboration, KSME IT Intelligence Convergence Division
- Session Chair of "Innovation in Emerging Technologies: Additive Manufacturing (AM) and Human Machine Collaboration" and "Design for Quality Excellence in AM" at 2020/2019 INFORMS Annual Meeting
- Reviewer for Journal of Intelligent Manufacturing, Journal of Computing and Information Science in Engineering, Journal of Manufacturing Science and Engineering, and Structural and Multidisciplinary Optimization

AWARDS

- 2024 Best Research Paper Award, IBPSA-USA SimBuild 2024 Conference
- 2022 Best Paper Award, ASCE Journal of Computing in Civil Engineering
- 3rd prize, Enova Hackathon, Oct 2012
- Best Undergraduate Thesis Presentation Award, SNU Mech. and Aerosp. Eng., Nov 2011
- Gold Prize, Electrical Exhibition Competition, SNU Elect. Eng., Nov 2008
- Best Presentation Award, Global Leadership Program, SNU Eng. and Lang. Educ. Inst., Feb 2007
- National Science & Technology Scholarship, Korea Sci. and Eng. Found. (KOSEF), Spring 2006 – Fall 2011
- '06 Career Development Scholarship, by College of Eng., SNU. Spring 2006