SungKu Kang
Postdoctoral Research Associate, Civil and Environmental Engineering Department, Northeastern 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 smart manufacturing/construction/service.

EDUCATION

University of Illinois at Urbana-Champaign (UIUC) Dec 2017
Doctor of Philosophy in Mechanical Engineering
- 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)
- Thesis advisor: Dr. Kyu-Jin Cho / Academic advisor: Dr. Joon Sik Lee
- Minor in Electrical Engineering

RESEARCH EXPERIENCE

Postdoctoral Research Associate Jul 2020 – Present
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 Assistant Aug 2012 – Dec 2017
Department of Mechanical Science and Engineering, UIUC
Research projects collaborated with GE Global Research
-NLP-based executable manufacturing rule extraction with disambiguation of the meaning via semantic model
-Semantic-model based augmentation of turbine blade features with semantic tags using spatial relations

GRANTS

Awarded Grants

1. 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)
2. 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)
3. 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)

4. 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)

Pending Grants

5. PI, "FMSG: Eco: Human-AI Mutual Reinforcement Learning (HAIM-RL) for Real-Time Joint Design of Product and Supply Chain Adaptable to Inconsistent Sustainable Feedstocks," $500K, Submitted to National Science Foundation Future Manufacturing Program (*Pending*)

PUBLICATIONS

Refereed Journal Papers (Published and Accepted)

1. **S. Kang**, J. G. Dy, and M. B. Kane, "Stone Masonry Design Automation via Reinforcement Learning," *Accepted for publication at Artificial Intelligence for Engineering Design, Analysis and Manufacturing*
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**, K. Sharma, M. Pathak, E. Casavant, K. Bassett, M. Pavel, D. Fannon, and M. B. Kane, "Toward A Dynamic Comfort Model for Human-Building Interaction in Grid-Interactive Efficient Buildings: Supported by Field Data," *In Revision*

Conference Proceedings (Published and Accepted)

1. **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
2. **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

3. 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. R. Jin, S. Sarin, and **S. Kang**, "Smart manufacturing roadmap for optical fiber manufacturing," Feb 2020
2. K. Cho, **S. Kang**, and H. In., "Passive brake apparatus for cable driving apparatus," Korean Patent Application No. 10-2012-0046596, 2012
3. M. B. Kane and **S. Kang**, "Building Operations Emulator," *U.S. Patent Pending*

CONFERENCE PRESENTATIONS

1. 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
2. **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
3. **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
4. **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
5. **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
6. **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

- 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 Product Lifecycle Management, Journal of Computing and Information Science in Engineering, Journal of Manufacturing Science and Engineering, and Structural and Multidisciplinary Optimization

AWARDS

- ASCE Journal of Computing in Civil Engineering Best paper award for 2022
- Best Undergraduate Thesis Presentation Award, SNU Mech. and Aerosp. Eng., Nov 2011
- Gold Prize, Electrical Exhibition Competition, SNU Elect. Eng., Nov 2008
- 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

REFERENCE

Asst. Prof. Michael Kane	Northeastern University	Postdoc. advisor	mi.kane@northeastern.edu
Prof. Jennifer Dy	Northeastern University	Postdoc. advisor	jdy@ece.northeastern.edu
Assoc. Prof. Ran Jin	Virginia Tech	Postdoc. advisor	jran5@vt.edu
Chancellor Debasish Dutta	University of Michigan-Flint	Doctoral advisor	dutta@umich.edu