# Hyeongmin Kim

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## RESEARCH INTERESTS

Integrating industrial domain knowledge with AI models and datasets to solve engineering problems in design and analysis.

- Domain knowledge-informed neural networks (DINN): embedding physics and expert knowledge into the inputs, architectures, and loss functions of neural networks
- AI-driven engineering design: surrogate modeling and inverse design of manufacturing processes
- AI-driven engineering analysis: fault diagnosis and health management of production equipment
- Engineering datasets: data generation and selection for engineering AI

## EDUCATION

**2019.03 – 2024.02** **Ph.D., Mechanical Engineering (Integrated M.S.–Ph.D. Program)**
Seoul National University, Seoul, Korea

- Advisor: Prof. Byeng D. Youn
- Dissertation: *Motor Fault Scale-focused Feature Learning Considering Operation Variability and Diagnosis Uncertainty* [J4, J9, J11]
- Outstanding Doctoral Dissertation Award, KSME CAE & Applied Mechanics Division (2024)

**2015.03 – 2019.02** **B.S., Mechanical and Aerospace Engineering**
Seoul National University, Seoul, Korea

- Advisor: Prof. Kyujin Cho. Thesis: *Development of Jump-Glider Robot for Safe Landing*

## EXPERIENCE

**2025.03 – Present** **Staff Engineer**
Samsung Research, Samsung Electronics, Seoul

- Data selection for behavior and bias correction of large language models, with evaluation of side effects on factuality, safety, and general capability (2026.04 – present).
- GraphRAG question answering; memory for coding agents (2026.01 – 2026.08).
- LLM-as-a-judge evaluation pipelines (2025.03 – 2025.12).
- Industrial work; internal results are not publicly available and are described here only at a general level.

**2024.03 – 2025.02** **Postdoctoral Researcher**
Hyperautonomy AI Lab (Prof. Byeng D. Youn), Department of Mechanical Engineering, Seoul National University

- Prepared seven research proposals for industry- and government-funded projects.
- Led research on domain knowledge-informed neural networks (DINN) for fault diagnosis and sensor fusion [J1].

**2023.06 – 2023.12** **Part-time Research Intern**

OnePredict Inc., Seoul

- Developed anomaly detection and fault diagnosis models for rotating machinery using industrial sensor data (concurrent with Ph.D. studies).

**2022.06 – 2022.08** **Visiting Researcher**

Fraunhofer Institute for Production Technology IPT, Aachen, Germany

- Die design for bipolar plate stamping with IPT researchers incl. Prof. Christian Brecher; collaboration continued after the stay (co-first author, *Measurement*, 2026) [J2].
- Reinforcement learning-based parameter estimation for an ultra-precision machine [C7].

**2019.03 – 2024.02** **Graduate Researcher (Ph.D.)**

System Health and Risk Management (SHRM) Lab (now Hyperautonomy AI Lab), Department of Mechanical Engineering, Seoul National University

- Designed and built a permanent magnet synchronous motor (PMSM) fault test bed and conducted the seeded-fault experiments for the dissertation [J4, J9, J11].
- Developed and validated fault diagnosis and anomaly detection models using test-bed data and field data from industrial collaborations (rotating machinery, overhead hoist transports [J6], and a thermal power plant boiler [J10]).
- Team leader, electrical components (motor) research team (2021 – 2024).

## RESEARCH HIGHLIGHTS

### Domain Knowledge-informed Neural Networks

- First-author review and taxonomy of DINN for prognostics and health management [J1].
- Knowledge built into the input (operating-condition compensation of motor current, SCOC) [J9], the architecture (multi-scale attention network) [J11], and the loss (center margin loss for unseen faults) [J4].

### AI-driven Design and Manufacturing

- Inverse die design for springback compensation of PEM fuel-cell bipolar plates, with Fraunhofer IPT (co-first author) [J2].
  - ABAQUS stamping model calibrated with tensile and friction tests; validated against optical 3D measurements (maximum error below 10% at 20 design points).
  - Uncertainty-based adaptive sampling built the surrogate from 57 FEM runs; a tandem neural network predicts the die shape for a target plate shape.
  - Lower maximum error than a standard DNN on 10 held-out designs.
- Reinforcement learning-based parameter estimation for an ultra-precision machine [C7].

### Fault Diagnosis and Health Management

- Built a PMSM fault test bed; seeded-fault experiments (inter-turn short, demagnetization, bearing damage).
- Unseen-fault detection with uncertainty [J4]; domain adaptation across 20 overhead hoist transports in semiconductor fabs [J6]; boiler tube leak detection in an operating power plant [J10].

### Data for Engineering AI

- Selecting simulations to run [J2], window size and sampling rate [C2], and transfer from simulation to experiment and across machines [J5, J6].
- Samsung Research: data selection for LLM behavior and bias correction (internal).

## JOURNAL PUBLICATIONS

13 peer-reviewed journal articles (12 published, 1 accepted). First or co-first author on 7: [J1], [J2], [J4], [J6], [J9], [J10], [J11]. Google Scholar: 248 citations, h-index 7 (accessed 19 November 2026).
★ five representative publications selected for relevance to Design & Smart Manufacturing † equal contribution (co-first author) candidate's name in bold.

**[J1]** ★ **Hyeongmin Kim**, Taehun Kim, Wonbin Song, Jong Moon Ha, Byeng D. Youn, "Domain knowledge-informed neural networks for prognostics and health management: A state-of-the-art review and taxonomy," *Archives of Computational Methods in Engineering*, accepted, 2026.

**[J2]** ★ **Hyeongmin Kim**†, Sangwook Langenstück-Lee†, Donghyu Lee, Florian Hüsing, Christian Brecher, Byeng D. Youn, "Deep learning-based rapid and precise die design to compensate springback in metallic bipolar plate stamping for proton exchange membrane fuel cells," *Measurement*, vol. 290, 122923, 2026. doi:10.1016/j.measurement.2026.122923

**[J3]** Sang Kyung Lee, **Hyeongmin Kim**, Minseok Chae, Hansoo Kim, Joonho Yang, Heonjun Yoon, Byeng D. Youn, "Frequency-band graph-based sensor fusion with sensitivity-aware energy assist network for machinery system fault diagnosis," *Engineering Applications of Artificial Intelligence*, vol. 179, 115273, 2026. doi:10.1016/j.engappai.2026.115273

**[J4]** ★ **Hyeongmin Kim**, Minseok Chae, Sang Kyung Lee, Hansoo Kim, Hye Jun Oh, Heonjun Yoon, Byeng D. Youn, "Center margin loss-based uncertainty-aware fault diagnosis for rotating machines to identify unseen faults," *Journal of Computational Design and Engineering*, vol. 13, no. 7, pp. 20–34, 2026. doi:10.1093/jcde/qwag057

**[J5]** Minseok Chae, **Hyeongmin Kim**, Sang Kyung Lee, Hansoo Kim, Joonho Yang, Heonjun Yoon, Byeng D. Youn, "An adapter-enhanced, Fourier feature deep operator network for fault severity estimation of stator inter-turn short circuits in induction motors," *Engineering Applications of Artificial Intelligence*, vol. 170, 114197, 2026. doi:10.1016/j.engappai.2026.114197

**[J6]** ★ Chaehyun Suh†, **Hyeongmin Kim**†, Chan Hee Park, Minseok Chae, Joung Taek Yoon, Ilkyu Lee, Heonjun Yoon, Byeng D. Youn, "FL-SSDAN: Fleet-level semi-supervised domain adaptation network for fault diagnosis of overhead hoist transports," *Journal of Computational Design and Engineering*, vol. 12, no. 7, pp. 49–60, 2025. doi:10.1093/jcde/qwaf058

**[J7]** Minseok Chae, **Hyeongmin Kim**, Hye Jun Oh, Chan Hee Park, Chaehyun Suh, Heonjun Yoon, Byeng D. Youn, "PCDC: Prototype-assisted dual-contrastive learning with depthwise separable convolutional neural network for few-shot fault diagnosis of permanent magnet synchronous motors under new operating conditions," *Journal of Computational Design and Engineering*, vol. 11, no. 3, pp. 337–358, 2024. doi:10.1093/jcde/qwae052

**[J8]** Sang Kyung Lee, **Hyeongmin Kim**, Minseok Chae, Hye Jun Oh, Heonjun Yoon, Byeng D. Youn, "Self-supervised feature learning for motor fault diagnosis under various torque conditions," *Knowledge-Based Systems*, vol. 288, 111465, 2024. doi:10.1016/j.knosys.2024.111465

**[J9]** ★ **Hyeongmin Kim**, Chan Hee Park, Chaehyun Suh, Minseok Chae, Hye Jun Oh, Heonjun Yoon, Byeng D. Youn, "Stator current operation compensation (SCOC): A novel preprocessing method for deep learning-based fault diagnosis of permanent magnet synchronous motors under variable operating conditions," *Measurement*, vol. 221, 113446, 2023. doi:10.1016/j.measurement.2023.113446

**[J10]** **Hyeongmin Kim**, Jin Uk Ko, Kyumin Na, Hyeonchan Lee, Hee-soo Kim, Jong-duk Son, Heonjun Yoon, Byeng D. Youn, "Opt-TCAE: Optimal temporal convolutional auto-encoder for boiler tube leakage detection in a thermal power plant using multi-sensor data," *Expert Systems with Applications*, vol. 215, 119377, 2023. doi:10.1016/j.eswa.2022.119377

**[J11]** **Hyeongmin Kim**, Chan Hee Park, Chaehyun Suh, Minseok Chae, Heonjun Yoon, Byeng D. Youn, "MPARN: Multi-scale path attention residual network for fault diagnosis of rotating machines," *Journal of Computational Design and Engineering*, vol. 10, no. 2, pp. 860–872, 2023. doi:10.1093/jcde/qwad031

**[J12]** Chan Hee Park, **Hyeongmin Kim**, Chaehyun Suh, Minseok Chae, Heonjun Yoon, Byeng D. Youn, "A health image for deep learning-based fault diagnosis of a permanent magnet synchronous

motor under variable operating conditions: Instantaneous current residual map," *Reliability Engineering & System Safety*, vol. 226, 108715, 2022. doi:10.1016/j.ress.2022.108715

**[J13]** Chan Hee Park, Junmin Lee, **Hyeongmin Kim**, Chaehyun Suh, Myeongbaek Youn, Yongjin Shin, Sung-Hoon Ahn, Byeng D. Youn, "Drive-tolerant current residual variance (DTCRV) for fault detection of a permanent magnet synchronous motor under operational speed and load torque conditions," *IEEE Access*, vol. 9, pp. 49055–49068, 2021. doi:10.1109/ACCESS.2021.3068425

### Manuscripts Under Revision

**[R1]** Hansoo Kim, **Hyeongmin Kim**, Minseok Chae, Sang Kyung Lee, Joonho Yang, Heonjun Yoon, Byeng D. Youn, "Torque-speed-aware dynamic kernel design in Gaussian process regression for non-stationary motor current fault detection," *Journal of Computational Design and Engineering*, under revision.

## CONFERENCE PUBLICATIONS

**[C1]** Sang Kyung Lee, **Hyeongmin Kim**, Minseok Chae, Hye Jun Oh, Heonjun Yoon, Byeng D. Youn, "Self-supervised stator current representation learning for motor fault diagnosis," *ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC-CIE)*, 2025.

**[C2]** **Hyeongmin Kim**, Byeng D. Youn, "Window size and sampling rate selection for cost-optimal deep learning-based fault diagnosis," *Asian Congress of Structural and Multidisciplinary Optimization (ACSMO)*, Zhengzhou, China, 2024.

**[C3]** Hye Jun Oh, Jinoh Yoo, Tae Hyung Kim, Minjung Kim, **Hyeongmin Kim**, "MALSTM-MCN ensemble learning-based planetary gearbox fault diagnosis method," *IEEE International Conference on Prognostics and Health Management (ICPHM)*, 2023.

**[C4]** **Hyeongmin Kim**, Kyumin Na, Jin Uk Ko, Heonjun Yoon, Byeng D. Youn, "Convolutional autoencoder based boiler tube leakage detection method in a thermal power plant," *ASME IDETC-CIE*, Boston, MA, USA, 2023.

**[C5]** Minseok Chae, **Hyeongmin Kim**, Hye Jun Oh, Chan Hee Park, Heonjun Yoon, Byeng D. Youn, "Few-shot learning method for fault diagnosis of permanent magnet synchronous motors under new operating conditions," *ASME IDETC-CIE*, Boston, MA, USA, 2023.

**[C6]** **Hyeongmin Kim**, Chan Hee Park, Chaehyun Suh, Minseok Chae, Heonjun Yoon, Byeng D. Youn, "A multi-scale residual network with attention mechanism for fault diagnosis of rotating machines," *ASME IDETC-CIE*, St. Louis, MO, USA, 2022.

**[C7]** **Hyeongmin Kim**, Maximilian Kosel, Byeng D. Youn, "Reinforcement learning-based optimal parameter estimation of ultra precision machine," *International Conference on Energy, Aquatech and Sustainability (ICEAS)*, Ansan, Korea, 2022.

**[C8]** Kyumin Na, Jin Uk Ko, **Hyeongmin Kim**, Byeng D. Youn, "A probabilistic threshold considering probability distribution of reconstruction error on a latent space for anomaly detection using autoencoder," *Asia Pacific Conference of the Prognostics and Health Management Society (PHMAP)*, Jeju, Korea, 2021.

**[C9]** Chan Hee Park, **Hyeongmin Kim**, Chaehyun Suh, Minseok Chae, Heonjun Yoon, Byeng D. Youn, "A novel health feature for fault diagnosis of a servo motor under non-stationary conditions," *PHMAP*, Jeju, Korea, 2021.

**[C10]** **Hyeongmin Kim**, Chan Hee Park, Chaehyun Suh, Minseok Chae, Heonjun Yoon, Byeng D. Youn, "Anomaly detection of multichannel complex industrial systems using physically grouped neural networks," *PHMAP*, Jeju, Korea, 2021.

**[C11]** Chaehyun Suh, Chan Hee Park, **Hyeongmin Kim**, Minseok Chae, Heonjun Yoon, Byeng D. Youn, "Physics-informed convolutional neural network based fault diagnosis for overhead hoist transports," *PHMAP*, Jeju, Korea, 2021.

**[C12]** Donghyu Lee, Jinwook Lee, **Hyeongmin Kim**, Hwayong Jeong, Dowan Kim, Byeng D. Youn, "Intelligent fault diagnosis and signal forecasting for prognostics and health management of an oil-injection screw compressor," *PHMAP*, Jeju, Korea, 2021.

**[C13]** Hyeonchan Lee, Kyumin Na, **Hyeongmin Kim**, Byeng D. Youn, "A physics-informed feature engineering approach to boiler tube diagnosis," *PHMAP*, Jeju, Korea, 2021.

**[C14]** Chan Hee Park, **Hyeongmin Kim**, Chaehyun Suh, Minseok Chae, Heonjun Yoon, Byeng D. Youn, "A novel deep learning-based fault diagnosis of a servo motor under non-stationary conditions," *International Conference on Energy, Aquatech and Sustainability (ICEAS)*, 2021.

**[C15]** Chaehyun Suh, Chan Hee Park, **Hyeongmin Kim**, Byeng D. Youn, "Domain adversarial neural network based unit adaptation method for fault detection of overhead hoist transports," *International Symposium on Precision Engineering and Sustainable Manufacturing*, 2020.

## PATENTS

Korean patents. English titles are translations. Inventors listed in the order of the patent record.

### Registered

**[P1]** Byeng D. Youn, Kyumin Na, Jin Uk Ko, **Hyeongmin Kim**, "Anomaly data detection apparatus and method based on an auto-encoder," KR 10-2653349, registered Mar 27, 2024.

**[P2]** Byeng D. Youn, Chan Hee Park, **Hyeongmin Kim**, Chaehyun Suh, Minseok Chae, Heonjun Yoon, "Method and apparatus for generating an image for motor fault diagnosis, and method and apparatus for motor fault diagnosis using said image," KR 10-2601072, registered Nov 7, 2023.

**[P3]** Byeng D. Youn, Jae Dong Kim, Jong Duk Son, Hee Soo Kim, Joon Seok Oh, **Hyeongmin Kim**, Kyumin Na, "System and method for detecting tube leakage using state signal of a power generation plant," KR 10-2560572, 10-2560573, 10-2557198, 10-2557199, 10-2554301 (five divisional registrations), 2023.

**[P4]** Byeng D. Youn, Chaehyun Suh, Chan Hee Park, **Hyeongmin Kim**, Minseok Chae, "Method and apparatus for diagnosis of a motor using multi-channel signals," KR 10-2480899, registered Dec 20, 2022.

**[P5]** Byeng D. Youn, **Hyeongmin Kim**, Chan Hee Park, Chaehyun Suh, Minseok Chae, "Error detection apparatus and method of a motor," KR 10-2473124, registered Nov 28, 2022.

### Filed (Pending)

**[P6]** Byeng D. Youn, Sang Kyung Lee, **Hyeongmin Kim**, Minseok Chae, Hansoo Kim, Joonho Yang, Heonjun Yoon, "Fault diagnosis method for mechanical systems," KR 10-2025-0132923, filed Sep 16, 2025.

**[P7]** Byeng D. Youn, Minseok Chae, Hansoo Kim, Joonho Yang, Sang Kyung Lee, **Hyeongmin Kim**, Heonjun Yoon, "Method for estimating motor fault severity," KR 10-2025-0132924, filed Sep 16, 2025.

**[P8]** Byeng D. Youn, Hansoo Kim, Minseok Chae, Joonho Yang, Sang Kyung Lee, **Hyeongmin Kim**, Heonjun Yoon, "Motor fault diagnosis method," KR 10-2025-0132925, filed Sep 16, 2025.

**[P9]** Byeng D. Youn, Heonjun Yoon, Sang Kyung Lee, **Hyeongmin Kim**, Minseok Chae, Hye Jun Oh, "Self-supervised learning based motor fault diagnosis system and method," KR 10-2025-0078755, filed Jun 16, 2025.

**[P10]** Byeng D. Youn, Heonjun Yoon, Sang Kyung Lee, **Hyeongmin Kim**, Minseok Chae, Hye Jun Oh, "Self-supervised learning model for motor fault diagnosis under various torque conditions," KR 10-2024-0111970, filed Aug 21, 2024.

**[P11]** Byeng D. Youn, **Hyeongmin Kim**, Chan Hee Park, Chaehyun Suh, Minseok Chae, Heonjun Yoon, "Apparatus and method for fault diagnosis of rotating machinery using multi-scale dilated convolution," KR 10-2022-0067622, filed Jun 2, 2022.

## RESEARCH PROJECTS

Participating researcher. Principal Investigator: Prof. Byeng D. Youn, Seoul National University.

**2018 – 2024** Korea–Germany Intelligent Manufacturing Systems Laboratory, *National Research Foundation of Korea*

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|---|---|
| **2020 – 2024** | Physics+AI Modeling and Evolution Methodology for Mechanical Systems, *National Research Foundation of Korea* |
| **2018 – 2022** | Development of AI-based Diagnosis and Prognostics System for Power Plant, *Korea Electric Power Corporation* |
| **2020** | Development of Deep Learning-based Anomaly Detection Techniques for OHT Driving Parts, *Samsung Electronics* |
| **2019** | Development of Machine Learning-based Condition Monitoring Techniques for OHT Driving Parts and Fault Detection Techniques for Stepper Motors, *Samsung Electronics* |

## AWARDS AND HONORS

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| **2024** | Outstanding Doctoral Dissertation Award, KSME CAE & Applied Mechanics Division |
| **2023** | 2nd Place, Data Challenge, IEEE International Conference on Prognostics and Health Management |
| **2023** | Editor's Choice Article, *Journal of Computational Design and Engineering* |
| **2022** | Silver Prize, Student Paper Competition, KSME CAE & Applied Mechanics Division Spring Conference |
| **2021** | 1st Place, Data Challenge, Asia Pacific Conference of the PHM Society (PHMAP 2021) |

## TEACHING AND SERVICE

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|---|---|
| **2019 Fall** | Teaching Assistant, *Mechanics and Design*, Dept. of Mechanical Engineering, Seoul National University |
| **2020 Spring** | Teaching Assistant, *Mechanical Engineering Laboratory*, Dept. of Mechanical Engineering, Seoul National University |
| **2024.11** | Session Chair, AI/Machine Learning Session, KSME Annual Fall Conference |
| **2024.06** | Session Chair, Industrial AI Session, PHM Korea 2024, Seoul |