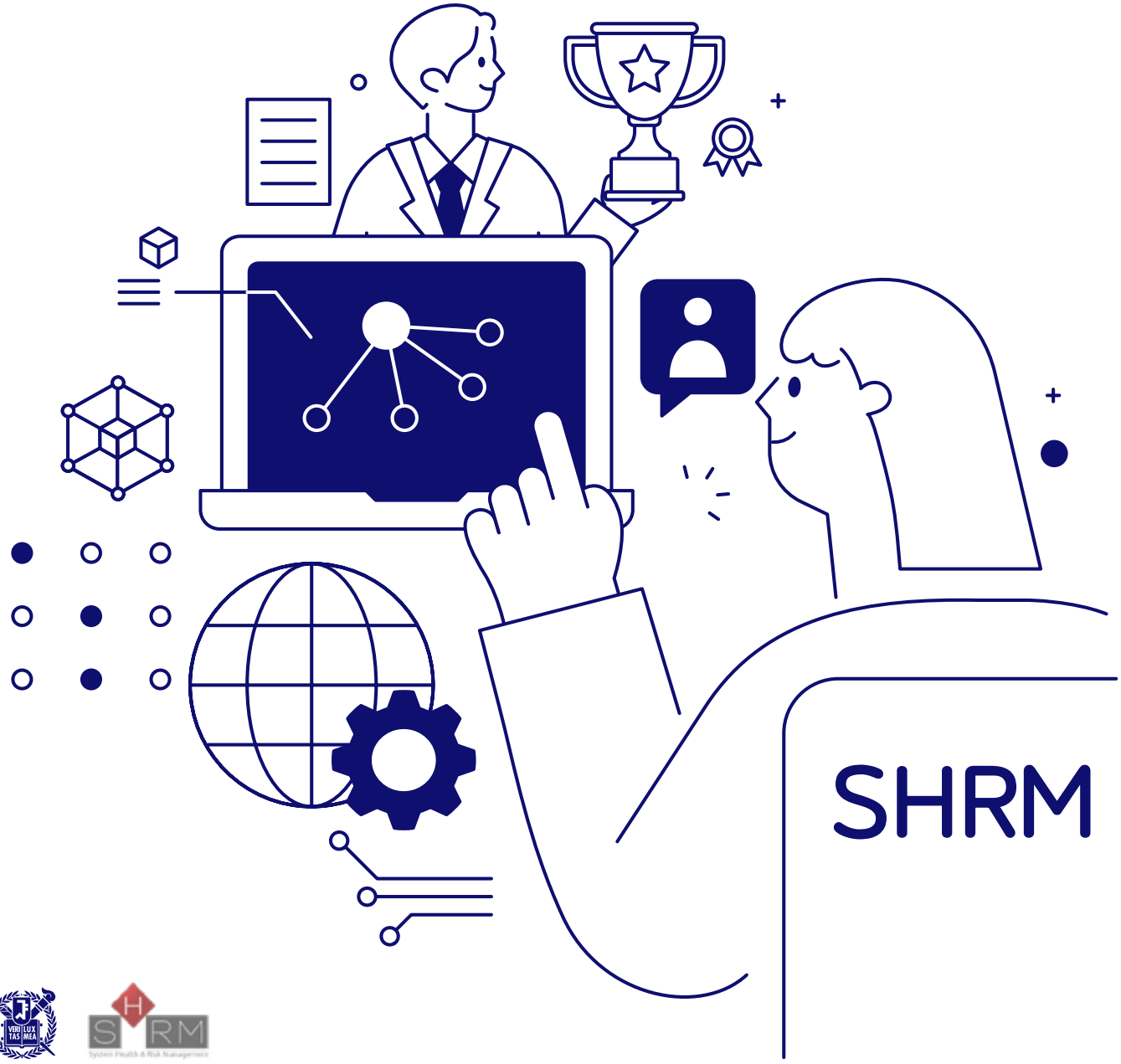
SHRM Newsletter

2021.6 - 2023.4



Dear.

SHRM Newsletter Subscribers

Greetings and Welcome to our SHRM newsletter!

In this edition, we are pleased to deliver highlights of SHRM member activities from June 2021 to April 2023. This newsletter features the wide-ranging scholarly and professional activities of current and former SHRM members, including notable achievements in both research and education activities.

From.

SHRM

Index

1

New Journal Papers / Awards / Patents

1. New Journal Papers / Awards / Patents

Journal Papers (50 Published, 14 Submitted)

50 Papers were published for publication in highly ranked journals. In addition, 14 papers are submitted. Progress on these papers will be reported in future newsletter.

Published

1 Hyeongmin Kim, Jin Uk Ko, Kyumin Na, Hyeonchan Lee, Hee-soo Kim, Jong-duk Son, Heonjun Yoon*, and 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, pp 119377, 2023-04

2 Jin Uk Ko, Jinwook Lee, Taehun Kim, Yong Chae Kim, and Byeng D. Youn*, "Deep-learning-based Fault Detection and Recipe Optimization for a Plastic Injection Molding Process Under the Class Imbalance Problem," Journal of Computational Design and Engineering, Vol 10, No 2, pp 694-710, 2023-04

3 Jin-gyun Park, Heonjun Yoon*, and Byeng D. Youn*, "Probabilistic Framework for Reliable Optimal Design of Gearboxes in General-purpose Industrial Robots Considering Random Use Conditions," Journal of Computational Design and Engineering, Vol 10, No 2, pp 539-548, 2023-04

4 Sehui Jeong, Hyunhee Choi, Byeng D. Youn*, and Hyejeong Son*, "Statistical Prior Modeling with Radius-Uniform Distribution for a Correlation Hyperparameter in Bayesian Calibration," Structural and Multidisciplinary Optimization, Vol 66, No 4, pp 69, 2023-04

5 Soo-Ho Jo*, Donghyu Lee, Heonjun Yoon, and Byeng D. Youn, "Double Piezoelectric Defects in Phononic Crystals for Ultrasonic Transducers," Journal of Physics D: Applied Physics, Vol 56, No 7, pp 074002, 2023-02

6 Kyumin Na, Heonjun Yoon*, Jaedong Kim, Sungjong Kim, and Byeng D. Youn*, "PERL: Probabilistic Energy-ratio-based Localization for Boiler Tube Leaks Using Descriptors of Acoustic Emission Signals," Vol 230, pp 108923, 2023-02

7 Soo-Ho Jo and Byeng D. Youn*, "Longitudinal Wave Localization Using a One-dimensional Phononic Crystal with Differently Patterned Double Defects," International Journal of Mechanical Sciences, Vol 237, pp 107783, 2023-01

8 Keunsu Kim, Heonjun Yoon*, and Byeng D. Youn*, “A Noise-robust Feature Extraction Method for Rolling Element Bearing Diagnosis: Linear Power-Normalized Cepstral Coefficients (LPNCC),” International Journal of Precision Engineering and Manufacturing-Green Technology, Vol 10, No 1, pp 217-232, 2023-01

9 Adam Thelen, Xiaoge Zhang, Olga Fink, Yan Lu, Sayan Ghosh, Byeng D. Youn, Michael D. Todd, Sankaran Mahadevan, Chao Hu*, and Zhen Hu*, “A Comprehensive Review of Digital Twin - Part 2: Roles of Uncertainty Quantification and Optimization, a Battery Digital Twin, and Perspectives,” Structural and Multidisciplinary Optimization, Vol 66, pp 1, 2023-01

10 Wongon Kim, Sunuwe Kim, Jingyo Jeong, Hyunjae Kim, Hyunchan Lee, and Byeng D. Youn*, “Digital Twin Approach for On-Load Tap Changers Using Data-driven Dynamic Model Updating and Optimization-based Operating Condition Estimation,” Mechanical Systems and Signal Processing, Vol 181, pp 109471, 2022-12

11 Boseong Seo, Jaekyung Shin, Taejin Kim*, and Byeng D. Youn*, “Missing Data Imputation Using an Iterative Denoising Autoencoder (IDAE) for Dissolved Gas Analysis,” Electric Power Systems Research, Vol 212, pp 108642, 2022-11

12 Haichao An, Byeng D. Youn*, and Heung Soo Kim*, “Optimal Placement of Non-redundant Sensors for Structural Health Monitoring under Model Uncertainty and Measurement Noise,” Measurement, Vol 204, pp 112102, 2022-11

13 Adam Thelen, Xiaoge Zhang, Olga Fink, Yan Lu, Sayan Ghosh, Byeng D. Youn, Michael D. Todd, Sankaran Mahadevan, Chao Hu*, and Zhen Hu*, “A Comprehensive Review of Digital Twin - Part 1: Modeling and Twinning Enabling Technologies,” Structural and Multidisciplinary Optimization, Vol 65, pp 354, 2022-11

14 Chan Hee Park, Hyeongmin Kim, Chaehyun Suh, Minseok Chae, Heonjun Yoon*, and 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, pp 108715, 2022-10

15 Wongon Kim, Guesuk Lee*, Hyejeong Son, Hyunhee Choi, and Byeng D. Youn*, “Estimation of Fatigue Crack Initiation and Growth in Engineering Product Development Using a Digital Twin Approach,” Reliability Engineering & System Safety, Vol 226, pp 108721, 2022-10

16 Yeongtak Oh, Yunhan Kim, Kyumin Na, and Byeng D. Youn*, “A Deep Transferable Motion-Adaptive Fault Detection Method for Industrial Robots Using a Residual-Convolutional Neural Network,” ISA Transactions, Vol 128, pp 521-534, 2022-09

17 Izaz Raouf, Hyewon Lee, Yeong Rim Noh, Byeng D. Youn, and Heung Soo Kim*, “Prognostic Health Management of the Robotic Strain Wave Gear Reducer Based on Variable Speed of Operation: A Data-Driven via Deep Learning Approach,” Journal of Computational Design and Engineering, Vol 9, No 5, pp, 1775–1788, 2022-10

18 Su J. Kim, Sungjong Kim, Seungyun Lee, Byeng D. Youn*, and Taejin Kim*, “Effective Band-selection Algorithm for Rolling Element Bearing Diagnosis Using AE Sensor Data under Noisy Conditions,” Structural and Multidisciplinary Optimization, Vol 65, pp 275, 2022-09

19 Soo-Ho Jo* and Byeng D. Youn*, “Enhanced Ultrasonic Wave Generation Using Energy-localized Behaviors of Phononic Crystals,” International Journal of Mechanical Sciences, Vol 228, pp 107483, 2022-08

20 Yunhan Kim[1], Taekyum Kim[1], Byeng D. Youn*, and Sung-Hoon Ahn*, “Machining Quality Monitoring (MQM) in Laser-Assisted Micro-Milling of Glass Using Cutting Force Signals: An Image-Based Deep Transfer Learning,” Journal of Intelligent Manufacturing, Vol 33, No 6, pp 1813-1828, 2022-08

21 Soo-Ho Jo and Byeng D. Youn*, “Designing a Phononic Crystal with a Defect for Target Frequency Matching Using an Analytical Approach,” Mechanics of Advanced Materials and Structures, Vol 29, No 17, pp 2454-2467, 2022-07

22 Soo-Ho Jo[1], Heonjun Yoon[1], Yong Chang Shin, Wonjae Choi, Byeng D. Youn*, and Miso Kim*, “L-shape Triple Defects in a Phononic Crystal for Broadband Piezoelectric Energy Harvesting,” Nano Convergence, Vol 9, pp 29, 2022-06

23 Feichao Cai, Soo-Ho Jo, Yuqin Ma*, Haiyin Guo, Yi Xu , Wei Xu, and Fei Li, “Effect of Four Groups of GO-CF/EP Composites with Ideal Infiltration Structure and Different Layering Ways on Damping Properties,” Polymers, Vol 14, No 12, pp 2358, 2022-06

24 Yong Chang Shin, Soo-Ho Jo, Heonjun Yoon*, and Byeng D. Youn*, “Design Principle for Effective Mechanical Boundary Using a Resonance Band Gap under Elastic Waves,” Journal of Computational Design and Engineering, Vol 9, No 2, pp 772-782, 2022-04

25 Su J. Kim, Keunsu Kim, Taewan Hwang, Jongmin Park, Hwayong Jeong, Taejin Kim*, and Byeng D. Youn*, “Motor-current-based Electromagnetic Interference De-noising Method for Rolling Element Bearing Diagnosis Using Acoustic Emission Sensor,” Measurement, Vol 193, pp 110912, 2022-04

26 Jin Uk Ko, Kyumin Na, Joon-Seok Oh, Jaedong Kim, and Byeng D. Youn*, “A New Auto-Encoder Based Dynamic Threshold to Reduce False Alarm Rates for Anomaly Detection of Steam Turbines,” Expert Systems with Applications, Vol 189, pp 116094, 2022-03

27 Sunuwe Kim, Jongmin Park, Wongon Kim, Soo-Ho Jo*, and Byeng D. Youn*, “Learning from Even a Weak Teacher: Bridging Rule-based Duval Method and a Deep Neural Network for Power Transformer Fault Diagnosis,” International Journal of Electrical Power and Energy Systems, Vol 136, pp 107619, 2022-03

28 Jong M. Ha and Byeng D. Youn*, “Fault Diagnosis of a Planetary Gearbox by D Norm-based Time Synchronous Averaging(DTSA) with Roughly Estimated Phase Information under an Encoder-less,” Journal of Sound and Vibration, Vol 520, pp 116546, 2022-03

29 Yunhan Kim, Kyumin Na, and Byeng D. Youn*, “A Health-adaptive Time-Scale Representation (HTSR) Embedded Convolutional Neural Network for Gearbox Fault Diagnostics,” Mechanical Systems and Signal Processing, Vol 167, pp 108575, 2022-03

30 Jungho Park, Yunhan Kim, Kyumin Na, Byeng D. Youn*, Yuejian Chen, Ming J. Zuo*, and Yong-Chae Bae, “An Image-based Feature Extraction Method for Fault Diagnosis of Variable-speed Rotating Machinery,” Mechanical Systems and Signal Processing, Vol 167, pp 108524, 2022-03

31 Haichao An, Byeng D. Youn*, and Heung Soo Kim*, “Optimal Sensor Placement Considering Both Sensor Fault under Uncertainty and Sensor Clustering for Vibration-Based Damage Detection,” Structural and Multidisciplinary Optimization, Vol 65, pp 102, 2022-03

32 Soo-Ho Jo, Heonjun Yoon*, Yong Chang Shin, and Byeng D. Youn*, “Revealing Defect-mode-enabled Energy Localization Mechanisms of a One-dimensional Phononic Crystal,” International Journal of Mechanical Sciences, Vol 215, pp 106950, 2022-02

33 Jinwook Lee, Myungyon Kim, Jin Uk Ko, Joon Ha Jung, Kyung Ho Sun, and Byeng D. Youn* , “Asymmetric Inter-Intra Domain Alignments (AIIDA) Method for Intelligent Fault Diagnosis of Rotating Machinery,” Reliability Engineering & System Safety, Vol 218, pp 108186, 2022-02

34 Hyejeong Son, Hyunhee Choi, Wongon Kim, Byeng D. Youn*, and Guesuk Lee*, “A Comparative Study of Statistical Validation Metrics with Consideration of Variance to Address Type II Errors in Statistical Model Validation,” Structural and Multidisciplinary Optimization, Vol 65, pp 63, 2022-02

35 Haichao An, Byeng D. Youn*, and Heung Soo Kim*, “A Methodology for Sensor Number and Placement Optimization for Vibration-Based Damage Detection of Composite Structures under Model Uncertainty,” Composite Structures, Vol 279, pp 114863, 2022-01

36 Myungyon Kim, Jin Uk Ko, Jinwook Lee, and Byeng D. Youn*, Joon Ha Jung, and Kyung Ho Sun, “A Domain Adaptation with Semantic Clustering (DASC) Method for Fault Diagnosis of Rotating Machinery,” ISA Transactions, Vol 120, pp 372-382, 2022-01

37 Joon Ha Jung, Myungyon Kim, Jin Uk Ko, Hyeon Bae Kong, Byeng D. Youn*, and Kyung Ho Sun, “Label-based, Mini-batch Combinations Study for Convolutional Neural Network Based Fluid-film Bearing Rotor System Diagnosis,” Computers in Industry, Vol 133, pp 103546, 2021-12

38 Soo-Ho Jo and Byeng D. Youn*, “An Explicit Solution for the Design of a Target-frequency-customized, Piezoelectric-defect-introduced Phononic Crystal for Elastic Wave Energy Harvesting,” Journal of Applied Physics, Vol 130, No 18, pp 184902, 2021-11

39 Hyejeong Son, Byeng D. Youn, and Taejin Kim* , “Model Improvement with Experimental Design for Identifying Error Sources in a Computational Model,” Structural and Multidisciplinary Optimization, Vol 64, pp 3109-3122, 2021-11

40 Yunhan Kim, Jong M. Ha, Kyumin Na, Jungho Park, and Byeng D. Youn*, “Cepstrum-assisted Empirical Wavelet Transform (CEWT) based Improved Demodulation Analysis for Fault Diagnostics of Planetary Gearboxes,” Measurement, Vol 183, pp 109796, 2021-10

41 Soo-Ho Jo and Byeng D. Youn*, “An Improved Analytical Model that Considers Lateral Effects of a Phononic Crystal with a Piezoelectric Defect for Elastic Wave Energy Harvesting,” International Journal of Mechanical Sciences, Vol 205, pp 106593, 2021-09

42 Haichao An, Byeng D. Youn*, and Heung Soo Kim*, “Reliability-based Design Optimization of Laminated Composite Structures under Delamination and Material Property Uncertainties,” International Journal of Mechanical Sciences, Vol 205, pp 106561, 2021-09

43 Sooho Kim, Jin-Oh Hahn*, and Byeng D. Youn*, “Deep Learning-Based Diagnosis of Peripheral Artery Disease via Continuous Property-Adversarial Regularization: Preliminary In Silico Study,” IEEE Access, Vol 9, pp 127433-127443, 2021-09

44 Soo-Ho Jo, Yong Chang Shin, Wonjae Choi, Heonjun Yoon, Byeng D. Youn*, and Miso Kim*, "Double defects-induced Elastic Wave Coupling and Energy Localization in a Phononic Crystal," Nano Convergence, Vol 8, pp 29, 2021-09

45 Chan Hee Park, Hyunjae Kim, Junmin Lee, Giljun Ahn, Myeongbaek Youn, and Byeng D. Youn*, "A Feature Inherited Hierarchical Convolutional Neural Network (FI-HCNN) for Motor Fault Severity Estimation Using Stator Current Signals," International Journal of Precision Engineering and Manufacturing-Green Technology, Vol 8, pp 1253-1266, 2021-07

46 Soo-Ho Jo and Byeng D. Youn*, "A Phononic Crystal with Differently Configured Double Defects for Broadband Elastic Wave Energy Localization and Harvesting," Crystals, Vol 11, No 6, pp 643, 2021-06

47 Jong M. Ha and Byeng D. Youn*, "A Health Data Map-Based Ensemble of Deep Domain Adaptation under Inhomogeneous Operating Conditions for Fault Diagnosis of a Planetary Gearbox," IEEE Access, Vol 9, pp 79118-79127, 2021-06

48 Hyeongmin Kim, Chan Hee Park, Chaehyun Suh, Minseok Chae, Heonjun Yoon*, and Byeng D. Youn*, "MPARN: Multi-scale Path Attention Residual Network for Fault Diagnosis of Rotating Machines," Journal of Computational Design and Engineering, Accepted

49 Jin Uk Ko, Jinwook Lee, Taehun Kim, Yong Chae Kim, and Byeng D. Youn*, "Frequency-learning Generative Network (FLGN) to Generate Signals of Variable Lengths," Expert Systems with Applications, Accepted

50 Hyeonchan Lee, Wongon Kim*, Hyejeong Son, Hyunhee Choi, Soo-Ho Jo, and Byeng D. Youn*, "A New Initial Point Search Algorithm for Bayesian Calibration with Insufficient Statistical Information: Greedy Stochastic Section Search," Structural and Multidisciplinary Optimization, Accepted

Submitted

1 Hye Jun Oh, Jinoh Yoo, Sangkyung Lee, Minseok Chae, Jongmin Park, and Byeng D. Youn*, "A Hybrid Approach of Data-Driven and Signal Processing-Based Methods for Fault Diagnosis of Hydraulic Rock Drill," International Journal of Prognostics and Health Management, Under Revision

2 Hyeongmin Kim, Chan Hee Park, Chaehyun Suh, Minseok Chae, Heonjun Yoon*, and 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, Under Revision

3 Wongon Kim and Byeng D. Youn*, "Physics-based Digital Twin Updating and Twin-based Explainable Crack Identification of Mechanical Lap Joint," Reliability Engineering & System Safety, Under Revision

4 Taewan Hwang, Jong M. Ha*, and Byeng D. Youn*, "Robust Deep Learning-based Fault Diagnosis of Planetary Gearbox Using Enhanced Health Data Map (enHDMap) under Domain Shift Problem," Journal of Computational Design and Engineering, Under Revision

5 Jongmin Park, Jinoh Yoo, Taehyung Kim, Jong M. Ha*, and Byeng D. Youn*, “Multi-head De-noising Autoencoder Based Multitask (MDAM) Model for Fault Diagnosis of Rolling Element Bearings under Various Speed Conditions,” Journal of Computational Design and Engineering, Under Revision

6 Haichao An, Byeng D. Youn*, and Heung Soo Kim*, “An Optimization Framework for Design of Variable-Stiffness Composites with Fiber Steering Constraints Using Dynamic and Exponential Multi-Fidelity Surrogate Models,” International Journal of Mechanical Sciences, Under Revision

7 Yong Chae Kim, Taehun Kim, Jin Uk Ko*, Jinwook Lee, and Keon Kim, “Domain Adaptation based Fault Diagnosis under Variable Operating Conditions of a Rock Drill,” International Journal of Prognostics and Health Management, Under Revision

8 Donghyu Lee, Byeng D. Youn*, and Soo-Ho Jo*, “Deep Learning-based Framework for Inverse Design of a One-dimensional Phononic Crystal with a Defect for Narrow Bandpass Filtering: A Comparative Study,” International Journal of Mechanical Sciences, Under Revision

9 Yong Chae Kim, Jin Uk Ko, Jinwook Lee, Taehun Kim, Joon Ha Jung*, and Byeng D. Youn*, “Latent Space Alignment based Domain Adaptation (LSADA) for Fault Diagnosis of Rotating Machinery,” Mechanical Systems and Signal Processing, Submitted

10 Jinoh Yoo, Jongmin Park, Taehyung Kim, Jong Moon Ha, and Byeng D. Youn*, “Weighted multi-order Viterbi algorithm (WMOVA): Instantaneous Angular Speed Estimation under Harsh Condition,” Mechanical Systems and Signal Processing, Submitted

11 Jinwook Lee, Jin Uk Ko, Taehun Kim, Yong Chae Kim, Joon Ha Jung*, and Byeng D. Youn*, “Domain Adaptation with Label-Aligned Sampling (DALAS) for Cross-Domain Fault Diagnosis Under Class Imbalance,” Expert Systems with Applications, Submitted

12 Chen Jiang, Hyunhee Choi, and Byeng D. Youn*, “Physics-informed Gaussian Process Probabilistic Modeling for Prognostics of Degradation Processes with Multi-source Data,” Mechanical Systems and Signal Processing, Submitted

13 Hyunhee Choi, Chen Jiang, Byeng D. Youn*, and Taejin Kim*, “Uncertainty Analysis of Stack Pressure in EV Battery Module System Using a Phenomenological Modeling Approach,” Journal of Energy Storage, Submitted

14 Hyunhee Choi, Hyejeong Son, Yong Hwan Choi, Byeng D. Youn*, and Guesuk Lee*, “Reliability-Based Design Optimization of a Pouch Battery Module Using Gaussian Process Modeling in the Presence of Cell Swelling,” Structural and Multidisciplinary Optimization, Submitted

Awards

38 awards were rewarded, 3 Achievement Awards, 16 AI Competition Winners, 19 Best Paper/Presentation/Poster Awards from Conferences.

Congratulations to all prize winners!

Achievement Awards

01

Byeng D. Youn

KSME Research Excellence Award in CAE & Applied Mechanics, The Korean Society of Mechanical Engineers (KSME)

May, 2022

02

Byeng D. Youn

The Korean Reliability Grand Prize, The Korean Reliability Society (KORAS)

November, 2021

03

Byeng D. Youn

Lifetime Achievement Award, Korea Society of Prognostics and Health Management (KSPHM)

September, 2021

AI Competiton Winners

01

Seungyun Lee and Bongmo Kim

2rd Place Winner, Industrial AI Hackathon Factory Hack Korea 2023

February 2023

02

Hyeongmin Kim, Minseok Chae, Hye Jun Oh, and Sang Kyung Lee

3rd Place Winner, Industrial AI Hackathon Factory Hack Korea 2023

February 2023

03

Sang Kyung Lee, Hye Jun Oh, Yong Chae Kim, and Bongmo Kim

Excellence Prize, Postech Open Innovation Big Data Challenge

December 2022

04

Hye Jun Oh, Jinoh Yoo, Sang Kyung Lee, Minseok Chae, Jongmin Park, and Byeng D. Youn

1st Place Winner, 2022 PHM Society Data Challenge Competition

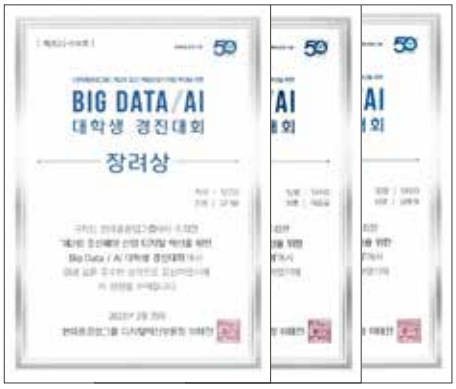
November 2022

05

Yong Chae Kim, Taehun Kim, Jin Uk Ko, Jinwook Lee, Keon Kim, and Byeng D. Youn

2nd Place Winner, 2022 PHM Society Data Challenge Competition

November 2022



06

Taehun Kim, Seungyun Lee, and Yong Chae Kim

Encourage Prize, Big Data,
AI Contest for Digital Innovation in Shipbuilding/Offshore industry

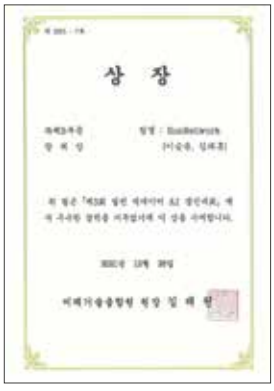
February 2022

07

Taehun Kim, Donghyu Lee, and Seungyun Lee

Encourage Prize, Industrial AI Hackathon Factory Hack Korea 2022

February 2022



08

Seungyun Lee and Taehun Kim

Encourage Prize, Korea East-West Power Data AI Competition

December 2021


상 장

09

Jin Uk Ko, Jinwook Lee, and Taehun Kim

The Grand Prize (Minister of SMEs and Startups Award), Korea-AI Manufacturing Data Analysis Competition 2021

December 2021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10

Wongon Kim and Minseok Chae

Excellece Prize (KAIST K-Industry 4.0 Head of Promotion Division), Korea-AI manufacturing data analysis competition 2021

December 2021


상 장

KAIST

11

Su J. Kim, Jongmin Park, and Sungjong Kim

Encourage Prize, Korea-AI manufacturing data analysis competition 2021

December 2021


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장

12

Donghyu Lee and Seungyun Lee

Grand Prize, Heart Disease AI Dathathon

December 2021


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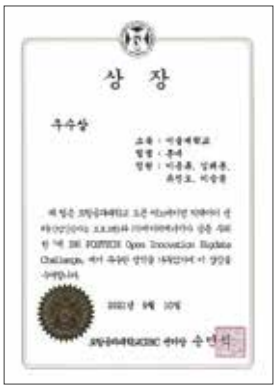
13

Chaehyun Suh, Dowan Kim, and Hyeonchan Lee

Grand Pize (Minister of Trade, Industry and Energy Award), Industry-Academic Project Challenge

November 2021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우수상

14

Donghyu Lee, Taehun Kim, Jinoh Yoo, and Seungyun Lee

Excellence Prize, Postech Open Innovation Big Data Challenge Competition

September 2021


Data Challenge Award

— 1st Place —

15

Hyeonchan Lee, Taehun Kim, In Chan Lee, Hyunhee Choi, and Byeng D. Youn

1st Place Winner, PHMAP 2021 Data Challenge Award

September 2021


Data Challenge Award

— 1st Place —

16

Jinwook Lee, Hyeongmin Kim, Donghyu Lee, Hwayong Jeong, Dowan Kim, and Byeng D. Youn

1st Place Winner, PHMAP 2021 Data Challenge Competition

September, 2021

Best paper/Presentation/Poster awards from conferences

01

Jin Uk Ko

Best Dissertation Award, Department of Mechanical Engineering, Seoul National University, “Deep-learning-based Methodology for Macro- and Micro-level Fault Diagnosis of Rotating Machinery Using Low- and High-resolution Signals”

February 2023

02

Taehun Kim

Best Dissertation Award, Department of Mechanical Engineering, Seoul National University, “Spectrum-guided GAN: A Reliable Signal Generation Approach for Fault Diagnosis of Rotating Machinery with Limited Data”

February 2023

03

Soo-Ho Jo

2022 Best Ph.D. Thesis Award

December 2022

04

Yong Chae Kim

Scholarship from Kwanjeong Educational Foundation

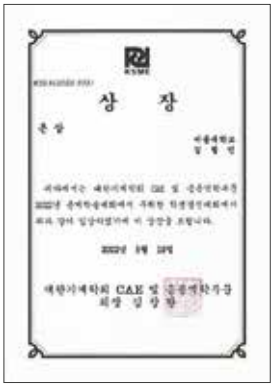
July 2022

05

Guesuk Lee, Hyunhee Choi, Yonghwan Choi, and Byeng D. Youn

Best Presentation Paper Award, The Korean Reliability Society (KORAS), “Reliability-Based Design Optimization of Pouch Type Battery Module in Electric Vehicle”

July 2022



06

Hyungmin Kim

Student competition, The Korean Society of Mechanical Engineers (KSME), “Deep Learning-based Fault Diagnosis of Motor under Various Operating Conditions”

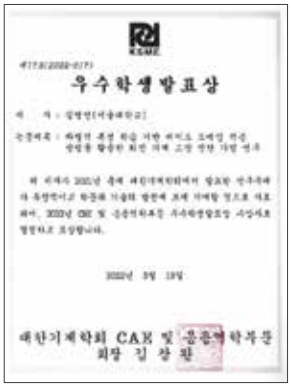
May 2022

07

Hyunhee Choi, Yonghwan Choi, Hyejeong Son, Guesuk Lee, and Byeng D. Youn

Best paper Award, The Korean Society of Mechanical Engineers (KSME), “Reliability Based Design Optimization of Pouch Battery Module in Stack Pressure Perspective”

May 2022



08

Myungyon Kim

Best Presentation Paper Award, The Korean Society of Mechanical Engineers (KSME), “Fault Diagnosis of Ratating Machinery Using Unsupervised Domain Adaptation Method Based on Discriminative Feature Learning”

May, 2022

09

Chehyun Suh

Best Dissertation Award, The Korean Society of Mechanical Engineers (KSME), “Feature-analytic, Fleet-adaptive Network for Fault Diagnosis of Automated Material Handling Systems”

May 2022

10

Chan Hee Park

Best Dissertation Award, The Korean Society of Mechanical Engineers (KSME), “Physics-guided Deep Learning Study for Fault Diagnostics of Industrial Motors Under Variable Operating Conditions Using Stator Current Signals”

May 2022

11

Yong Chae Kim

Fellowship Scholarship as the 4th BK 21 Outstanding Graduate Student

March 2022

12

Yunhan Kim

Best Dissertation Award, The Korean Society of Mechanical Engineers (KSME), “Vibration-based Gearbox Diagnostics by Enhancement of Weak Fault-characteristic Information”

March 2022

13

Yunhan Kim

Best Dissertation Award, Department of Mechanical Engineering, Seoul National University, “Vibration-based Gearbox Diagnostics by Enhancement of Weak Fault-characteristic Information”

February 2022

14

Soo-Ho Jo and Byeng D. Youn

Best Presentation Award, Autumn conference of The Korean Sensors Society, “Broadband Power Generation Using Decoupling Characteristics of Double Defects in a Phononic Crystal”

October 2021

15

Chan Hee Park and Byeng D. Youn

Best Student Award (Gold Medal), Asia Pacific Conference of the Prognostics and Health Management Society,
“A Novel Health Feature for Fault Diagnosis of a Servo Motor Under Non-stationary Conditions”

September 2021

16

Yunhan Kim and Byeng D. Youn

Best Student Award (Bronze Medal), Asia Pacific Conference of the Prognostics and Health Management Society,
“A Novel Multiscale Convolutional Neural Network for Industrial Gearbox Fault Diagnostics”

September 2021

17

Chan Hee Park, Hyeongmin Kim, Chaehyun Suh, Minseok Chae, Heonjun Yoon, and Byeng D. Youn

Best Presentation Award, International Conference on Energy, Aquatech and Sustainability 2021, “A Novel Method for Deep learning-based Fault Diagnosis of a Servo Motor Under Non-stationary Conditions”

August 2021

18

Soo-Ho Jo

Best Dissertation Award, The Korean Society of Mechanical Engineers (KSME), “Modeling and Design of a Phonoic Crystal with Piezoelectric Defects for Broadband Energy Localization and Harvesting”

August 2021

19

Soo-Ho Jo

Editor’s Choice Article, Crystals
“A Phononic Crystal with Differently Configured Double Defects for Broadband Elastic Wave Energy Localization and Harvesting”

June 2021

Patents

27 domestic patents have been registered and 9 domestic patents have been applied. And 1 International patent has been registered and 2 International patents have been applied.

Domestic Patent (27 Registrations)

1. Byeng D. Youn, Keon Kim, Jong M. Ha, and Kyumin Na, “Method and System for Detecting Fault of Swing Device,” 10-2485686, January 3, 2023

2. Byeng D. Youn, Chaehyun Suh, Chan Hee Park, Hyeongmin Kim, and Minseok Chae, “Method and Apparatus for Diagnosis of Motor Using Multi-Channel Signals,” 10-2480899, December 20, 2022

3. Byeng D.Youn, Jin Uk Ko, Jinwook Lee, Taehun Kim, and Yong Chae Kim, “Method for Training Fault Detection Model of Injection Molding Process and Method for Optimizing Recipe of Injection Molding Process,” 10-2479531, December 15, 2022

4. Byeng D. Youn, Hyeongmin Kim, Chan Hee Park, Chaehyun Suh, and Minseok Chae, “Error Detection Apparatus and Method of Motor,” 10-2473124, November 28, 2022

5. Byeng D. Youn, Hyejeong Son, and Taejin Kim, “Model Updating with Error Sources Identification by Information Matrix,” 10-2434219, August 11, 2022

6. Byeng D. Youn, Sooho Kim, and Hyunhee Choi, “Apparatus and Method for Preprocessing Data,” 10-2427540, July 27, 2022

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4 Byeng D. Youn and Jong M. Ha, "The system and Method for D-norm Based Time-Synchronous Averaging for Diagnosing Faults of Rotation Body," 10-2021-0178709, December 14, 2021

5 Byeng D. Youn, Chan Hee Park, Hyeongmin Kim, Chaehyun Suh, Minseok Chae, and Heonjun Yoon, "Method and Apparatus for Generating an Image for Motor Fault Diagnosis, and Method and Apparatus for Motor Fault Diagnosis Using Said Image," 10-2021-0141137, October 21, 2021

6 Byeng D. Youn and Soo-Ho Jo, "Metamaterial-based Elastic Wave Parallel Translato," 10-2021-0124170, September 16, 2021

7 Byeng D. Youn, Hyeonchan Lee, Wongon Kim, Hyejeong Son, and Hyunhee Choi, "Initial Point Search Method for Markov Chain Monte Carlo Sampling," 10-2021-0097098, July 23, 2021

8 Byeng D. Youn, Kyumin Na, and Yunhan Kim, "Motion Signal Extraction System and Method Based on Vibration Signal," 10-2021-0078274, June 16, 2021

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1 Byeng D. Youn, Deog Hyeon Kim, Yong Un Cho, Yongchae Lim, Hyunseok Oh, and Junmin Lee, "Apparatus and Method for Predciting Fault State of Inverter," ZL20170130059.6, China, August 03, 2021 (China)

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1 Byeng D. Youn, Wongon Kim, Hwayong Jeong, Yong Seok Choi, and Soon Chul Byun, "System and Method for Estimating Pressure DIstribution of a Battery Cell," 18/079695, December 1, 2022 (USA)

2 Byeng D. Youn, Sunuwe Kim, Soo-Ho Jo, Jongmin Park, and Wongon Kim, "Fault Diagnosis Device of Transformer and Fault Diagnosis Method Using the Same," PCT/KR2021/013631, October 1, 2021 (PCT)

2

Project Updates

2. Project Updates

In Progress

01 Development of Diagnosis Section Segmentation and Load Estimation for Earth Moving Machinery, HD Hyundai Xitesolution

2023-03-01 ~ 2024-02-29

02 Development of Deep-learning-based Fault Diagnosis for Tipper System, Ministry of Science and ICT

2023-03-01 ~ 2024-06-30

03 Development of Diagnostic Technology for Gearbox Non-stationary Drive Area, Hyundai Genuine

2023-03-01 ~ 2024-02-28

04 A Study on Bayesian-based Signal Acquisition System and Physics-AI Hybrid Model for Next-Generation Aircraft Structure Damage Estimation, National Research Foundation of Korea

2022-09-30 ~ 2024-09-29

05 ASIP Data Analysis and Prediction of Maintenance Demand Based on Big Data, Korea Aerospace Industries

2021-07-01 ~ 2024-06-30

06 Korea-Germany Intelligent Manufacturing Systems Laboratory, National Research Foundation of Korea

2021-03-01 ~ 2024-02-29

07 Physics+AI Modeling and Evolution Methodology for Mechanical Systems, National Research Foundation of Korea

2020-03-01 ~ 2024-02-29

08 Industrial Artificial Intelligence (AI) Human Resource Development (HRD), Ministry of Trade, Industry and Energy

2020-03-01 ~ 2024-02-29

Completed

01 A Mechanical Fault Diagnosis of Induction Motors Using Current Signals, OnePredict Inc.

2023-01-05 ~ 2023-04-05

02 Medical Artificial Intelligence Convergence Human Resource Development, Ministry of Health and Welfare & Korea Health Industry Development Institute

2022-07-01 ~ 2023-01-17

03 Development of Diagnostic Technology for Gearbox Non-stationary Drive Area, Hyundai Doosan Infracore

2022-03-01 ~ 2023-02-28

04 Development of Industrial Robot Fault Detection using Current Signal with Physics-based Inverse Modeling, Hyundai Motor

2021-11-15 ~ 2022-09-15

05 Data-Driven Modelling of Swelling Degradation for a Reliable Battery Module & Pack Design, Hyundai NGV

2021-04-15 ~ 2022-10-14

06 Development of Fault Diagnosis for Gearbox under Non-stationary Rotational Operating Conditions, Doosan Infracore

2021-03-01 ~ 2022-02-28

07 Operation of Industry-Academic Advisory Group for Reliability Component Development, Hyundai Motor

2021-03-01 ~ 2022-02-28

08 Development of Health State Diagnostics and Prognostics for Substation Facility based on Integration of Artificial Intelligence and Expert Knowledge, Korea Electric Power Corporation

2020-08-01 ~ 2022-05-19

09 Operation of Industry-Academic Advisory Group for Improving Automotive Reliability, Hyundai Motor

2020-06-01 ~ 2022-03-20

10 Industrial Artificial Intelligence for Intelligent Machines and Manufacturing Digitalization, Korea Institute for Advancement of Technology

2019-12-01 ~ 2022-11-30

11 Developement of Interconnected Modular Exo-Suit System Technology for Muscular Strength of Human's Waist, Shoulder, and Knee, Civil Military Technology Cooperation Center

2019-10-01 ~ 2021-09-30

12 Development of AI-based Diagnosis and Prognostics System for Power Plant, Korea Electric Power Corporation

2018-07-01 ~ 2022-05-19

3

Alumni News

3. Alumni News

SHRM alumni have recently received several appointments and awards from SHRM and other organizations, including professors, researchers and engineers.

1

Dr. Guesuk Lee

Dr. Guesuk Lee is appointed as a Researcher of Korea Electronics Technology Institute (KETI) in March 2022.

2

Dr. Joon Ha Jung

Dr. Joon Ha Jung is appointed as an Assistant Professor in the Department of Industrial Engineering at Ajou University in September 2022.

3

Dr. Soo-Ho Jo

Dr. Soo-Ho Jo is appointed as an Assistant Professor in the Department of Mechanical, Robotics and Energy Engineering at Dongguk University in March 2023.

4

Dr. Haichao An

Dr. Haichao An is appointed as an Assistant Professor at Beijing Institute of Technology in January 2023.

5

Dr. Hyejeong Son

Dr. Hyejeong Son has worked SAMSUNG Electronics in September 2021.

6

Dr. Yong Chang Shin

Dr. Yong Chang Shin has worked SAMSUNG Electronics in September 2021.

7

Dr. Sunuwe Kim

Dr. Sunuwe Kim has worked SAMSUNG Electronics in September 2021.

8

Dr. Myungyon Kim

Dr. Myungyon Kim has worked SAMSUNG Electronics in September 2021.

9

Dr. Wongon Kim

Dr. Wongon Kim will have been appointed as a Postdoctoral Researcher at Structural Integrity and Health Monitoring Laboratory, Imperial College London in May 2023.

10

Dr. Chan Hee Park

Dr. Chan Hee Park has worked SAMSUNG Electronics in March 2022.

11

Dr. Yunhan Kim

Dr. Yunhan Kim has worked SAMSUNG Electronics in March 2022.

12

Dr. Chulmin Cho

Dr. Chulmin Cho has worked as a Senior Researcher at SAMSUNG Electronics in 2020.

13

Dr. Su J. Kim

Dr. Su J. Kim has worked OnePredict Inc. in September 2022.

14

Dr. Boseong Seo

Dr. Boseong Seo has worked LG AI Research in March 2023.

15

Ms. Jinshi Cui

Ms. Jinshi Cui has worked as an AI & Application Data Engineer at SKF in July 2022.

16

Dr. Jin Uk Ko

Dr. Jin Uk Ko has worked SAMSUNG Electronics in March 2023.

17

Mr. Yongjin Shin

Mr. Yongjin Shin has worked MakinaRocks Inc. in September 2021.

18

Mr. In Chan Lee

Mr. In Chan Lee has worked SAMSUNG Electronics in March 2022.

19

Mr. Hyeonchan Lee

Mr. Hyeonchan Lee has worked SAMSUNG Electronics in March 2022.

20

Mr. Chaehyun Suh

Mr. Chaehyun Suh has worked SAMSUNG Electronics in March 2022.

21

Mr. Dowan Kim

Mr. Dowan Kim has worked SAMSUNG Electronics in September 2022.

22

Mr. Hwayong Jeong

Mr. Hwayong Jeong has worked Hyundai Genuine in March 2023.

23

Mr. Taehun Kim

Mr. Taehun Kim has been appointed as a Ph.D. Student at SHRM in March 2023.

24

Dr. Guilian Yi

Dr. Guilian Yi has worked as a Senior R&D Engineer at Ansys Inc. in April 2022.

25

Dr. Jisun Kim

Dr. Jisun Kim has worked as a Postdoctoral Researcher at Keimyung University in March 2023.

26

Mr. Joowhan Song

Mr. Joowhan Song has worked as a deep learning game developer at KRAFTON in 2021.

4

Students News

4. Students News

**The graduates in 2021,2022 and 2023 shared their stories about research in SHRM.
12 student has received on Ph.D. degree and 7 students have received on M.S. degree.
Also, 2 postdoctoral researcher and 11 students have newly entered SHRM in 2021~2023.**

Ph.D.

Yong Chang Shin

Highly-Dense Elastic Wave Energy Harvesting via Standing Wave Manipulation Using a Phononic Band Gap

In order to bridge the domains of band gap reflection and piezoelectric energy harvesting (PEH), fundamental questions of importance arise on 1) how to estimate the output electric power of phononic crystal (PnC)-based PEH considering electroelastic coupling, 2) how the key design parameters of the PnC and PEH affect the output performance respectively. In order to tackle these topics, this doctoral dissertation aims at advancing three essential and co-related research area. Research Thrust 1 presents an electroelastically coupled analytical model of a quadra-morph piezoelectric bar under elastic waves. Newton's 2nd law and constitutive equations of linear piezoelectricity are used to derive a mechanical equation of motions. Research Thrust 2 pursues a deep understanding of interrelationship between the standing wave formation and piezoelectric transduction under elastic waves. Two key parameters of a PnC-based PEH are thoroughly investigated to reveal the effect of the phononic band gap on the output performance of the PnC-based PEH system. Research Thrust 3 proposes a concept of an "effective" boundary formed by a band gap of the PnC and provide its theoretical foundation based on wave physics at boundaries.

Sunuwe Kim

Deep-Learning-Based Fault Diagnosis Using Dissolved Gas Analysis for Unlabeled Fault Data of Industrial Power Transformers

Deep-learning-based fault diagnosis methods are developed to overcome three issues that currently prevent this type of diagnosis in industrial power transformers: 1) the visualization of health feature space issue, 2) the insufficient data issue, and 3) the severity issue. To cope with these challenges, this thesis is composed of three research thrusts. The first research thrust develops a health feature space via a semi-supervised autoencoder with an auxiliary detection task. The proposed method can visualize a monotonic health trendability of the transformer's degradation properties. Next, the second research thrust proposes a new framework, that bridges the rule-based Duval method with an AI-based deep neural network (BDD). In this method, the rule-based Duval method is utilized to pseudo-label a large amount of unlabeled data. Finally, the third thrust not only identifies fault types but also indicates a severity level. However, the balance between labeled fault types and the severity level is imbalanced in real-world data. Therefore, in the proposed method, diagnosis of fault types – with severity levels – under imbalanced conditions is addressed by utilizing a generative adversarial network with an auxiliary classifier.

Hyejeong Son

Optimization-based Model Improvement for Error Sources Identification in a Computational Model

Optimization-based model improvement (OBMI) has difficulty identifying the error sources required to enable accurate prediction ability of the computational model. Thus, eventually, OBMI may fail to propose an appropriate solution. To cope with this challenge, this doctoral dissertation research addresses three essential issues. Research Thrust 1 – a new experimental design approach for model calibration to reduce parameter estimation errors. This study aims to develop a model improvement process that identifies the leading cause of invalidity of a prediction. Research Thrust 2 – a device bias quantification method for considering model form errors with bound information. This study proposes a new formulation of a bias term that depends on the output responses to resolve the gap in appropriate bias that arises due to the different dimensions of the predicted responses. Research Thrust 3 – comparison of statistical validation metrics to consider type II errors in model validation. This research compares various statistical validation metrics to highlight those that show fewer errors in hypothesis testing.

Myungyon Kim

Maximal Information Use for Deep Learning Based Fault Diagnosis Techniques

This dissertation research investigated three research thrusts aimed toward maximizing the use of information to improve the performance of deep learning based fault diagnosis techniques. The first research thrust suggests an advanced CNN-based architecture to improve the gradient information flow within the deep learning model. By directly connecting the feature maps of different layers, the diagnosis model can be trained efficiently thanks to enhanced information flow. The second research thrust suggests a parameter transfer and metric learning based fault diagnosis method. The proposed approach facilitates robust and discriminative feature learning to enhance fault diagnosis performance under insufficient and noisy data conditions. Finally, the last research thrust proposes a label information propagation strategy to increase the fault diagnosis performance in the unlabeled target domain. The label information obtained from the source domain is transferred and utilized for developing fault diagnosis methods in the target domain.

Wongon Kim

Investigation on Statistical Model Calibration and Updating of Physics and Data-driven Modeling for Hybrid Digital Twin

The applicability of the digital twin approach has been limited by a lack of prior information. In order to build a hybrid digital twin under insufficient prior information, this doctoral dissertation aims the investigation on three co-related research areas in model calibration and updating. Thrust 1 proposes Data-driven dynamic model updating for anomaly detection with insufficient prior knowledge. The time-frequency domain features are extracted from the observed signal using signal pre-processing. Research Thrust 2 proposes a new calibration metric: Marginal Probability and Correlation Residual (MPCR), to improve the accuracy and efficiency of model calibration considering statistical correlation. Thrust 3 proposed a hybrid digital twin approach for estimating fatigue crack initiation and growth considering those uncertainties. The proposed approach for estimating fatigue crack initiation and growth is based on two techniques; (i) statistical model calibration and (ii) probabilistic element updating.

Chan Hee Park

Physics-guided Deep Learning Study for Fault Diagnostics of Industrial Motors Under Variable Operating Conditions Using Stator Current Signals

The conventional fault diagnosis methods have challenges: 1) significant amount of parameter settings, 2) limited fault identification, 3) inconsistent severity estimation. To address these challenges, three research thrusts are proposed in this dissertation. The first research thrust proposes a fault detection method with enhancing fault-sensitivity by reducing the effects of variable speed and load torque conditions in stator current signals. The proposed method does not require significant amount of diagnostic knowledge and difficult expert knowledge such as motor- or fault related information. The second research thrust proposes a health image constructed by fault-related component pairs extracted from instantaneous amplitude and phase of a stator current signal. The instantaneous amplitude and phase of a stator current signal reveal the drive-related and the fault-related component, respectively. The third research thrust proposes a deep learning-based fault severity estimation method using stator current signals. Using a hierarchical deep learning architecture, the proposed method is constructed to assign a fault diagnosis task to a parent module and severity estimation tasks to child modules, then propagate the latent features in the parent module to the child modules.

Yunhan Kim

Vibration-based Gearbox Diagnostics by Enhancement of Weak Fault-characteristic Information

This doctoral dissertation proposes three research thrusts to enable vibration-based gearbox diagnostics by enhancing weak fault-characteristic information. The first research thrust proposes a de-noising technique for unsynchronized signals. In the proposed method, the noise of the unsynchronized signal can be reduced by averaging the magnitudes of the unsynchronized signals and retaining the phase information of each unsynchronized signal; the magnitudes and phase information can be obtained via Fourier transform. The second research thrust proposes a new signal decomposition method that can highlight the fault-related features in the vibration signals. In the proposed method, a cepstrum analysis is newly employed to create a smoothed spectrum of a vibration signal that reveals the modulation sideband cluster. By adaptively designing a bandpass filter in the smoothed spectrum using the proposed method, decomposed signals with enhanced fault-related features are achieved. The third research thrust proposes a new deep-learning model that considers the physics of the fault-characteristic information for health classification. To effectively extract and classify fault-related signals with various waveforms, a new time-frequency representation is constructed based on multiscale convolutional filters.

Sooho Kim

Inference of Central Blood Pressure Waveform and Arterial Disease Diagnosis Using Explainable Artificial Intelligence Regularized for Individuality

This doctoral dissertation aims at advancing three essential and co-related research areas. Research Thrust 1: An initial proof-of-cencept of deep learning-based arterial pulse waveform analysis is proposed for affordable and convenient arterial disease screening as well as presents challenges that must be addressed for real-world clinical applications. Research Thrust 2: A continuous property-adversarial regularization (CPAR) approach is proposed to robust generalization of a DNN against scarce anatomical and iv physiological characteristics of datasets. Research Thrust 3: A sequence-oriented neural network is proposed to robust inference of central BPW by modulating distal BPWs. Inspired by Wavenet, which is applied for modulation of waveform data surprisingly decrease computational cost by utilizing convolutional neural network (CNN) architecture, conserving sequential characteristics.

Su J. Kim

Investigation on Fault Information Extraction for Acoustic Emission based Rolling Element Bearing Diagnostics under Noisy Conditions

This doctoral dissertation focuses on developing signal processing techniques for AE-based bearing diagnosis under noisy conditions. The first research thrust suggests an effective band-selection method for AE sensor data under severe noise conditions. To increase the method's practicality in real applications, the proposed method defines a new indicator that is calculated from the time-domain features of the measured signal, without additional spectrum analysis. The other research thrust proposes a de-noising technique for electrical components, especially electromagnetic interference (EMI), which easily corrupts AE measurements with highly non-stationarity. To this end, this study employs multi-sensor approach with an additional current sensor. In addition, an empirical mode decomposition (EMD) and probability-based dynamic filter are designed to adaptively sort out EMI components.

Boseong Seo

Deep Learning Based Health Prognostics of Oil-immersed Transformers for Contaminated Dissolved Gas Analysis Data

To improve the diagnosis performance of the transformer, there are three main issues to be addressed. The first study proposes iterative denoising autoencoder (IDAE) for multiple missing value imputation. The proposed method can restore the original value of the missing value by iteratively performing denoising autoencoder (DAE). The second study proposes a method of extracting health features through semisupervised autoencoder (SSAE). The proposed method can extract two characteristic features with monotonous degradation behavior by simultaneously performing dimension reduction and health status learning of transformers. Finally, the third study proposes a health prognosis of transformers through the XGBoost regression method. The proposed method can obtain a robust prognosis model on the irregular sampling intervals by learning the irregular time series data using tree-based ensemble learning methods

Keunsu Kim

A Study on Diagnosis of Bearings in Incipient Fault Stage Considering Vibration Generation Mechanisms

This dissertation aims at advancing two research thrusts focused on developing techniques for modeling and analyzing vibration signals based on physical phenomena. In Research Thrust 1, a quasi-periodic impulse train model with an impact force function is suggested to bridge the gap between theory and reality. In this research, a pseudo second-order cyclostationary signal is modeled using the quasi-periodic impulse train model. In order to simulate the dynamic response of a system, considering the physical behaviors in bearings, the impact force function that reflects the change in contact stress is used. In Research Thrust 2, a new feature extraction method is proposed for bearing diagnosis using vibration signals, namely the linear power normalized cepstral coefficients (LPNCC). The proposed approach is designed to enhance the bearing signal, which is buried in noise that arises from environmental effects, and which contains mechanical phenomena. The proposed approach is designed to enhance the bearing signal, which is buried in noise that arises from environmental effects, and which contains mechanical phenomena.

Jin Uk Ko

Deep-learning-based Methodology for Macro- and Micro-level Fault Diagnosis of Rotating Machinery Using Low- and High-resolution Signals

This doctoral dissertation proposes a deep-learning-based methodology for macro- and micro-level fault diagnosis using operation and vibration signals from rotating machinery. The first research thrust proposes new methods for modeling and threshold setting to reduce false alarms related to anomaly detection. The proposed modeling method is developed by applying ensemble and denoising techniques to auto-encoders. Further, a threshold is newly proposed using the joint distribution of the output and the residual. The second research thrust proposes a new generative network to generate signals of variable lengths. The proposed network, whose input and output are the time and amplitude, respectively, is designed to learn the frequency information of the training data. The proposed method is implemented to reflect the signal processing knowledge, including the use of the Nyquist theorem. The third research thrust proposes a novel training method that simultaneously learns the classification and denoising tasks. In the proposed scheme, multi-task learning is used to allow a classifier to solve the classification and denoising tasks concurrently. The proposed method can be applied to any deep-learning algorithm, regardless of the network type.

M. S.

Dongkyu Lee

A Diagnosis Framework for the Robotic Arm Joint with Strain Wave Gearing based on Ordinal Pattern Analysis

A diagnosis framework of robots with SWG gearing based on ordinal pattern analysis with optimal parameter selection considering physical interpretation is proposed. The framework is composed ii of the following steps: 1) Motion Segmentation based on Time-Frequency Representation (TFR), 2) Ordinal Pattern Analysis of Motor Current (OPAMC), and 3) Distribution-based fault detection. At first, in the motion segmentation process, the motor current signal is frequency demodulated using Temporal Fine Structure (TFS) since the robot's joint speed has a linear relationship with the current signal's frequency component. Secondly, in OPAMC, the segments are time-synchronized with reference motion and Hilbert-transformed to get an envelope for ordinal pattern extraction. Finally, each JSD distribution among different joints is represented on 3- dimensional feature space through point estimate of mean and variance and Kolmogorov-Smirnov statistics whose dimension is then reduced to 1 dimension scalar through linear discriminant analysis.

In Chan Lee

Deep Learning-Based Domain Adaptation Method for Identifying Peripheral Arterial Disease Locations under Various Severity Levels

This paper's primary purpose is to develop a blood pressure waveform (BPW) based deep learning diagnosis model for identifying peripheral arterial disease (PAD) on frequent PAD occurrence arteries. Two issues make it hard to obtain a generalized PAD diagnosis model with a data-driven approach: 1) domain discrepancy resulted from the differences of disease severity and occurring location, 2) data imbalance resulted from the symptomless characteristic of mild PAD. To train a generalized PAD diagnosis model considering practical issues, we propose auxiliary tasks-assisted maximum classifier discrepancy for supervised domain adaptation. The proposed model is validated using virtual patients' BPWs generated from the transmission line model under various disease severity levels. The results show that the proposed model has a superior performance for identifying PAD locations under various disease severity levels.

Chaehyun Suh

Feature-analytic, Fleet-adaptive Network for Fault Diagnosis of Automated Material Handling Systems

This paper proposes a Feature-analytic, Fleet-adaptive Network (FAFAN) for fault diagnosis of automated material handling systems (AMHSs) in semiconductor fabs. To effectively deal with the situation where the torque signals from different Overhead Hoist Transport (OHT) units diverge from each other, the proposed method learns fault-discriminative and OHT unit-domain-invariant features by selectively using pre-processed, multichannel torque signals. Next, the approach independently extracts features from each channel and automatically learns the channel weights to leverage them, considering domain generalizability and the presence of fault signatures. The proposed method ii consists of three main steps; 1) dividing the OHT dataset into a fully labeled source domain and a sparsely labeled target unit domain, 2) pre-processing front and rear torque signals into three-channel signals, and 3) extracting features to classify signals into normal, wheel fault, and gear fault states, while minimizing domain discrepancy through the use of semi-supervised domain adaptation.

Dowan Kim

Fault Detection of Gearbox in Industrial Robot using Current Residual from Singular Spectrum Template Matching

Industrial robots are essential equipment for process automation in a wide range of industrial fields. In manufacturing fields, unexpected faults of robots can severely damage the economy of a company. Fault can occur in various components of the robot and a faulty gearbox can have a significant effect on the robot's driving performance and manufactured product. Therefore, in this paper, gearbox fault detection of an industrial robot is performed using current signals applied to the actuating motor. The proposed method synchronizes normal current signal data to reference phase by resampling through Hilbert Transform. The synchronized signals are then split by singular value decomposition, and the principal components are extracted and averaged to establish normal template. Residual signal is then extracted by subtracting normal template from synchronized unknown signal. Finally, health management feature is calculated from the residual signal to perform fault detection.

Hyeonchan Lee

A New Initial Point Search Algorithm for Bayesian Calibration with Insufficient Statistical Information: Greedy Stochastic Section Search

This thesis proposed the Greedy Stochastic Section Search (GSSS) algorithm, an initial point search algorithm, to perform Bayesian model calibration using the MCMC method with insufficient statistical information. The first contribution is the analysis of the effect of the initial point of the MCMC method for Bayesian model calibration. When applying the MCMC method practically, the initial value is greatly affected by resource limitations, numerical errors, the high dimensionality of distribution, and multi-modal characteristics. In order to use the MCMC through this study, the necessity of systematically selecting initial values was suggested. The second contribution is development of cost-effective initial point search algorithms applicable to the high-dimensional multi-modal distribution. The proposed method can search high-dimensional distribution efficiently, and furthermore, it is applicable to multi-modal distribution. The third contribution is conducting a case study in the various field, applying the proposed method to examples in various fields. We verified the utility of the GSSS algorithm by conducting three case studies: one numerical example and two engineering examples. This process confirmed that the proposed method had a positive effect on the Bayesian model calibration.

Hwayong Jeong

A Study of Deep Learning-based Spall Size Distribution Estimation for Rolling Element Bearing Diagnosis

In this study, the spall size distribution estimation for rolling element bearing using regression based deep learning was proposed. In order to estimate the spall size through the time difference between the entry and the exit event, the time-frequency representation, CWT, was normalized by time to enhance the amplitude of the entry signal feature. The DAE is used to remove the features unrelated to the entry-exit event through a signal modeled analytically on a target signal and a noise signal with Gaussian noise. Then, the spall size of the target signal can be extracted from the signals learned through the CNN-SVR model. Through the weighted ensemble averaging, the spall size was estimated considering the rotational uncertainty due to the random slip of the balls, and through this, the spall size distribution was estimated. To quantify the performance of the proposed method, the research described in this study employed KL divergence. The proposed method was demonstrated by experimental data from SNU bearing testbed data. By comparing the signal processing methods which use the time-frequency representation and the deep learning method without ensemble, the proposed method efficiently estimates spall size distribution.

Taehun Kim

Spectrum-guided GAN: A Reliable Signal Generation Approach for Fault Diagnosis of Rotating Machinery with Limited Data

Although much of the works have validated that Generative adversarial network (GAN) is effective to handle the class-imbalance problem for fault diagnosis, several critical limitations still remain. First, GAN requires sufficient amount of data for training, despite it should leverage only small amount of data to improve the classifier. Second, randomness exists while sampling the latent vectors from prior distribution. To tackle these problems, we propose the spectrum-guided GAN which generates magnitude and phase spectra in frequency domain instead of producing time-series signal. In addition, a new sampling method based on density of features inside generator via principal component analysis (PCA) is introduced to replace a conventional random sampling. The proposed method is validated with GE Bently Nevada RK4 rotor kit and Signallink rotor-testbed (KAMP-Rotor) dataset. The results show that the proposed method outperforms the conventional GAN and the density-based sampling method enhances the reliability of the sampling process.

New Postdoctoral Researcher and Students

2021

Taehyung Kim

Wongon Kim
(Postdoctoral Researcher)

Chen Jiang
(Postdoctoral Researcher)

2022

Dapeng Wang
(visiting scholar)

Seungyoung Park

Hye Jun Oh

Yong Chae Kim

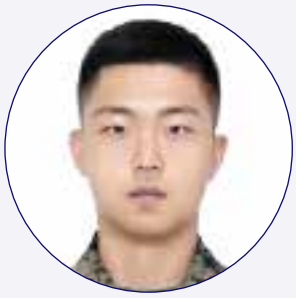
Sang Kyung Lee

Bongmo Kim

2023

Hansoo Kim

Jiwon Lee



Jonghwa Baek

Gyeong Ryun Gwon

Min Jung Kim

5

Press

5. Press

Lots of articles about SHRM lab as well as OnePredict Inc. have been published.

News Script

1

OnePredict introduces facility diagnostic solution at Korea Nara Market Expo 2023, Industrial Daily

April 30, 2023

2

OnePredict introduces software for diagnosing substation facilities and predicting failures at the 2023 International Electric Power Exhibition… 'Minimize production losses, maximize facility utilization', Aving

April 7, 2023

3

[Contributed Article] The Path for Mechanical Engineers in the Digital Age, MT News

April 3, 2023

4

Stone Bridge Ventures invests 120 billion won in semiconductor and AI startups such as OnePredict, Hankyung IT

March 9, 2023

5

OnePredict, 'GardiOne' motor participates in Korea's largest 'Smart Factory Automation World', Maeil Business News

February 28, 2023

6

[SF+AW 2023 Interview with Participating Companies] Youn Byeng Dong, CEO of OnePredict, said, “By expanding the application field of GardiOne solutions, it stands as a leading companies in predictive maintenance,” Hello T

February 7, 2023

7

OnePredict was selected ‘2023 Emerging AI+X Top 100’ by Artificial Intelligence Industry Association, AI Times

January 30, 2023

8

[Contributed Article] Facilities Prognostics Maintenance Optimization Solution Guide for Digital Transformation, ET News

January 23, 2023

9

OnePredict, Establishing a U.S.A. corporation and recruiting local experts... Accelerate global expansion, Maeil Business News

January 19, 2023

10

[Contributed Article] Facility maintenance digital transformation in the real industrial sites, ET news

December 21, 2022

11

OnePredict supplies ‘GardiOne Motor’ industrial AI motor diagnosis solution to GS Power, ET news

December 14, 2022

12

OnePredict Supplies of ‘GardiOne’ industrial AI-based facility predictive diagnosis solution to E1, Digital Times

November 30, 2022

13

OnePredict Introduces industrial AI solution in Saudi Arabia_GardiOne Substation & Motor was introduced at an event hosted by Saudi Aramco, Digital Times

November 22, 2022

14

Industrial AI startup, OnePredict recruits CTO Geum Mo Lee from NC Soft, Maeil Business News

November 09, 2022

15

'GardiOne Substation' of OnePredict gets grade 1 certified by GS, Asia Economy

May 18, 2022

16

OnePredict Introduces Motor Fault Diagnosis Products with AI at SFAW2022, Digital Times

March 31, 2022

17

Industrial AI specialist OnePredict successfully attracted 30 Billion Series C, DongA Daily

March 28, 2022

18

OnePredict releases 'GardiOne motor' which is a comprehensive motor diagnosis management solution, Maeil Business News

March 14, 2022

19

Interview with participating companies in SF+AW 2022, CEO Byeng Dong Youn of OnePredict said "The Gardione solution is digial brain….Realistically and innovatively suggest solutions to customer concerns," Hello T

February 19, 2022

20

Industrial AI startup OnePredict “more than doubled new customers and sales this year”, Digital Times

December 21, 2021

21

Hyundai Electric, “Promoting the development of an online power facility prevention diagnosis solution OnePredict, an AI solution company.” Daily Economy

October 13,2021

22

OnePredict Successfully Participates in ‘Tech Crunch Disrupt’, North America’s Largest Startup Conference, Hello T

September 30, 2021

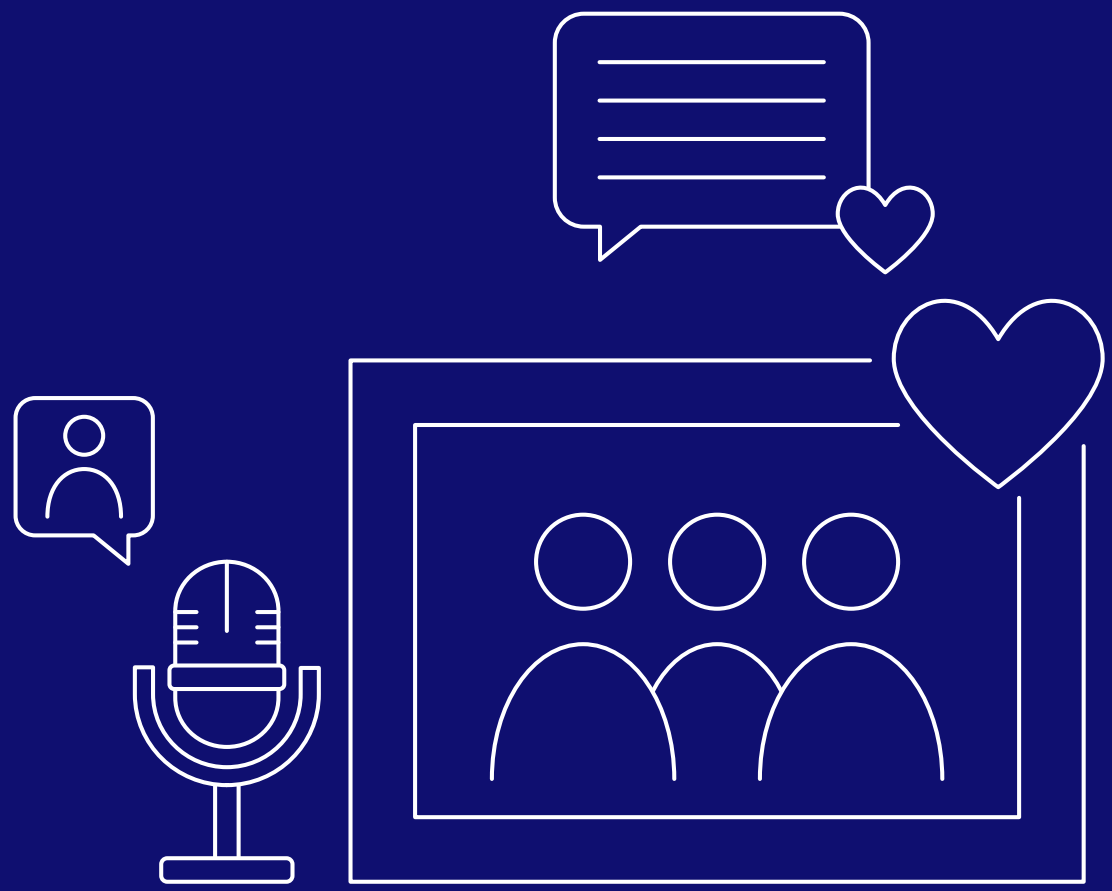
23

LG U+Launches Smart Factory Solution with Industrial AI Specialist ‘One Predict’, Yonhapnews

July 29, 2021

6

Other News and Events



6. Other News and Events

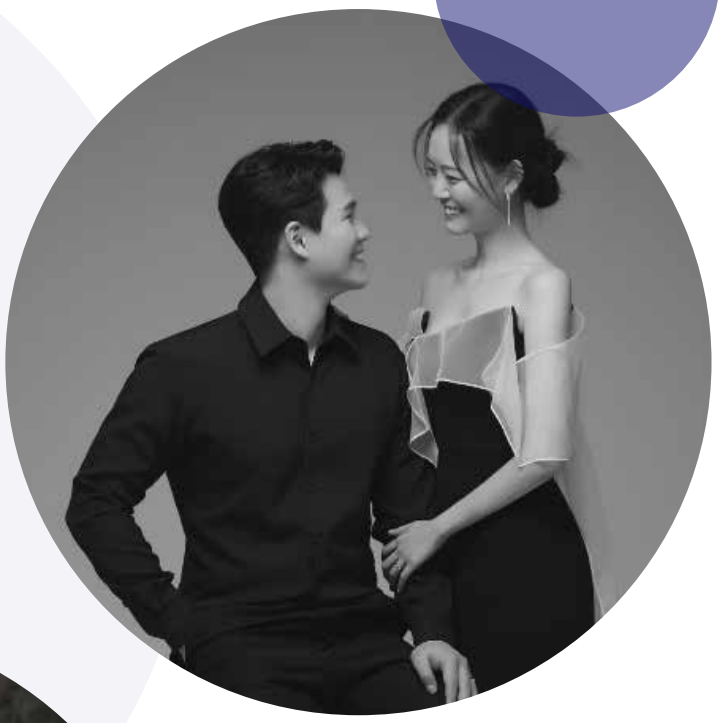
News from SHRM students,
SHRM lab and Prof. Youn are presented with heartfelt greetings and thanks

Family Event

Mr. Hwayong Jeong married on
29th October, 2022

Mr. Jinwook Lee married on
5th November, 2022

Dr. Boseong Seo married on
1st April, 2023



Mr. Jongmin Park married on
15th April, 2023

Dr. Sunuwe Kim married on
30th April, 2023

Prof. Youn's Seminar

Asia Pacific Conference of the Prognostics and Health Management Society (PHMAP) 2021, September 2021

세부세션

시 간	내 용	연 사
09:00 – 09:10	Opening	사회자
09:10 – 09:30	Welcome address (디지털엔지니어링센터 전략 소개 외)	박귀열 상무
09:30 – 10:20	비추얼이노베이션리서치랩 연구 현황	한용하 연구위원
	Break time	
10:40 – 11:30	Industrial AI and Its Best Practices for Digital Transformation	윤병동 교수
11:30 – 12:10	주행데이터 기반 진단/예지 기술 확보를 통한 SVM(Smart Vehicle Monitoring) 플랫폼 구축	박제승 팀장
	Lunch	
13:30 – 14:10	개발방식 혁신을 위한 버추얼 기술 거시 전략 및 적용 방향성	김철웅 실장
14:10 – 14:50	Virtual Product Engineering from Concept Design to Prototyping Test using System Simulation, CAE Simulation, TEST and AI	홍정호 상무
14:50 – 15:30	Central Management of Virtual Prototypes from a Lifecycle Perspective	남창훈 대표
	Break time	
15:50 – 16:50	패널 토의 (데이터 중심, 모델 기반의 일하는 방식과 개발 방식의 변화)	참석자
16:50 – 17:00	Closing	

연사(외부)

윤병동
교수

서울대학교, 원프레딕트(OnePredict)
- 서울대학교 기계공학부 교수
- (주) 원프레딕트 대표이사 겸 창업자
- 한국PHM학회 전임 학회장
- 국제 PHM학회 Fellow

Invited talk in "R&D E-Conference" organized by Hyundai-Motor Group, October 2021

2nd SHRM Industrial AI Concert, November 2021

The Korean Society of Mechanical Engineers (KSME) CAE & Applied mechanics, May 2022

Invited talk in “Samsung Global Investors Conference 2022” organized by Samsung securities Co., Ltd, August 2022

◇ 프로그램 ◇

시간	주제	발표자
12:00~13:00	등록	
13:00~13:40	스마트 제조와 지능형 로봇	김종형 (서울과학기술대학교 교수)
13:40~14:20	대면적 나노마이크로성형기술 최신동향	최두선 (한국기계연구원)
14:20~14:30	Coffee break	
14:30~15:10	디지털 트윈과 스마트팩토리 설계, 운영	노상도 (성균관대학교 교수)
15:10~16:00	산업인공지능을 이용한 설비예지보전	윤병동 (서울대학교 교수, 원프레딕트 CEO)
16:00~18:00	패널 디스커션	한국기계가공학회 회장 (안동대 김호찬 교수)
18:00~19:00	Reception	

Invited talk in “Smart Manufacturing and Advanced Process Technology Workshop”
organized by The Korean Society of Manufacturing Process Engineers (KSMPE), September 2022

Invited talk in “AI/DT Insight Seminar” organized by SK Hynix, September 2022

Invited talk in “2022 SNU Tech-Career Expo & Open Lab” organized by Seoul National University, September 2022

Invited talk in “A Briefing Session on Promising Companies in the 4th Industry”
organized by Dongguk University, September 2022

Mechanical Engineering Seminar Series

- **Date: Wednesday, September 28th, 2022**
- **Time: 17:00 PM KST Online**
- **Zoom Meeting ID: 951 4959 4171 / PW: 100269**

Infinite Challenge of Onepredict

Prof. Byeng Dong Youn

Prof. Youn is a Professor of Mechanical Engineering at Seoul National University (SNU) and a founder and CEO of OnePredict Inc. (onepredict.com). He is also a Fellow of the PHM Society, an Associate Member of the National Academy of Engineering of Korea (NAEK), and a former President of the Korean Society of PHM. His current research includes prognostics and health management (PHM), engineering design under uncertainty, and energy harvester design. His dedication and efforts in research and development have garnered substantive peer recognition resulting in many notable awards including World's Top 2% Scholar, Stanford University (2020), the Prime Minister Award (2019), the Outstanding Awards from the Korean Society of Prognostics and Health Management (KSPHM), the Korean Society of Design Optimization (2019), the Shin Yang Academic Award from Seoul National University (2017), the 11-time winner of Global PHM Data Challenges including PHM Society Data Challenge, etc.

Abstract

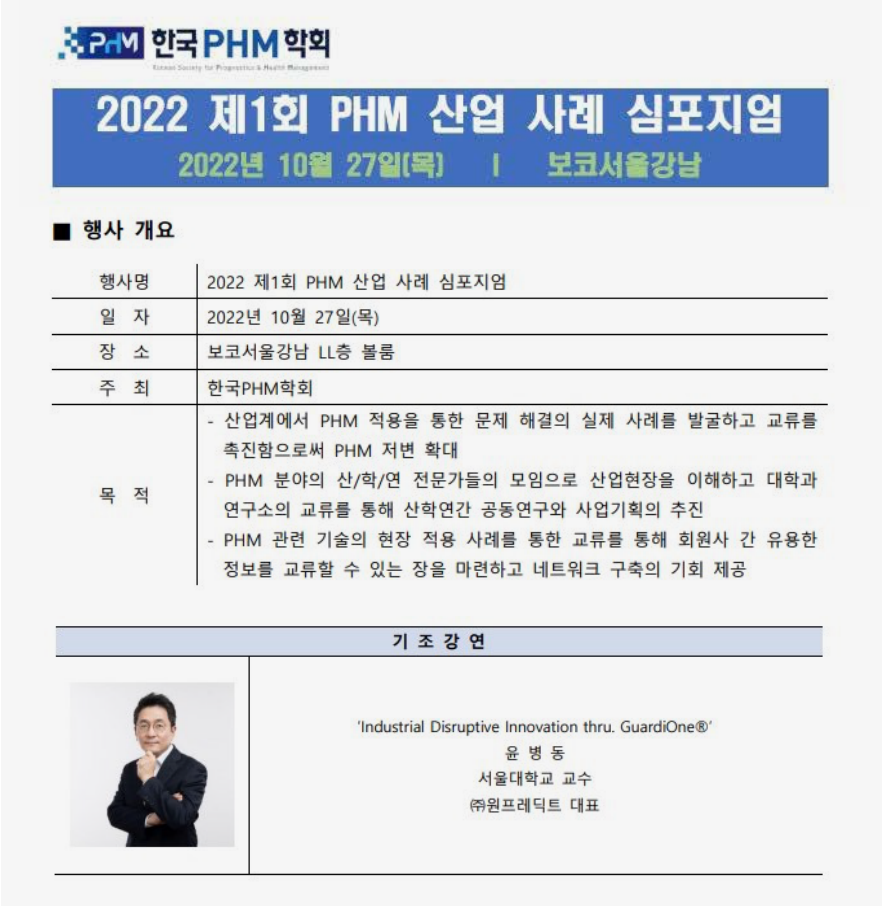
The transformation from a professor to an enterpriser is an exciting challenge. Although technology is excellent, business is a series of unexpected events beyond our imagination. Especially, developing a non-existent business model like 'Industrial AI-based Predictive Maintenance (PdM) Digital Twin' has been the biggest challenge in my career, but surely it is meaningful and heart beating. In this seminar, the "infinite challenge" story of the Onepredict company will be presented. Onepredict received 40 million US dollars over 5 years and dreaming about a KOSDAQ IPO in early 2024. You can learn the challenge, failure, and lesson-learned stories that have been experienced in the process of the company growth such as the motivation of founding Onepredict, failure and success of financial investments, and difficulties in product development.

SUNY Korea

Stony Brook University

Invited talk in "Mechanical Engineering Seminar Series" organized by Stony Brook University, September 2022

Invited talk in "Breakfast Forum (AI is Anywhere)" organized by Artificial intelligence Industry Association, October 2022



Invited talk in "The 1st Symposium on PHM Industrial Case" organized by Korean Society for Prognostics & Health Management, October 2022

Invited talk in “Dependability Forum” organized by Korean Reliability Society, November 2022

3rd SHRM Industrial AI Concert, November 2022

1st Industrial AI HRD Business Performance Announcement, February 2023

OnePredict News

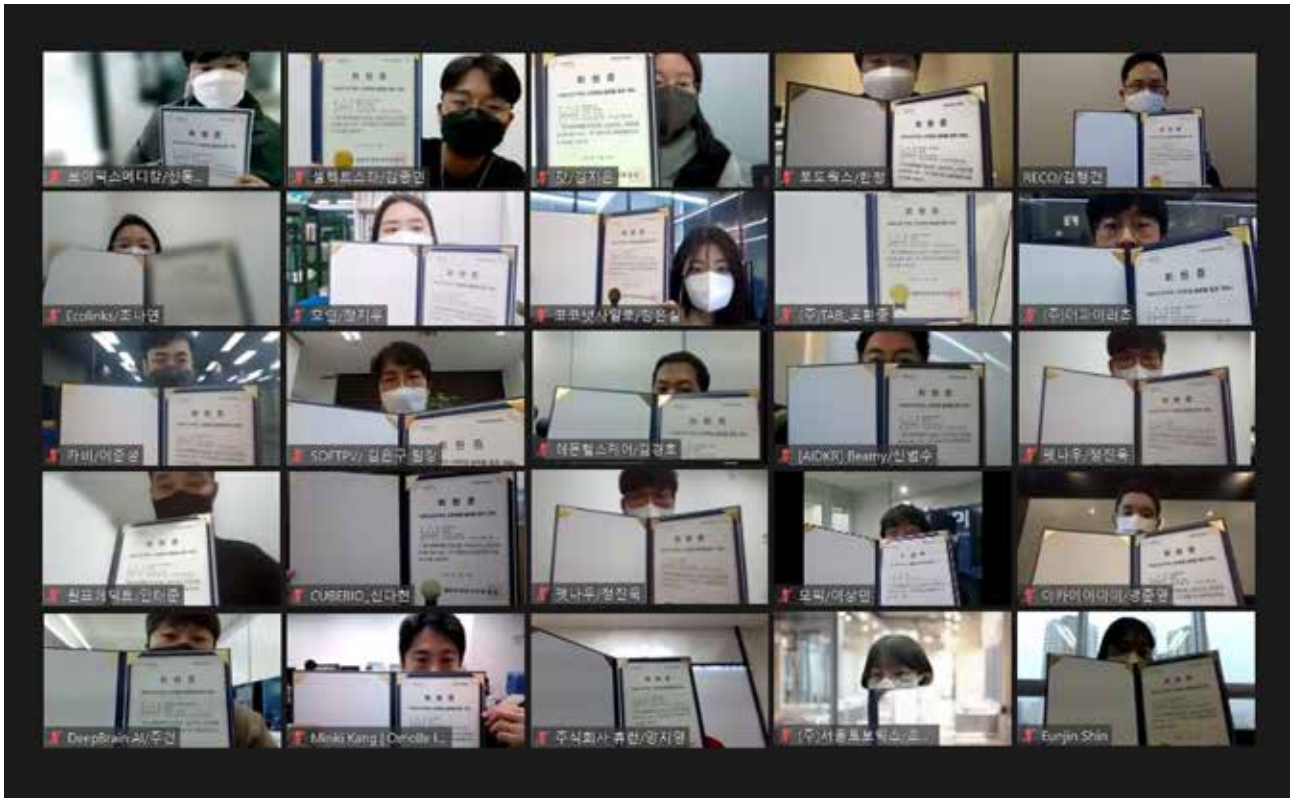
onepredict

OnePredict was officially selected as an Excellent Corporation R&D Center (ECRC) by the Ministry of Science and ICT, June 2021

OnePredict has been selected for the Korea AI Startup 100; a project organized by The Korea Economic Daily newspaper and AI One Team to identify 100 AI startups that will drive the Korean innovation ecosystem, October 2021

OnePredict won the grand prize in the small and medium-sized enterprise category at the Korea Reliability Awards, November 2021

Global Jump 300



OnePredict has been selected for Global Jump 300, a global startup incubation program hosted by the Korea Trade-Investment Promotion Agency (KOTRA), January 2022

OnePredict's GuardiOne® Turbo has been designated as an outstanding R&D innovation product by the Ministry of Science and ICT, July 2022

OnePredict, developer of the GuardiOne solution for industrial AI-powered predictive maintenance, has been named to the 2022 Advanced Manufacturing 50 by global market research firm CB Insights. OnePredict was recognized in the Predictive Maintenance category for its ability to revolutionize the process of facility maintenance, July 2022

코리아 AI 스타트업 100

분류	기업명
교육	콴다(메스프레소) 아카에이아이, 튜링
교통 운송	스트라드비젼, 팬텀에이아이 토르드라이브, 인피닉 스프링 클라우드, 베스텔라랩 니어스랩, 라이드플럭스 서울로보틱스
금융 보험	크래프트테크놀로지스, 파운트 자비스앤빌런즈 디셈버앤컴퍼니자산운용 웨이브릿지, 에이젠글로벌
농축산	한국축산데이터, 아이오크롭스
로봇	베어로보틱스, 클로봇 뉴빌리티, 트위니, 알지티
버추얼휴먼	클레온, 딥브레인에이아이 디오비스튜디오
미디어 컨텐츠	네오사피엔스, 비프로컴퍼니 마이셀럽스, 시어스랩 보이저엑스, 엑스엘에이트
세일즈 마케팅	빅인사이트, 오브젠
스마트 시티	수퍼빈, 케이웨더
스마트 에너지	인코어드테크놀로지스
스마트 팩토리	원프레딕트, 알티엠, 인이지
패션	마크비전, 아이딕션 스타일봇, 오드컨셉
푸드테크	신스타프리젠츠
프롭테크	제너레잇

분류	기업명
헬스케어	스탠다임, 에어스메디컬 뉴로핏, 토모큐브, 딥바이오 클라리파이, 휴레이포지티브 룰루랩, 휴톰 에이아이트릭스, 팜캐드 쓰리빌리언, 코어라인소프트 에덴룩스, 뉴로젠, 메디픽셀 제노플랜코리아 온코소프트, 히츠
AI 솔루션 플랫폼	마키나락스, 쓰리아이 브이터치, 애자일소다 올거나이즈 더화이트커뮤니케이션 뷰메진, 제네시스랩 악어디지털, 노타 알고리즘랩스, 커먼컴퓨터 포지큐브, 솔루게이트 프렌들리에이아이 슈퍼브에이아이 트웰브랩스, 업스테이지
AI 프로세서	퓨리오사에이아이 리벨리온, 딥엑스, 모빌린트 알세미
데이터 가공	딥핑소스, 에이모 씨앤에이아이, 셀렉트스타 크라우드웍스
요소기술(NLP, 컴퓨터비전 등)	스켈터랩스, 리턴제로 리플에이아이, 액션파워
정보보안	에스투더블유

OnePredict was selected as <Korea AI Startup 100> for the second year in a row, 2021 & 2022