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 May 2020 to August 2021.
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.

Index

1 New Journal Papers / Awards / Patents

Journal Papers (25 Published, 16 Submitted)

25 papers were published for publication in highly ranked journals.
In addition, 16 papers are submitted. Progress on these papers will be reported in a future newsletter.

Published

1) 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," Vol 183, pp 109796, 2021-10

2) 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

3) 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

4) 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

5) 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

6) 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

7) Chan Hee Park, Junmin Lee, Hyeongmin Kim, Chaehyun Suh, Myeongbaek Youn, Yongjin Shin, Sung-Hoon Ahn, and 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, 2021-04

8) Soo-Ho Jo, Heonjun Yoon*, Yong Chang Shin, and Byeng D. Youn*, "An Analytical Model of a Phononic Crystal with a Piezoelectric Defect for Energy Harvesting Using an Electroelastically Coupled Transfer Matrix," International Journal of Mechanical Sciences, Vol 193, pp 106160, 2021-03

9) Jin Uk Ko, Joon Ha Jung, Myungyon Kim, Hyeon Bae Kong, Jinwook Lee, and Byeng D. Youn*, "Multi-Task Learning of Classification and Denoising (MLCD) for Noise-Robust Rotor System Diagnosis," Computers in Industry, Vol 125, pp 103385, 2021-02

10) Soo-Ho Jo[1], Yiwei Xia[1], Adriane G. Moura, Heonjun Yoon*, Yong Chang Shin, Alper Erturk, and Byeng D. Youn, "Experimentally Validated Broadband Self-Collimation of Elastic Waves," International Journal of Mechanical Sciences, Vol 192, pp 106131, 2021-02

11) Yong Chang Shin[1], Heonjun Yoon[1], Soo-Ho Jo, Wonjae Choi, Choon-Su Park, Miso Kim*, and Byeng D. Youn*, "Phononic Band Gap of a Quarter-Wave Stack for Enhanced Piezoelectric Energy Harvesting," International Journal of Mechanical Sciences, Vol 189, pp 106003, 2021-01

12) Woo-Kyun Jung, Dong-Ryul Kim, Hyunsu Lee, Tae-Hun Lee, Insoon Yang, Byeng D. Youn, Daniel Zontar, Matthias Brockmann, Christian Brecher, and Sung-Hoon Ahn*, "Appropriate Smart Factory for SMEs: Concept, Application and Perspective," International Journal of Precision Engineering and Manufacturing, Vol 22, pp 201-215, 2021-01

13) Useok Jeong[1], Keunsu Kim[1], Sang-Hun Kim[1], Hyunhee Choi, Byeng D. Youn*, and Kyu-Jin Cho*, "Reliability Analysis of a Tendon-Driven Actuation for Soft Robots," International Journal of Robotics Research, Vol 40, pp 494-511, 2021-01

14) Tae-Gon Lee, Soo-Ho Jo, Hong Min Seung, Sun-Woo Kim, Eun-Ji Kim, Byeng D. Youn, Sahn Nahm[*], and Miso Kim[*], "Enhanced Energy Transfer and Conversion for High Performance Phononic Crystal-Assisted Elastic Wave Energy Harvesting," Nano Energy, Vol 78, pp 105226, 2020-12

15) Salman Khalid, Woocheol Lim, Heung Soo Kim[*], Yeong Tak Oh, Byeng D. Youn, Hee-Soo Kim, and Yong-Chae Bae, "Intelligent Steam Power Plant Boiler Waterwall Tube Leakage Detection via Machine Learning-Based Optimal Sensor Selection," Sensors, Vol 20, pp 6356, 2020-11

16) Sunuwe Kim[1], Soo-Ho Jo[1], Wongon Kim, Jongmin Park, Jingyo Jeong, Yeongmin Han, Daeil Kim, and Byeng D. Youn[*], "A Semi-Supervised Autoencoder with an Auxiliary Task (SAAT) for Power Transformer Fault Diagnosis Using Dissolved Gas Analysis," IEEE Access, Vol 8, pp 178295-178310, 2020-10

17) Myungyon Kim, Joon Ha Jung, Jin Uk Ko, Hyeon Bae Kong, Jinwook Lee, and Byeng D. Youn[*], "Direct Connection-Based Convolutional Neural Network (DC-CNN) for Fault Diagnosis of Rotor Systems," IEEE Access, Vol 8, pp 172043-172056, 2020-09

18) Myeongbaek Youn, Yunhan Kim, Dongki Lee, Minki Cho, and Byeng D. Youn[*], "Fatigue Crack Length Estimation and Prediction using Trans-Fitting with Support Vector Regression," International Journal of Prognostics and Health Management, Vol 11, 2020-08

19) Woosung Choi, Heonjun Yoon, and Byeng D. Youn[*], "Operation-Adaptive Damage Assessment of Steam Turbines Using a Nonlinear Creep-Fatigue Interaction Model," IEEE Access, Vol 8, pp 126776-126783, 2020-07

20) Hyeon Bae Kong, Soo-Ho Jo[*], Joon Ha Jung, Jong M. Ha, Yong Chang Shin, Heonjun Yoon, Kyung Ho Sun, Yun-Ho Seo, and Byung Chul Jeon, "A Hybrid Approach of Data-driven and Physics-Based Methods for Estimation and Prediction of Fatigue Crack Growth," International Journal of Prognostics and Health Management, Vol 11, 2020-07

21) Sooho Kim, Jin-Oh Hahn[*], and Byeng D. Youn[*], "Detection and Severity Assessment of Peripheral Occlusive Artery Disease via Deep Learning Analysis of Arterial Pulse Waveforms: Proof-of-Concept and Potential Challenges," Frontier in Bioengineering and Biotechnology, Vol 8, pp 720, 2020-07

22) 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, Online-Published

23) Myungyon Kim, Jin Uk Ko, Jinwook Lee, 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, Online-Published

24) 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, Online-Published

25) 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, Online-Published

Submitted

1) Haichao An, Byeng D. Youn[*], and Heung Soo Kim[*], "A Robust Design Framework for Sensor Number and Placement Optimization under Uncertainty for Vibration-Based Damage Detection of Composite Structures," Composite Structures, Under Revision

2) 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 Rotor System Diagnosis," Computers in Industry, Under Revision

3) 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, Under Revision

4) Yeongtak Oh, Yunhan Kim, Kyumin Na, and Byeng D. Youn[*], "A Deep Transferable Motion-Adaptive Fault Detection Method for Industrial Robot Using Residual-Convolutional Neural Network," ISA Transactions, Under Revision

5) Jong M. Ha and Byeng D. Youn[*], "Fault Diagnosis of a Planetary Gearbox by Dnorm-based Time Synchronous Averaging (DTSA) Encapsulating Results from Multiple Minimum Entropy Deconvolution (MED) Filters," Journal of Sound and Vibration, Under Revision

6) Yunhan Kim, Kyumin Na, and Byeng D. Youn[*], "A Health-daptive Time-Scale Representation (HTSR) Embedded Convolutional Neural Network for Gearbox Fault Diagnostics," Mechanical Systems and Signal Processing, Under Revision

7) 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, Under Revision

8) 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, Under Revision

9) 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, Under Revision

10) Sooho Kim, Hyunjae Kim, and Byeng D. Youn[*], "Interpretation of How Convolutional Neural Network Diagnoses Health Status of Rotating Machinery: Preliminary Study on Case of Planetary Gearbox and Challenges," ISA Transactions, Under Revision

11) 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, Under Revision

12) Yong Chang Shin, Soo-Ho Jo, Heonjun Yoon[*], and Byeng D. Youn[*], "Effective Boundary Manipulation Using a Band Gap of a Locally Resonant Elastic Metamaterial," Advanced Theory and Simulations, Submitted

13) 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, Submitted

14) 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," Mechanical Systems and Signal Processing, Submitted

15) 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, Submitted

16) Soo-Ho Jo and Byeng D. Youn[*], "An Explicit Solution to the Design of a Target-Frequency-Customized, Piezoelectric-Defect-Introduced Phononic Crystal for Elastic Wave Energy Harvesting," International Journal of Mechanical Sciences, Submitted

Awards

13 awards were rewarded, 4 AI competition winners, 1 achievement Award, and 8 best paper/presentation/poster awards from conferences.

Congratulation to all prize winners!

1) Soo-Ho Jo, Best Doctoral Dissertation Award, The Korean Society of Mechanical Engineers (KSME) 2021 Spring Annual Meeting - CAE and Applied Mechanics Division, August, 2021

2) Hyeonchan Lee, In Chan Lee, and Dowan Kim, Encouragement Award, 2nd Factor Hack Korea (Industrial AI Hackathon), January, 2021

3) Jinwook Lee and Jonghyun Choi, Best Award (The 1st Place Winner), 2nd Factor Hack Korea (Industrial AI Hackathon), January, 2021

4) Hyeongmin Kim, Sungjong Kim, and Chaehyun Suh, Encouragement Award, 2nd Factor Hack Korea (Industrial AI Hackathon), January, 2021

5) Byeng D. Youn, Outstanding Service Award, Journal of Mechanical Science Technology (JMST), November, 2020

6) Myungyon Kim, Jin Uk Ko, and Jinwook Lee, Encouragement Award, KMSE-SEMES Open Innovation Challenge, November, 2020

7) Soo-Ho Jo, Heonjun Yoon, Yong Chang Shin, and Byeng D. Youn, Best Paper Award, The Korean Society of Mechanical Engineers (KSME) 2019 Spring Annual Meeting - CAE and Applied Mechanics Division, August, 2020

8) Soo-Ho Jo, Best Student Presentation Award, The Korean Society of Mechanical Engineers (KSME) 2020 Spring Annual Meeting - CAE and Applied Mechanics Division, August, 2020

9) Hyejeong Son, Best Student Presentation Award, The Korean Society of Mechanical Engineers (KSME) 2020 Spring Annual Meeting - CAE and Applied Mechanics Division, August, 2020

10) Yunhan Kim, Jingyo Jeong, Sooho Kim, and Byeng D. Youn, Best Presentation Award, PHM KOREA 2020, July, 2020

11) Su J. Kim, Keunsu Kim, Jongmin Park, Hwayong Jeong, Jonghyun Choi, and Byeng D. Youn, Best Poster Award, PHM KOREA 2020, July, 2020

12) Myeongbaek Youn, Chan Hee Park, Jungho Park, and Byeng D. Youn, Best Paper Award, The Korean Society of Mechanical Engineers (KSME) 2020 Spring Annual Meeting - Reliability Division, July, 2020

13) Yunhan Kim, Jungho Park, Kyumin Na, and Byeng D. Youn, Best Student Paper Award, The Korean Society of Mechanical Engineers (KSME) 2019 Annual Meeting - Reliability Division, July, 2020
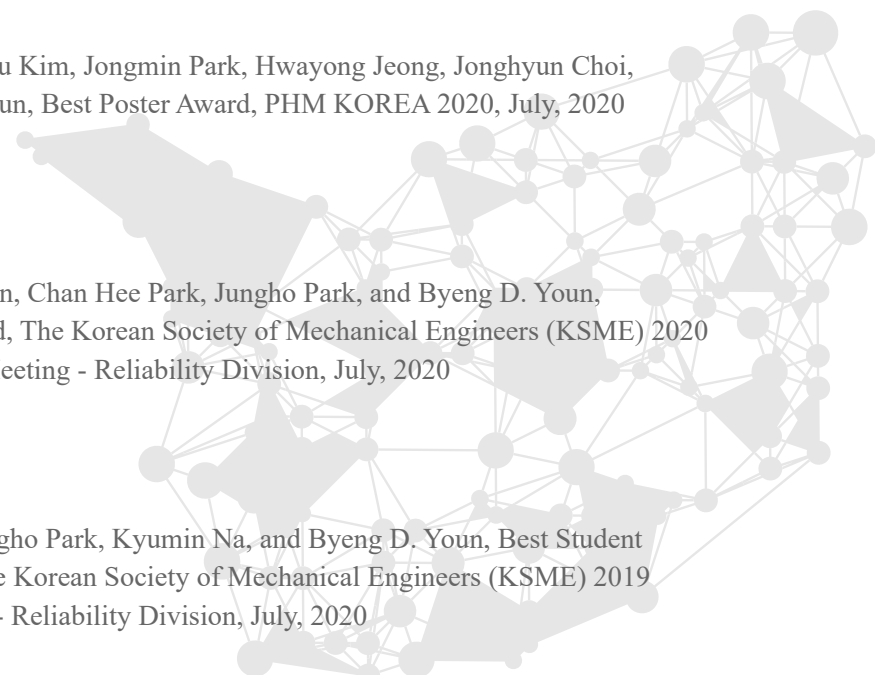
Patents (15 Registered, 14 Applied)

1 international and 14 domestic patents have been registered and 20 domestic patents have been applied.

International Patent (1 Registered)

1) Deog Hyeon Kim, Yong Un Cho, Yongchae Lim, Byeng D. Youn, Hyunseok Oh, and Junmin Lee, Apparatus and Method for Predciting Fault State of Inverter, ZL20170130059.6 (China), August 3, 2021

Domestic Patent (14 Registered)

2) Jin Gyun Park, Byeng D. Youn, Jungho Park, and Jong M. Ha, Fault Diagnosis System of Industrial Robot, 10-2266220, June 11, 2021

3) Byeng D. Youn, Yong Chang Shin, Heonjun Yoon, Soo-Ho Jo, Miso Kim, Wonjae Choi, and Choon-Su Park, Elastic Metamaterial Structure Having Octagonal Hole, 10-2243507, April 16, 2021

4) Byeng D. Youn, Sooho Kim, Jongmin Park, and Sunuwe Kim, Apparatus and Method for Detecting Data Needs Label Update, 10-2242203, April 14, 2021

5) Byeng D. Youn, Hyunseok Oh, Sang Min Lee, Woosung Choi, and Sung Ho Jang, System and Method for Predicting Life of Turbine, 10-2240646, April 9, 2021

6) Byeng D. Youn, Jonghyun Choi, Dongkyu Lee, Yongcheon Song, Jungho Park, and Taewan Hwang, Method for Diagnosis Bearing Fault Based on Band Optimization and Apparatus for Performing the Same, 10-2231315, March 18, 2021

7) Woosung Choi, Sungmin Kim, Heesoo Kim, Seokman Sohn, Jong-Duk Son, Joon-Seok Oh, Byeng D. Youn, Kyumin Na, and Yeongtak Oh, Boiler Piping Monitoring System and Method, 10-2226050, March 4, 2021

8) Byeng D. Youn, Soo-Ho Jo, Boseong Seo, Dongki Lee, and Hyunseok Oh, Fault Detection Method for Electronic Valve, 10-2223767, February 26, 2021

9) Byeng D. Youn, Soo-Ho Jo, Heonjun Yoon, Yong Chang Shin, Miso Kim, and Wonjae Choi, Defect-Based Broadband Energy Harvester, 10-2217914, February 15, 2021

10) Byeng D. Youn, Junmin Lee, Chan Hee Park, Giljun Ahn, and Myeongbaek Youn, Fault Diagnosis Method of Synchronous Motor, 10-2212084, January 29, 2021

11) Byeng D. Youn, Soo-Ho Jo, Heonjun Yoon, and Yong Chang Shin, Gradient Phononic Crystal-Based Broadband Energy Harvester, 10-2212083, January 29, 2021

12) Byeng D. Youn, Yongcheon Song, and Taewan Hwang, Data Standardization Method Considering Operating Condition for Diagnosis for Rotating Machinery Failure and Diagnosis Method Rotating Machinery Failure Using the Same, 10-2198190, December 28, 2020

13) Byeng D. Youn, Yongcheon Song, and Beom Chan Jang, Method for Data Imaging for Equipments Diagnosis and Diagnosis Method Using the Same, 10-2165396, October 7, 2020

14) Byeng D. Youn, Jungho Park, Yunhan Kim, and Kyumin Na, Apparatus and Method for Detecting Fault Using Time-Frequency Image, 10-2161577, September 24, 2020

15) Byeng D. Youn, Sunuwe Kim, Sooho Kim, Hyunjae Kim, Jongmin Park, and Wongon Kim, Fault Diagnosis Method of Transformer, 10-2128460, June 24, 2020

Domestic Patent (20 Applied)

1) 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

2) Byeng D. Youn and Soo-Ho Jo, Elastic Wave Energy Harvesting Apparatus Based on Piezoelectric Defect, 10-2021-0092699, July 15, 2021

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

4) Byeng D. Youn, Hyejeong Son, and Taejin Kim, Model Updating with Error Sources Identification by Information Matrix, 10-2021-0070169, May 31, 2021

5) Byeng D. Youn, Kyumin Na, Jin Uk Ko, and Hyeongmin Kim, Anormaly Data Detection Apparatus and Method on Auto Encoder, 10-2021-0067561, May 27, 2021

6) Byeng D. Youn, Jin Uk Ko, Myungyon Kim, Jinwook Lee, and Taehun Kim, Vibration Signal Generation Device and Vibration Signal Generation Method Using the Same, 10-2021-0067574, May 26, 2021

7) Byeng D. Youn, and Soo-Ho Jo, Apparatus for Metamaterial-based Elastic Wave Energy Localization, 10-2021-0066972, May 25, 2021

8) Byeng D. Youn, Myungyon Kim, Jin Uk Ko, and Jinwook Lee, Apparatus and Method for Fault Diagnosis of Rotor Systems Based on Directly Connected Model Using Vibration Signal Image, 10-2021-0053650, April 26, 2021

9) Byeng D. Youn, Chan Hee Park, Hyunjae Kim, Junmin Lee, and Myeongbaek Youn, Method and Apparatus for Diagnosis of Motor Using Current Signals, 10-2021-0047020, April 12, 2021

10) Byeng D. Youn, Chaehyun Suh, Chan Hee Park, Hyeongmin Kim, and Minseok Cha, Method and Apparatus for Diagnosis of Motor Using Multi-Channel Signals, 10-2021-0045959, April 8, 2021

11) Byeng D. Youn, Yunhan Kim, Sung-Hoon Ahn, Taekyum Kim, Machining Quality Monitoring Apparatus and Method Based on Transfer Learning with Multi-Layer Recurrence Plot, 10-2021-0038569, March 25, 2021

12) Byeng D. Youn, Jinwook Lee, Myungyon Kim, and Jin Uk Ko, Fault Diagnosis Device Using Unsupervised Domain Adaptation Technique and Fault Diagnosis Method Using The Same, 10-2021-0031583, March 11, 2021

13) Byeng D. Youn and Soo-Ho Jo, Metamaterial-based Elastic Wave Parallel Translator, 10-2021-0023427, February 22, 2021

14) Byeng D. Youn, Yunhan Kim, and Kyumin Na, Apparatus and Method for Detecting Fault of Planetary Gearbox Using Cepstrum-Based Signal Analysis, 10-2021-0013583, January 29, 2021

15) Byeng D. Youn, Hyeongmin Kim, Chan Hee Park, Chaehyun Suh, and Minseok Chae, Error Detection Apparatus and Method of Motor, 10-2021-002614, January 8, 2021

16) Byeng D. Youn, Sunuwe Kim, Soo-Ho Jo, Wongon Kim, and Jongmin Park, Fault Diagnosis Device of Fusion Transformer and Fault Diagnosis Method Using the Same 10-2020-0187981, December 30, 2020

17) Byeng D. Youn, Sunuwe Kim, Soo-Ho Jo, Wongon Kim, and Jongmin Park, Method and Apparatus for Diagnosing Power Transformer Using Health Feature Space, 10-2020-0187980, December 30, 2020

18) Byeng D. Youn, Chan Hee Park, Junmin Lee, Yongjin Shin, Giljun Ahn, and Myeongbaek Youn, Apparatus and Method for Determining Fault of Motor in Variable Driving Environment, 10-2020-0159884, November 25, 2020

19) Byeng D. Youn, Jongmin Park, and Sooho Kim, System and Method for Monitoring Partial Discharge Using Sensor Data, 10-2020-0118344, September 15, 2020

20) Byeng D. Youn, Yunhan Kim, Kyumin Na, and Jungho Park, Apparatus and Method for Detecting Fault of Gearbox Using Phase Information, 10-2020-0093508, July 28, 2020

2 Project Updates

11 projects are in progress and 8 projects are successfully completed.

In Progress

1) ASIP Data Analysis and Prediction of Maintenance Demand Based on Big Data, Korea Aerospace Industries, Ltd. (2021-07-01 ~ 2024-06-30)

2) Data-Driven Modelling of Swelling Degradation for a Reliable Battery Module & Pack Design, Hyundai NGV (2021-04-15 ~ 2022-10-14)

3) Korea-Germany Intelligent Manufacturing Systems Laboratory, National Research Foundation of Korea (2021-03-01 ~ 2024-02-28)

4) Development of Fault Diagnosis for Gearbox under Non-stationary Rotational Operating Conditions, Doosan Infracore (2021-03-01 ~ 2022-02-28)

5) Operation of Industry-Academic Advisory Group for Improving Automotive Reliability, Hyundai Motor (2021-03-01 ~ 2022-02-28)

6) 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 ~ 2021-12-31)

7) Physics+AI Modeling and Evolution Methodology for Mechanical Systems, National Research Foundation of Korea (2020-03-01 ~ 2024-02-29)

8) Industrial Artificial Intelligence (AI) Human Resource Development (HRD), Ministry of Trade, Industry and Energy (2020-03-01 ~ 2024-02-28)

9) Industrial Artificial Intelligence for Intelligent Machines and Manufacturing Digitalization, Korea Institute for Advancement of Technology (2019-12-01 ~ 2022-11-30)

10) 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 ~ 2020-07-31)

11) Development of AI-based Diagnosis and Prognostics System for Power Plant, Korea Electric Power Corporation (2018-07-01 ~ 2021-10-31)

Completed

1) Operation of Industry-Academic Advisory Group for Improving Automotive Reliability, Hyundai Motor (2020-06-01 ~ 2021-05-31)

2) Korea-Germany Intelligent Manufacturing Systems Laboratory, National Research Foundation of Korea (2018-08-01 ~ 2021-02-28)

3) Development of Deep Learning based Anomaly Detection Techniques for OHT (Overhead Hoist Transport) Driving Parts, Samsung Electronics (2020-05-21 ~ 2020-12-31)

4) Development of Scale-Free Fault Diagnosis Techniques for Similar Mechanical Systems, Korean Institute of Machinery and Materials (2018-01-01 ~ 2020-12-31)

5) Structural Analysis for Pressurizing System Design of an All-Solid-State Battery, Hyundai Motor (2019-11-25 ~ 2020-11-24)

6) Operation of Industry-Academic Advisory Group for Improving Reliability and Process of Enterprise Parts, Hyundai Motor (2019-11-01 ~ 2020-10-31)

7) Automation Framework of Reliability-Based Battery Pack System Analysis Considering Cell Characteristics, Hyundai Motor (2019-04-15 ~ 2020-10-14)

8) Development of Health State Diagnostics and Prognostics based on Integration of Artificial Intelligence and Expert Knowledge, Korea Electric Power Corporation (2017-08-01 ~ 2020-07-31)
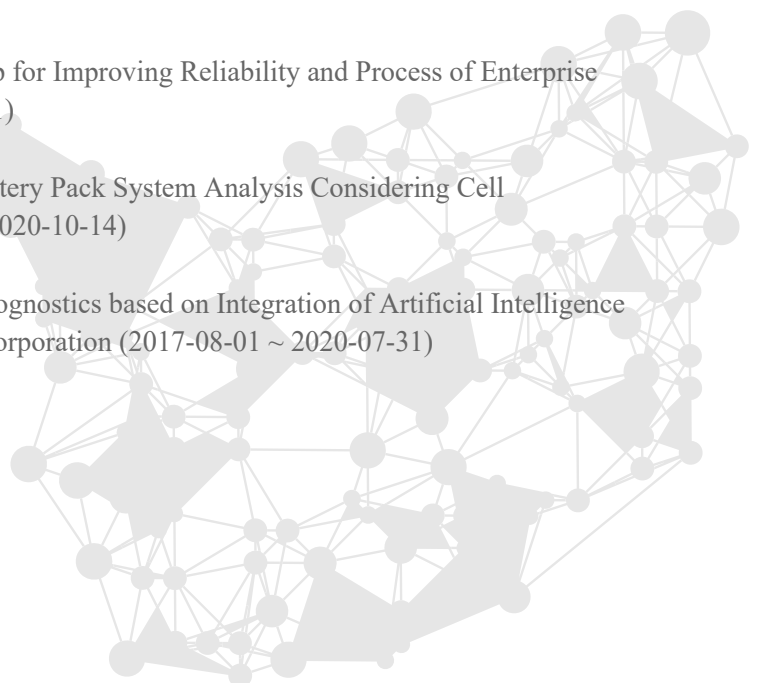
3 Alumni News

SHRM alumni got serveral appointments and awards from SHRM and other organizations recently, including professors, researchers and engineers.

Alumni

1) Dr. Taejin Kim has been appointed as an Assistant Professor at the Department of Industrial and Information Systems Engineering, Jeonbuk National University, Republic of Korea in September 2020.

2) Dr. Heonjun Yoon has been appointed as an Assistant Professor at the School of Mechanical Engineering, Soongsil University, Seoul, Republic of Korea in September 2020.

3) Dr. Soo-Ho Jo has been appointed as a Postdoctoral Researcher at SHRM in March 2021.

4) Dr. Woosung Choi will be dispatched to EPRI, the Electric Power Research Institute located in Charlotte NC, for two years from August 2021 to August 2023.

5) Dr. Sunuwe Kim has worked for SAMSUNG Electronics in September 2021.
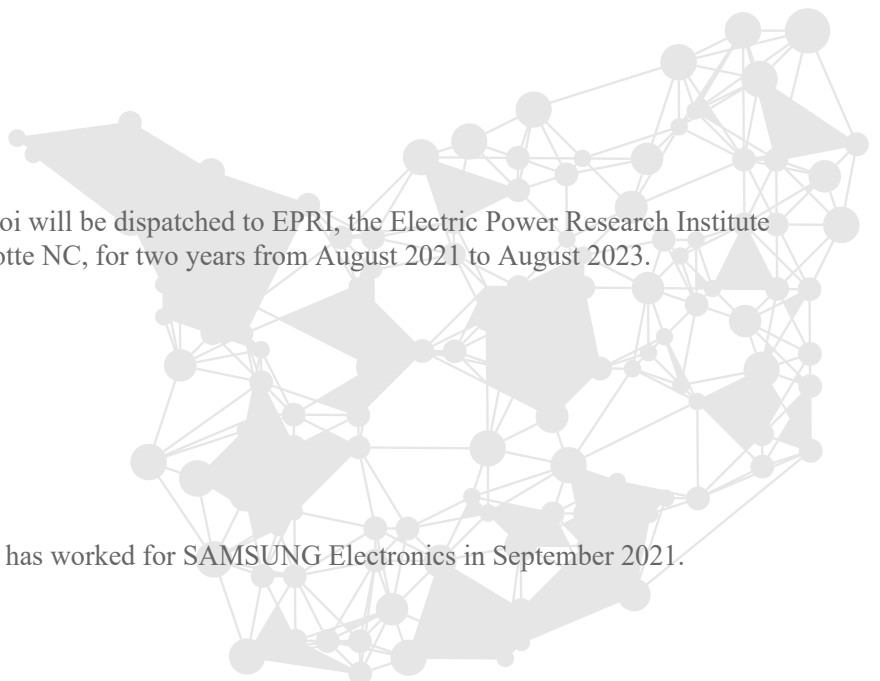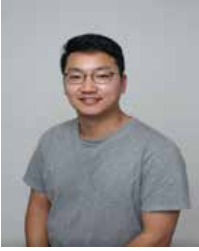
6) Dr. Yong Chang Shin has worked for SAMSUNG Electronics in September 2021.

7) Dr. Hyejeong Son has worked for SAMSUNG Electronics in September 2021.

8) Dr. Myungyon Kim has worked for SAMSUNG Electronics in September 2021.
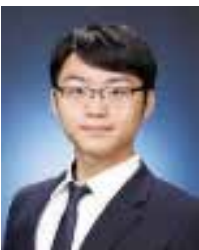
11) Mr. Yeongtak Oh entered Republic of Korea Army in July 2020.

10) Mr. Myeongbaek Youn has worked for SAMSUNG Electronics in September 2020.

9) Mr. Jonghyun Choi has worked for Hyundai Motors in March 2021.
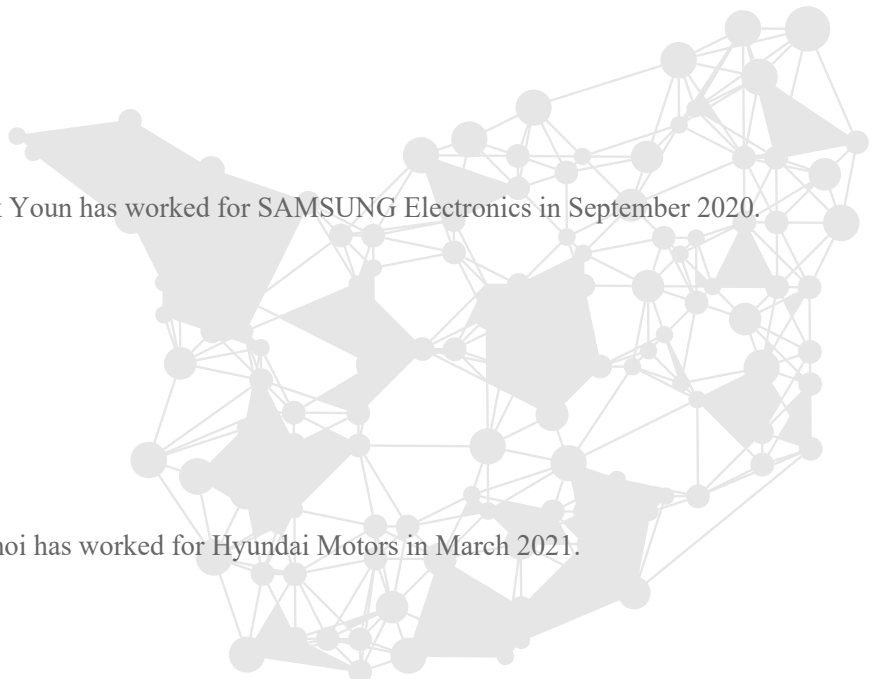
4 Students News

The graduates in 2020 and 2021 shared their stories about research in SHRM.
5 students have received on Ph.D. degree and 5 students have received on M.S. degree.
Also, 1 postdoctoral researcher and 8 students have newly entered SHRM in the last one year.

Ph.D.

Soo-Ho Jo
(2021/02)

Modeling and Design of a Phononic Crystal with Piezoelectric Defects for Broadband Energy Localization and Harvesting

When bridging the domains of energy localization of a defected phononic crystal (PnC) and piezoelectric energy harvesting (PEH), little attention has been paid to the following three issues that can arise:
1) there is no design rationale for a PnC with single or double defects for high dense PEH,
2) defect mode-enabled energy localization has inherently narrowband characteristics, and
3) there are few attempts to demonstrate the formation or splitting of defect bands and investigate how electroelastic coupling effects affect defect bands. Therefore, this doctoral dissertation aims at advancing three essential research areas as follows:
1) Research Thrust 1 provides provide guidelines and rationales for key design parameters for the purpose of maximizing the harvestable electric power. Here, design parameters include: the supercell size, defect location, and relative position between double defects in the mechanical domain and the electrical circuit connection between double defects in the electrical domain.
2) Research Thrust 2 proposes new design concepts of a PnC with piezoelectric defects that can realize broadband energy localization and harvesting; one is a PnC with L-shape arranged triple defects and the other is a graded PnC with decoupled double defects.
3) Research Thrust 3 presents one topic about a lumped-parameter model of a one-dimensional PnC with single or double defects to fundamentally elucidate the formation and splitting of defect bands and the other topic about an electroelastically coupled analytical model of a one-dimensional PnC with a single defect to predict defect bands and output performance of PEH.

Yong Chang Shin
(2021/08)

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

To bridge the domain of band gap reflection of a phononic crystal (PnC) and piezoelectric energy harvesting (PEH), fundamental questions of importance arise on
1) how to estimate the output electric power of 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:
1) Research Thrust 1 – an electroelastically coupled analytical model of a quadra-morph piezoelectric bar under elastic waves;
2) Research Thrust 2 – quantification of effects of a phononic band gap on performance of piezoelectric energy harvesting; and
3) Research Thrust 3 – realization of resonance for elastic wave amplification and harvesting: an effective boundary formed by a phononic band gap.

**Hyejeong Son
(2021/08)**

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

Since numerous error sources in an experimental and computational model are intertwined with each other, 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 aims to develop a model improvement process that identifies the leading cause of invalidity of a prediction. In this work, an experimental design method is integrated with optimization-based model improvement to minimize the effect of estimation errors in model calibration. Through use of the proposed method, after calibration, the computational model mainly includes the effects of unrecognized modeling errors.

Research Thrust 2 devises proportionate bias calibration to quantify the amount of degradation of the predicted responses due to model form errors in a computational model. In this framework, 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 provides a statistical validation metric that is sensitive to a discrepancy in the mean or variance of the two distributions from the predictions and observations. The result can highlight the statistical validation metrics that show fewer errors in hypothesis testing. Statistical validation metrics examined in this study include Kullback-Leibler divergence, area metric with U-pooling, Bayes factor, likelihood, probability of separation, and the probability residual.

**Sunuwe Kim
(2021/08)**

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

Although deep-based fault diagnosis methods have been widely used in many engineering systems, little attention has been paid to the industrial field of power transformers fault diagnosis with unlabeled data. There are following three practical issues that can arise:
1) there are few attempts to elucidate monotonic health trendability in feature space,
2) underperformance of fault identification due to a lack of fault labeled DGA data, and
3) absence of fault identification that reflects severity levels. Therefore, this doctoral dissertation aims at advancing three essential research areas as follows:
1) Research Thrust 1 proposes a semi-supervised autoencoder with an auxiliary task (SAAT) to extract a health feature space for power transformer fault diagnosis using dissolved gas analysis (DGA). The health feature space generated by a semi-supervised autoencoder (SSAE) not only identifies normal and thermal/electrical fault types but also presents the underlying characteristics of DGA.
2) Research Thrust 2 proposes a new framework, named BDD, that bridges Duval's method with a deep neural network (DNN) approach for power transformer fault diagnosis using dissolved gas analysis (DGA). BDD overcomes problems found in real-world industrial settings, where a large amount of DGA data is unlabeled and an extremely small size of data is labeled.
3) Research Thrust 3 presents a generative adversarial network with embedding severity DGA level for fault diagnosis and feature extraction (GANES). By taking advantage of the generative adversarial network and the DGA condition level, the proposed method could generate various kinds of DGA data that could balance the imbalanced data with unlabeled DGA data. In addition, since GAN could train under unlabeled data, it could extract severity features even in the insufficient industrial data.

Maximal Information Use for Deep Learning Based Fault Diagnosis Techniques

Myungyon Kim
(2021/08)

For the mechanical systems that are operating in the real world, it is not easy to obtain sufficient data and label information. Consequently, this doctoral dissertation investigates three research thrusts for maximizing the use of information to improve the performances 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. In addition, the dimension reduction module also can increase the training efficiency by reducing the number of trainable parameters significantly.

The second research thrust suggests the parameter transfer and metric learning based fault diagnosis method. This facilitates robust and discriminative feature learning to enhance the fault diagnosis performance under insufficient and noisy data conditions. The pre-trained model trained using the abundant source domain data is transferred and used to develop a robust fault diagnosis method. Moreover, a semi-hard triplet loss function is adopted to learn the features with high separability according to the class labels.

Finally, the last research thrust proposed 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 the fault diagnosis methods in the target domain. Simultaneously, the newly devised semantic clustering loss is applied at multiple feature levels to learn discriminative domain-invariant features. As a result, features that are not only semantically well-clustered but also domain-invariant can be effectively learned.

M. S.

A Weighted Residual Rényi Information (WRRI) for Detecting Fault Feature of Motor and Gearbox in Linear Time-Frequency Representation

Myeongbaek Youn
(2020/08)

Many studies have been conducted for fault detection of rotating machineryunder varying speed conditions using time-frequency representation (TFR). However, the parameters of TFR have been selected by researchers empirically in most previous studies. Also, the previously proposed TFR measures do not suggest the optimal parameter for fault diagnosis. This paper thus proposed a TFR measure to select the parameter from the perspective of detecting fault features. The proposed measure, Weighted Residual Rényi Information (WRRI), is based on Rênyi Information, selected through a comparative study among previously suggested measures. WRRI, defined as a modified form of the input atom of Rényi Information, consists of two terms. The first term is the residual term that extracts the fault feature, and the second term is the weighting term that reduces the effect of noise.
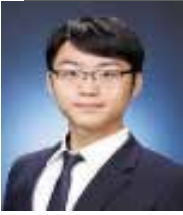
Motion-Adaptive Few-Shot Fault Detection Method of Industrial Robot Gearboxes via Residual Convolutional Neural Network

In this paper, we propose a novel motion-adaptive few-shot (MAFS) fault detection method of industrial robot gearboxes using torque ripples via a one-dimensional (1D) residual-convolutional neural network (Res-CNN) and binary-supervised domaina daptation (BSDA). The overall procedure of the proposed method is as follows. First, applying the moving average filtering to the torque signal to extract the data trend,and the torque ripples of the high-frequency band are obtained as a residual value between the original signal and the filtered signal. Second, classifying the state of pre-processed torque ripples under various operating and environmental conditions. It is shown that Res-CNN network 1) distinguishes small differences between normal and fault torque ripples effectively, and 2) focuses on important regions of the input data by the attention effect.Third, after constructing the Siamese network with a pre-trained network in the source domain,which consisted of simple motions, detecting the faults on the target domain, which consisted of complex motions through BSDA.

Yeongtak Oh
(2020/08)

Deep Neural Network based Disease Severity Regression for Diagnosis of Abdominal Aortic Aneurysm

This study proposes a disease diagnosis and severity regression technique that combines deep learning. There are three research thrusts here: 1) generating normal and disease data through simulation model, 2) regression of disease severity, and 3) reflecting individual diversity when generating data. In the first thrust, data is generated using a simulation model. One of the simulation models for diagnosing human disease is a transmission line model (TLM). A transmission line model modified from the model proposed in other previous papers is used. In order to obtain blood pressure through the model, the input impedance needs to be calculated, which was calculated using a recursive algorithm. In the second thrust, disease incidence is monitored through severity regression. Deep neural network (DNN) is used as a tool to perform regression. In the third thrust, biometric parameter values are given as distributions. In consideration of the characteristics of each parameter, an appropriate distribution is assigned to each.

Joo Hyeon Im
(2021/02)

Study of Interpretable AI Based Bearing Fault Frequency Estimation Utilizing Generated Signal

This paper suggests a deep learning-based approach using one-dimensional attention gated convolutional neural network(1D- AttGCNN) trained only with a generated signal. The model learns to regress pre- defined resonant parameters of the generated signals and require no additional training whendiagnosing a real fault signal. The proposed architecture includes an attention-gated layer, which automatically learns to localize resonance-induced impulse through backpropagation. Moreover, uncertainty and non-Gaussian noise were taken into account in the signal generating process to facilitate the model adaptation to the real target signal. The validity of the proposed model is examined in various environments with different difficulties via three case studies. Furthermore, comparisons with the conventional Fast Kurtogram and Autogram methods are presented with quantitative measures based on mean absolute deviation distance. Results demonstrate the superiority of the proposed method over the conventional method and the effectiveness of the proposed architecture and signal generation methods.

Jonghyun Choi
(2021/02)

Deep Learning Approach for Motor Diagnosis Using Bayesian Based Class Weight Optimization

Diagnosis of motor defects are essential task, because the defects can lead to failure of an entire system, causing deterioration in quality of applications and user dissatisfaction. Recently, this problem has been addressed by a data-driven approach based on deep learning methods. However, in real industrial environment, defect data are insufficient compared to the normal data, which significantly degrades the learning performance of the diagnostic model. This paper proposes a deep learning-based diagnosis method, defining weight balancing parameters to solve the class imbalance between normal and defect data. The parameters can make the model to more focus on the defect data during training. We optimized the parameters through Bayesian method, and find the best model to improve classification performance in minor classes. Experimental results show that the model with optimized paramet/ers enhanced performance in given imbalanced data. This refers that the model can proceed training without editing the input data to balance between minor and major classes.

Yongjin Shin
(2021/02)

New Postdoctoral Researcher and Students

2020 /

Minseok Chae

Sungjong Kim

2021 /

Soo-Ho Jo
(Postdoctoral Researcher)

Keon Kim

Joo Hyeon Im

Donghyu Lee

Seung Yun Lee

Jinoh Yoo

Taehun Kim

5 Press

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

News Script

1) LG U+ has released a smart factory solution that diagnoses and inspects failures of plant facilities in advance with OnePredict, an industrial artificial intelligence company, Yonhap, 2021-07

2) YUILROBOTICS Co., Ltd is stepping up its development of robot technology, Hankyung, 2021-07

3) LG U+ develops Ulsan petrochemical complex to 5G Smart Factory, Yonhap, 2021-07

4) LINC+ of Dong-A University held Smart Factory and Artificial Intelligence Platform Conference, Hankyung, 2021-07

5) OnePredict is selected as excellent corporate affiliated research institute by the Ministry of Science and ICT, E-daily, 2021-06

6) The number of innovative technology-based start-up has been increasing mainly in universities, Jungang, 2021-06

7) Ministry of Science and ICT announced this year's 15 potential Unicorn companies, Dongascience, 2021-05

8) LG U+ constructs the smart world with 5G mobile edge computing sevice, Etnews, 2021-05
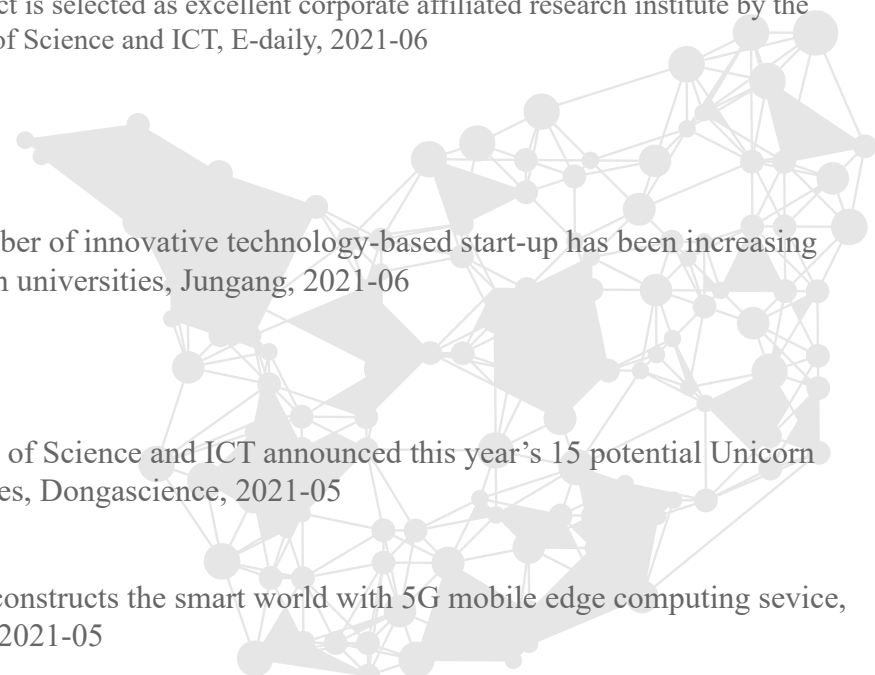
9) S-Oil is expanding the proportion of chemicals and hydrogen, Hankyung Business, 2021-04

10) Global expansion of new businesses out of mobile carriers, Digital Today, 2021-04

11) Digital twin changes the paradigm of power generation industry, Electimes, 2021-04

12) Another land of opportunity for the 5G industry, B2B. "The influence of telecommunications companies is becoming icreasingly igreemportant", Green Economic Daily, 2021-04

13) Hwaseong Industrial Promotion Agency (HIPA) was officially launched to create a shared growth ecosystem, KyeonginDaily, 2021-03

14) LG U+ expands AI preservation service. Diagnosis and prognosis of failure of facilities, Kukinews, 2021-02

15) S-Oil seeks a survival solution through business diversification, Fetv, 2021-02

16) LG U+ has provided effective 'MEC-Based 5G Public Service', Kukinews, 2021-02

17) Prof. Byeng D. Youn, "predicting the power plant turbine failure 6 months in advance...", Hankyung Business, 2021-01

18) SJ Investment Partners, 'Jeonbuk First Mover Fund' supports local ventures, The bell, 2021-01
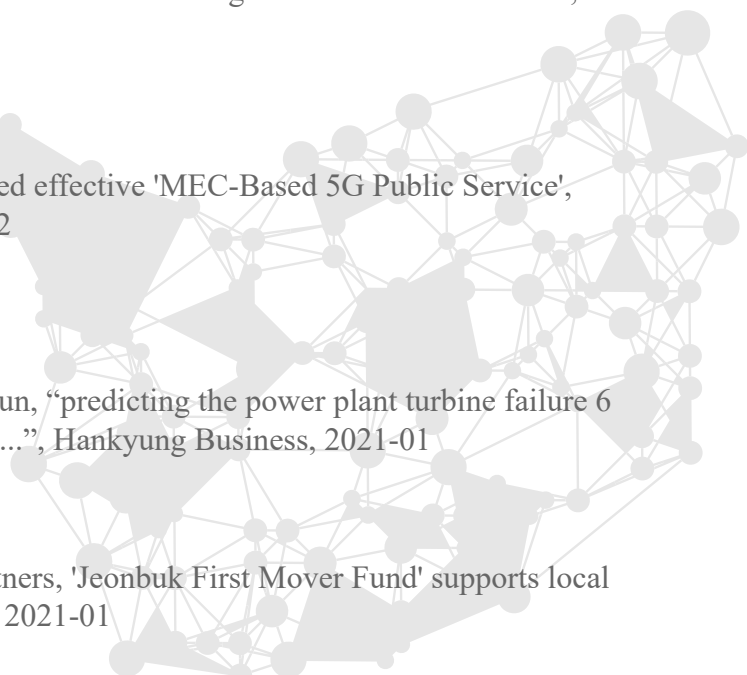
19) More catastrophic than corona is climate change, Environmental Daily, 2021-01

20) S-Oil invests equity in high performance sulfur modifier technology startup, Maeil Business News, 2020-12

21) Yeosu Gwangyang Port Authority (YGPA) introduces AI-based fault diagnosis method for port transformer, Wikitree, 2020-12

22) Korea East-West Power Corporation held 'Big Data AI Competition', Global Economic, 2020-12

23) Digital twin solutions and expected effects using industrial artificial intelligence Technology, Ksnve Journal, 2020-11

24) [Market Insight] Industrial AI venture company OnePredict, won successive contracts, Hankyung, 2020-11

25) COMEUP 2020, the digitalization of manufacturing and beyond, Venture Square, 2020-11

26) Untact startup festival 'COMEUP 2020', Maeil Business News, 2020-11

27) OnePredict is selected as 25 AI startup company, Hankyung Business, 2020-10
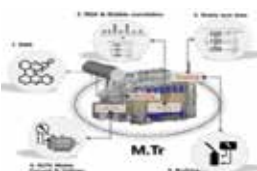
28) KEPCO advances AI-based fault diagnosis and prognosis technology for substation facility, Energy Daily, 2020-10
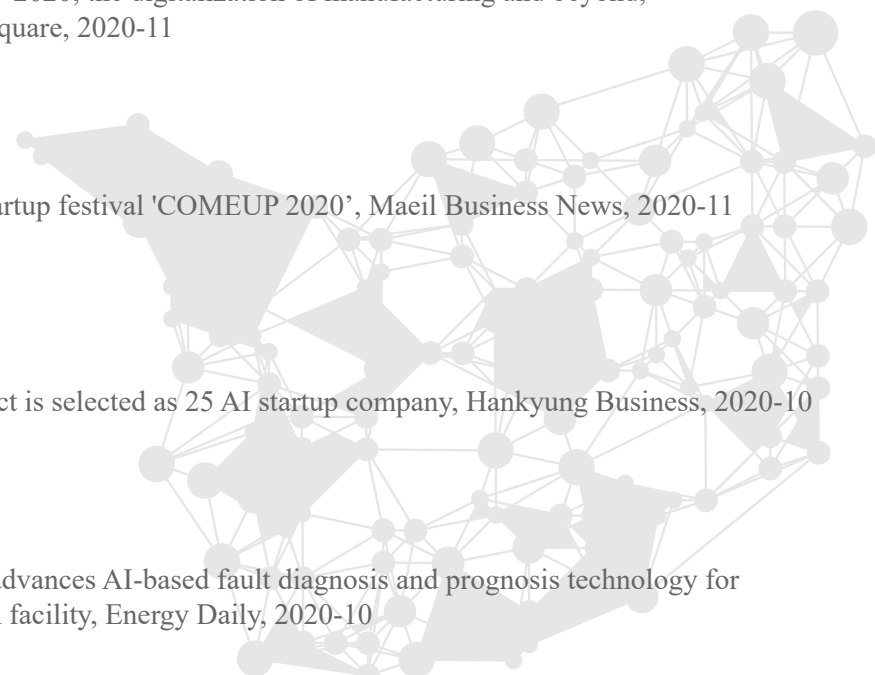
29) OnePredict is selected as 25 AI startup company, Hankyung Business, 2020-10
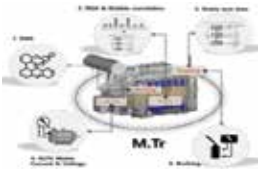
30) KEPCO advances AI-based fault diagnosis and prognosis technology for substation facility, Energy Daily, 2020-10

31) The key to future car reliability, Mobility Insight, 2020-10

32) Choi Dong-yeol, executive director of Stone Bridge Ventures, said, "the focus is on investing in segmentation of DNA(Data, Network, AI) and Big 3(Bio, System Semiconductor, and Self-driving), The Bell, 2020-09

33) SJ Investment Partners exhausted 37.5 billion won for investment of 'New Challenge Fund', The Bell, 2020-09

34) Yeosu Gwangyang Port Authority (YGPA) held an untact business briefing session for venture companies, Dailylog, 2020-08

35) [Weekly Column] Industrial digital transformation in preparation for post-corona, seoul forum for industry-university-research cooperation, 2020-08

36) OnePredict is selected as 15 'ICT GROWTH' companies, Maeil Business News, 2020-07
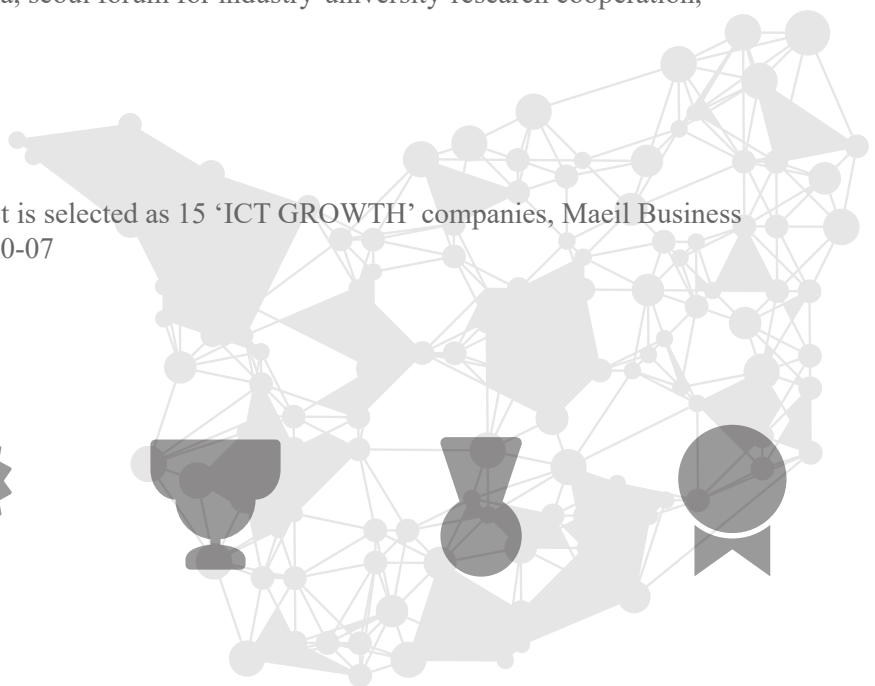
6 Other News and Events

Family Event

CONGRATURATION   WEDDING MARCH!
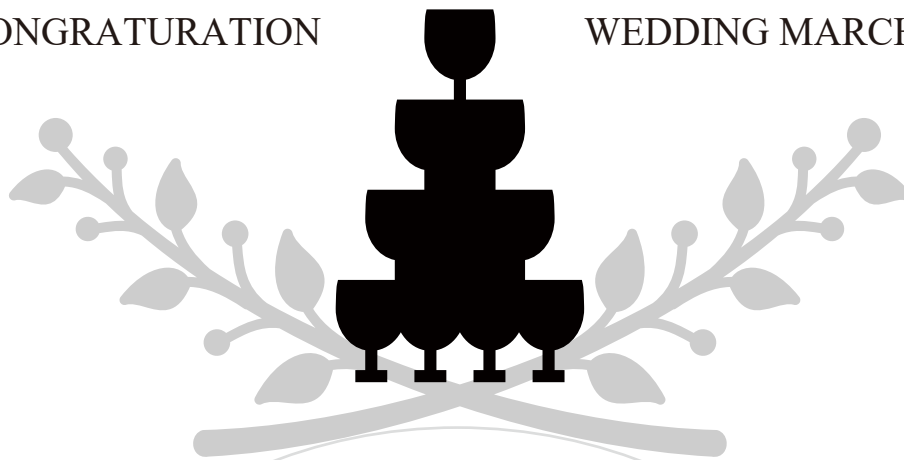
Mr. Jin Uk Ko married on 17th April, 2021

Mr. Wongon Kim married on 10th April, 2021

Mr. Beom Chan Jang married on 20th December, 2020

Dr. Joung Taek Yoon married on 5th December, 2020

Mr. Sooho Kim married on 28th November, 2020

Mr. Giljun Ahn married on 6th September, 2020

Dr. Junmin Lee married on 23rd August, 2020

Prof. Youn's Seminar

April 2021, Digital Transformation Conference

March 2021, On-campus Seminar

January 2021, SHRM Industrial AI Concert

November 2020, Keynote Speech in ACSMO 2020

November 2020, COMEUP 2020

Prof. Youn's Academic Activity _____

Prof. Youn contributed to the "Mechanical Systems and Signal Processing (MSSP)" Special Issue on "Physics-Informed Machine Learning Enabling Fault Feature Extraction and Robust Failure Prognosis" as a Guest Editor. This special issue is intended to include original, high-quality work that creates new theoretical foundations and models/algorithms of physics-informed machine learning for failure prognosis.

Important Dates
February 1st, 2021: Elsevier System open for submission
December 15th, 2021: Deadline for paper submission
March 1st, 2022 or earlier: Completion of first-round reviews
May 15th, 2022 or earlier: Revised paper submission
June 20th, 2022 or earlier: Final decision notification

Guest Editors
Chao Hu, Iowa State University, US, chaohu@iastate.edu
Kai Goebel, PARC (Palo Alto Research Center), US, kgoebel@parc.com
David Howey, University of Oxford, UK, david.howey@eng.ox.ac.uk
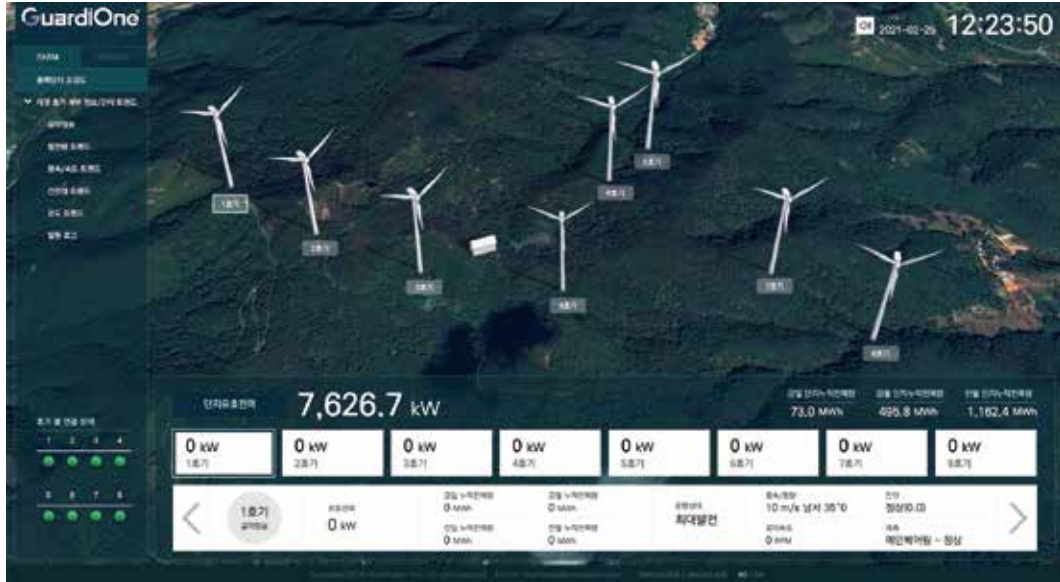Zhike Peng, Shanghai Jiao Tong University, China, z.peng@sjtu.edu.cn
Dong Wang, Shanghai Jiao Tong University, China, dongwang4-c@sjtu.edu.cn
Peng Wang, University of Kentucky, US, edward.wang@uky.edu
Byeng D. Youn, Seoul National University, South Korea, bdyoun@snu.ac.kr

OnePredict News

GuardiOne® Wind, fault diagnosis and prognosis solution of OnePredict,
was registered as a development selection by Korean Western Power.
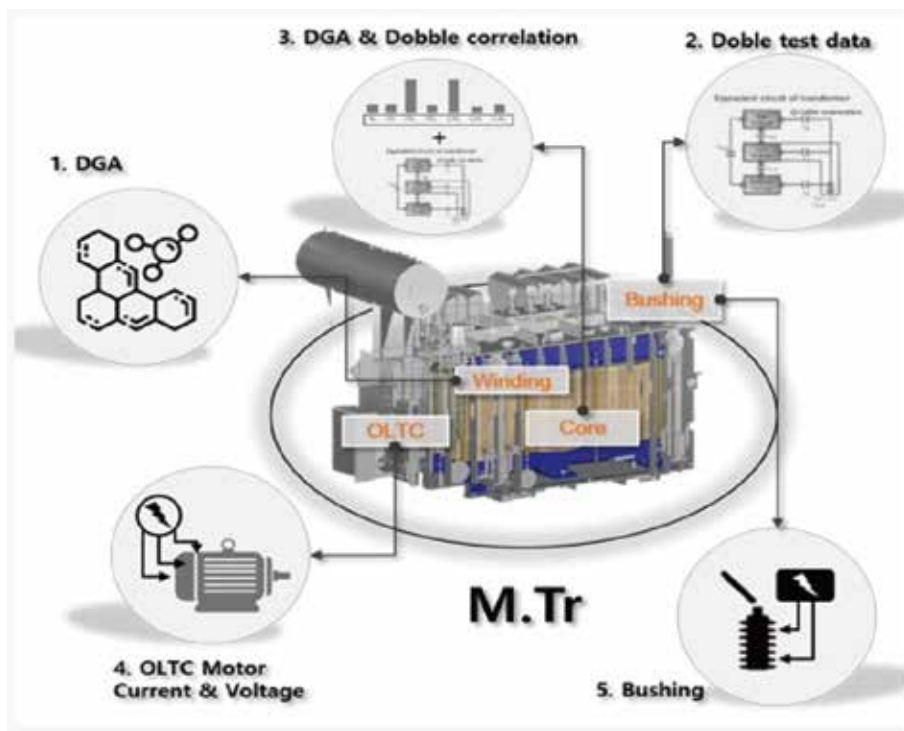

OnePredict was selected as 2021 KEPCO Trusted Partner.

Noh Kwangyong, the section chief of OnePredict, made a presentation about
'PHM-based prognosis and diagnosis solution (GuardiOne®)' at the 2021 AI Platform Conference.

OnePredict will participate in the 5g Multi-access Edge Computing (MEC)
construction project of LGU+ in Ulsan industrial complex.

OnePredict signed an MOU with Nearthlab, a developer of autonomous flight drones for facility safety inspection, for a 'facility inspection and diagnosis solution business'.

OnePredict launched the advanced AI-based transformer diagnosis and prediction technology project with Korea Electric Power Corporation (KEPCO).

OnePredict was selected as Excellent Corporation R&D Center (ECRC) hosted by Ministry of Science and ICT.

OnePredict introduced an AI smart factory solution with LGU+.

OnePredict signed a contract to provide its industrial AI solution, 'GuardiOne® Transformer' for eight 345 kilovolt electric transformers to Korea Western Power Co., Ltd. (KOWEPCO) thermal power plant.

OnePredict introduced an AI-based port transformer facility diagnosis method to 154/22.9kV transformers with Yeosu Gwangyang Port Authority (YGPA).

LG U+ signed an MOU with OnePredict to improve competitiveness
in the field of AI-based facility predictive maintenance.

OnePredict was selected a supplier for the '2021 AI Voucher Support Program'
hosted by the National IT Industry Promotion Agency (NIPA).

OnePredict obtained certification for New Excellent Technology (NET)
from Korean Agency for Technology and Standards.