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 2018 to May 2019.
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 (23 Published, 3 Accepted, 5 submitted)

23 papers were published and 3 papers were accepted for publication in highly ranked journals.
In addition, 5 papers are submitted. Progress on these papers will be reportedin a future newsletter.

Published or Accepted

1) Guesuk Lee, Guilian Yi, and Byeng D. Youn, “A Comprehensive Study on Optimization-Based Model Calibration Using Gradient Information,” Structural and Multidisciplinary Optimization, v57, n5, 2018-05

2) Junpeng Zhao, Byeng D. Youn, Heonjun Yoon, Zhifang Fu, and Chunjie Wang, “On the Orthogonal Similarity Transformation (OST)-Based Sensitivity Analysis Method for Robust Topology Optimization under Loading Uncertainty: A Mathematical Proof and Its Extension,” Structural and Multidisciplinary Optimization, v58, n1, 2018-07

3) Sihyeong Woo, Taejin Kim, Junmin Lee, Hyunseok Oh, Byeng D. Youn, and Daeil Kwon, “TDR based Multiple Leaks Detection System using S-parameters Transmission Line Model and Bayesian Inference for Long Distance Pipeline,” International Journal of Prognostics and Health Management, v9, p1-13, 2018-07

4) Jong M. Ha, Jungho Park, Kyumin Na, Yunhan Kim, and Byeng D. Youn, “Tooth-wise Fault Identification for a Planetary Gearbox Based on a Health Data Map,” IEEE Transactions on Industrial Electronics, v65, n7, 2018-07

5) Junpeng Zhao, Heonjun Yoon, and Byeng D. Youn, “An Efficient Decoupled Sensitivity Analysis Method for Multiscale Concurrent Topology Optimization Problems,” Structural and Multidisciplinary Optimization, v58, p445-457, 2018-08

6) Jungho Park, Byungjoo Jeon, Jongmin Park, Jinshi Cui, Myungyon Kim, and Byeng D. Youn, “Failure Prediction of a Motor-driven Gearbox in a Pulverizer Under External Noise and Disturbance,” Smart Structures and Systems, v22, p185-192, 2018-08

7) Jinshi Cui, Heonjun Yoon, and Byeng D. Youn, “An Omnidirectional Biomechanical Energy Harvesting (OBEH) Sidewalk Block for a Self-Generative Power Grid in a Smart City,” International Journal of Precision Engineering and Manufacturing-Green Technology, v5, n4, 2018-08

8) Insun Shin, Junmin Lee, Jun Young Lee, Kyusung Jung, Daeil Kwon, and Byeng D. Youn, “A Framework for Prognostics and Health Management Applications toward Smart Manufacturing Systems,” International Journal of Precision Engineering and Manufacturing-Green Technology, v5, p535-554, 2018-08

9) Taejin Kim, Byeng D. Youn, and Hyunseok Oh, “Development of a Stochastic Effective Independence (SEFI) Method for Optimal Sensor Placement under Uncertainty,” Mechanical Systems and Signal Processing, v111, p615-627, 2018-10

10) Taejin Kim, Guesuk Lee, and Byeng D. Youn, “Uncertainty Characterization Under Measurement Errors Using Maximum Likelihood Estimation: Cantilever Beam End-to-End UQ Test Problem,” Structural and Multidisciplinary Optimization, v59, n2, 2019-02

11) Heonjun Yoon and Byeng D. Youn, “System Reliability Analysis of Piezoelectric Vibration Energy Harvesting Considering Multiple Safety Events Under Physical Uncertainty,” Smart Materials and Structures, v28, n2, 2019-02

12) Jungho Park, Moussa Hamadache, Jong M Ha, Yunhan Kim, Kyumin Na, and Byeng D. Youn, “A Positive Energy Residual (PER) based Planetary Gear Fault Detection Method under Variable Speed Conditions,” Mechanical Systems and Signal Processing, v117, p347-360, 2019-02

13) Choon-Su Park, Yong Chang Shin, Soo-Ho Jo, Heonjun Yoon, Wonjae Choi, Byeng D. Youn, and Miso Kim, “Two-dimensional Octagonal Phononic Crystals for Highly Dense Piezoelectric Energy Harvesting,” Nano Energy, v57, 2019-03

14) Junmin Lee, Hyunseok Oh, Chan Hee Park, Byeng D. Youn, and Bongtae Han, “Test Scheme and Degradation Model of Accumulated Electrostatic Discharge (ESD) Damage for Insulated Gate Bipolar Transistor (IGBT) Prognostics,” Nano Energy, v19, p233-241, 2019-03

15) Hyunjae Kim and Byeng D. Youn, “A New Parameter Repurposing Method for Parameter Transfer with Small Dataset and Its Application in Fault Diagnosis of Rolling Element Bearings,” IEEE Access, p1, 2019-03

16) Joung Taek Yoon, Byeng D. Youn, Minji Yoo, Yunhan Kim, and Sooho Kim, “Life-Cycle Maintenance Cost Analysis Framework Considering Time-Dependent False and Missed Alarms for Fault Diagnosis,” Reliability Engineering & System Safety, v184, p181-192, 2019-04

17) Woosung Choi, Byeng D. Youn, Hyunseok Oh, and Nam H. Kim, “A Bayesian Approach for a Damage Growth Model Using Sporadically Measured and Heterogeneous on-site Data from a Steam Turbine,” Reliability Engineering & System Safety, v184, p137-150, 2019-04

18) Junpeng Zhao, Heonjun Yoon, and Byeng D. Youn, “An Efficient Concurrent Topology Optimization Approach for Frequency Response Problems,” Computer Methods in Applied Mechanics and Engineering, v347, p700-734, 2019-04

19) Jungho Park, Yunhan Kim, Kyumin Na, and Byeng D. Youn, “Variance of Energy Residual (VER): An Efficient Method for Planetary Gear Fault Detection Under Variable-Speed Conditions,” Journal of Sound and Vibration, v453, p253-267, 2019-08

20) Minji Yoo, Taejin Kim, Joung Taek Yoon, Yunhan Kim, Sooho Kim, and Byeng D. Youn, “A Resilience Measure Formulation that Considers Sensor Faults,” Reliability Engineering & System Safety, Online Published

21) Guesuk Lee, Wongon Kim, Hyunseok Oh, Nam H. Kim, and Byeng D. Youn, “Review of Statistical Model Calibration and Validation-From the Perspective of Uncertainty Structures,” Structural and Multidisciplinary Optimization, Online Published

22) Hyunseok Oh, Hwanoh Choi, Joon Ha Jung, and Byeng D. Youn, “A Robust and Convex Metric for Unconstraint Optimization in Statistical Model Calibration – Probability Residual (PR),” Structural and Multidisciplinary Optimization, Online Published

23) Moussa Hamadache, Joon Ha Jung, Jungho Park, and Byeng D. Youn, “A Comprehensive Review of Artificial Intelligence-Based Approaches to Rolling Element Bearing PHM: Shallow & Deep Learning,” Journal of Mechanical Science and Technology - Advances, Online Published

24) Guilian Yi, Yong Chang Shin, Heonjun Yoon, Soo-Ho Jo, and Byeng D. Youn, “Topology Optimization for Phononic Band Gap Maximization Considering a Target Driving Frequency,” Journal of Mechanical Science and Technology - Advances, Accepted

25) Guesuk Lee, Hyejeong Son, and Byeng D. Youn, “Sequential Optimization and Uncertainty Propagation Method for Efficient Optimization-Based Model Calibration,” Structural and Multidisciplinary Optimization, Accepted

26) Taejin Kim, Gueseok Lee, and Byeng D.Youn, “PHM Experimental Design for Effective State Separation using Jensen-Shannon Divergence,” Reliability Engineering & System Safety, Accepted

Submitted

1) Useok Jung, Keunsu Kim, Sanghun Kim, Hyunhee Choi, Byeng D. Youn, and Kyu-Jin Cho, “Reliability Analysis of Bowden-Cable Transmissions for Soft Robotic Systems,” International Journal of Robotics Research, Submitted

2) Junpeng Zhao, Heonjun Yoon, and Byeng D. Youn, “Concurrent topology optimization with uniform microstructure for minimizing dynamic response in the time domain,” Computers & Structures, Submitted

3) Wongon Kim, Heonjun Yoon, Guesuk Lee, Taejin Kim, and Byeng D. Youn, “A New Calibration Metric Considering Statistical Correlation: Marginal Probability and Correlation Residuals (MPCR),” Reliability Engineering & System Safety, Submitted

4) Yunhan Kim, Jungho Park, Kyumin Na, Hao Yuan, Byeng D. Youn, and Chang-soon Kang, “Phase-based time domain averaging (PTDA) for fault detection of a gearbox in an industrial robot using vibration signals,” Mechanical Systems and Signal Processing (Special Issue), Submitted

5) Vikas Sharma, Jungho Park, Yunhan Kim, and Byeng D. Youn, “Tunable Wavelet assisted Empirical Mode Decomposition based Fault Diagnosis Approach for Planetary Gearbox under Varying Speed,” International Journal of Precision Engineering and Manufacturing - Green Technology, Submitted

Awards

8 awards were rewarded, including 2 Commendation of Prime Minister,
1 Young Scientist Award, 1 Reviewer Award from journal, and 2 Best Paper Awards from conferences.

Congratulation to all prize winners!

1) Heonjun Yoon, Young Scientist Award, Asian Society of Structural Multidisplinary Optimization, May, 2018.

2) Sooho Kim, Sunuwe Kim, Hyunjae Kim, Jungho Park and Byeng D. Youn, ICES 2018 Outstanding Presentation Award, October, 2018.

3) Chung-gu Lee, Commendation of Prime Minister,Ministry of Public Administration and Security, December, 2018

4) Byeng D. Youn, KSDO Pidotech, “A Prospective Researcher Award”, Korean Society for Design Optimization (KSDO), January, 2019

5) Soo-Ho Jo, Best Paper Award, The Korean Society of Noise and Vibration Engineering, February 2019

6) Myeongbaek Youn, Jungho Park, Byeng D. Youn, Best Student Paper Award, The Korean Society of Mechanical Engineers(KSME), February, 2019

7) Heonjun Yoon, Outstanding Reviewer Awards 2018, Journal of Physics D: Applied Physics, March, 2019

8) Byeng D. Youn, Commendation of Prime Minister, Ministry of Public Administration and Security, April, 2019

Patent

To date, 3 patents have been applied and 2 patents have been registered, consisting of 5 domestic patents.

Domestic Patent

1) Youn B.D., Park J.H., Ha J.M., Kim Y., Na G.M., Vibration characteristics data map processing apparatus for diagnosing a fault of planetary gear box, Patent Application, 10-2018-0060479, May 28, 2018

2) Youn B.D., Shin Y.C, Yoon H.J, Jo S.H., Energy Harvester Based on Metamaterial, Patent Registration, 10-1885731-0000, July 31, 2018

3) Youn B.D., Park J.H., Kim Y., Na G.M., Fault detection apparatus and method for gears under variable-speed condition using Short-Time Fpurier Transform, Patent Application, 10-2018-0114952, September 27, 2018

4) Youn B.D., Kim D.H, Jo Y.W, Im Y.C, Oh H.S, Lee J.M., Apparatus and Method for Failure Prognosis in Inverter, Patent Registration, 10-1916060, November 01, 2018

5) Youn B.D., Kim S., Park J., Kim S., Refinement of inaccurate data labels for training image data, based on election of high similarity population, Patent Application, 10-2019-0035767, March 28, 2019

2 Project Updates

11 projects are in progress now, with 2 projects completed.

In Progress

1) System Reliability Improvement and Validation for New Growth Power Industry Equipment, Korea Evaluation Institute Of Industrial Technology (2014-11-01 ~ 2019-10-31)

2) Center for Soft meta-Human, Ministry of Science, ICT and Future Planning (2016.11.01 ~ 2022.12.31)

3) Development of 6-DOF Cooperative Robot Technology with Repetition Accuracy of 0.1mm and Payload of 15kg in Compliance with International Safety Certification Standard, Korea Evaluation Institute Of Industrial Technology (2017-04-01 ~ 2019-12-31)

4) Analysis and Design of Elastic Metamaterials for Energy Focusing, National Research Council of Science & Technology (2017-05-22 ~ 2022-05-21)

5) Development of Health State Diagnostics and Prognostics based on Integration of Artificial Intelligence and Expert Knowledge, Korea Electric Power Corporation (2017-08-01 ~ 2020-07-30)

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

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

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

9) Development of Machine Learning based Condition Monitoring Techniques for OHT(Overhead Hoist Transport) Driving Parts and Fault Detection Techniques for Stepper Motor, Samsung Electronics (2019-01-01 ~ 2019-12-31)

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

11) KF -X Engine tendency analysis and review of diagnostic system needs, Korea Aerospace Industries (2019-01-31 ~ 2019-07-30)

Completed

1) Development of Health Feature Model in an Industrial Robot Considering Operating Conditions, Hyundai Robotics (2017-07-01 ~ 2018-06-30)

2) Advances in Fault Detection Techniques for OHT (Overhead Hoist Transport) Driving and Non-driving Parts, Samsung Electronics (2018-01-01 ~ 2018-12-31)

3 Alumni News

SHRM alumni got several appointments and awards from SHRM and other organizations recently, including assistant professor, researchers and engineers.

Alumni

1) Dr. Heonjun Yoon is awarded the government funding for postdoctoral fellowship (National Research Foundation of Korea, Sep. 2019 - Aug. 2020, $38,400).
Dr. Yoon will join Prof. Alper Erturk's Lab. at Georgia Institute of Technology, USA.

2) Dr. Jong Moon Ha was moved to a Senior Researcher at Korea Research Institute of Standards and Science (KRISS) in April, 2019

3) Dr. Joon Ha Jung was moved to a Senior Researcher at Korea Institute of Machinery and Materials (KIMM) in April, 2019

4) Dr. Taejin Kim started to work for LG Electronics in March, 2019

5) Dr. Guesuk Lee started to work for SAMSUNG Electronics in March, 2019

6) Mr. Byungjoo Jeon started to work for SAMSUNG Electronics in March, 2019

7) Mr. Won Park established a technology consulting firm, PATHPLUS Co., Ltd. in March, 2019

8) Mr. Dongki Lee started to work for LG Electronics in September, 2018

9) Dr. Woosung Choi was awarded Minister prize of Minisry of Trade, Industry and Energy in August, 2018

11) Mr. Chulmin Cho entered Applied Nano and Thermal Science Laboratory in Seoul national university for Ph. D.

4 Students News

The graduates after 2018 shared their stories about research in SHRM.
4 students have completed/progressed in visiting scholar.
3 students have received on Ph.D. degree and 2 students have received on M.S. degree.
Also, 9 new members have enrolled into SHRM in these two years.

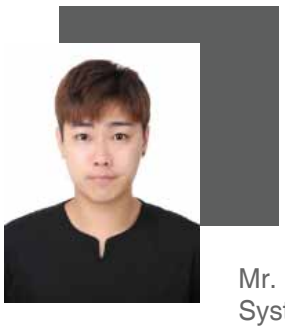
Visiting Scholar

Sooho Kim

Mr. Sooho Kim worked as a visiting student in the Viper (Visual Information Processing for Enhanced Retreival) Group, co-organized by Université de Genève (UniGe) and works for the topic of Haute école de gestion de Genève (HES-SO) for visiting research as a visiting scholar.

Chan Hee Park

Ms. Chan Hee Park is currently working in the Smart Convergence Group, KIST (Korea Institute of Science and Technology) Europe as a visiting student and she is developing.



Soo-Ho Jo

Mr. Soo-Ho Jo has joined Prof. Alper Erturk's group (Smart Structures & Dynamical Systems Laboratory), G. W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology at Atlanta, U.S.A. to establish cooperative ties for research and scholarly exchange as a visting scholar.

Jungho Park

Mr. Jungho Park completed the visiting student work at University of Alberta, Edmonton, Canada from June 2018 to Dec. 2018 as a visiting scholar. During the role, he developed fault diagnosis of rotating machines under variable-speed conditions.

Ph.D.

Woosung Choi

This research aims at advancing three essential and co-related research areas for RUL prediction of steam turbine using the Bayesian approach: (1) Research Thrust 1 – an RUL prediction framework for steam turbine with failure mode and effective analysis (FMEA) analysis; (2) Research Thrust 2 - a damage growth model for RUL prediction of steam turbine (empirical model-based approach); (3) Research Thrust 3 - a mode-dependent damage model for steam turbine with creep-fatigue interaction (physical model-based approach).
The research scope in this doctoral dissertation is to develop technological advances in the following three research thrusts: First, Research Thrust 1 proposes an RUL prediction framework for steam turbine with FMEA. Second, Research Thrust 2 aims at developing damage growth model for RUL prediction of steam turbine based as a data-driven approach. Finally, Research Thrust 3 proposes a mode-dependent damage model with creep-fatigue interaction as a model-based approach.

Joon Ha Jung

This doctoral dissertation aims at developing preprocessing and transformation steps of vibration signals for deep learning based reliability diagnosis of rotating machinery (e.g., turbines in thermal power plant): Thrust 1) – study of optimal vibration image size; Thrust 2) – label-based mini-batch gradient descent method with filter sensitivity analysis; Thrust 3) – retraining scheme for imbalanced data problems. Thrust 1 proposes optimal preprocessing and transformation techniques for convolutional neural network (CNN) based diagnosis with vibration images considering the temporal and the spatial correlations of omnidirectional regeneration (ODR) signals of a fluid-film bearing rotor system. Thrust 2 considers reducing the bias between mini-batches to improve the overall erformance of the network. Thrust 3 proposes a two-phase approach with oversampling of the minor class samples that showed better recognition performance in several imbalanced data set problems.

Guesuk Lee

To cope with unknown input variables that impact the credibility of a computational model, model calibration has been explored, and optimization-based model calibration(OBMC) is recognized as a promising solution for estimating the unknown input variables through the optimization techniques. This doctoral dissertation aims to address four essential issues: 1) Research Thrust 1 – characterize the uncertainty in experimental observations considering the systematic and random measurement errors; 2) Research Thrust 2 – derive analytical sensitivity information, and conduct robust OBMC 3) Research Thrust 3 – formulate an optimization under uncertainty loop, and uncertainty propagation processes, 4) Research Thrust 4 – validate the calibrated model derived from OBMC considering with statistical approach and straightforward explanation. The first research proposes a method that utilizes maximum likelihood estimation to properly develop a probability distribution that describes the uncertainty in the experimental observations. The second research presents an investigation of fundamental explanations of the inaccurate and unstable calibrated results and enhancing the robustness of OBMC. The third research presents a sequential OBMC approach that makes efficient, and highly accurate uncertainty propagation method using proposed method called sequential optimization and uncertainty propagation(SOUP). As the final process of model calibration, the fourth research checks the calibrated results using proposed validation metric called probability of coincidence (POC).

M.S.

Dongki Lee

This research proposes a 4-step framework to establish a defective BLDC motor classifier of multi-channel acoustic signals using convolutional neural network(CNN).
This thesis consists of two research thrusts: 1) Visualizing abnormal signals of a defective motor by generated representative image combined with characteristics of three-channel signals, 2) Constructing optimized CNN architecture to classify the defective motor and minimizing a missed alarm occurrence rate. The proposed framework is implemented to classify a defect in one type of BLDC motor, which is applied to an air conditioner.
The first research thrust presents a correlation of different signals and physical characteristics by expressing 3-channel motor signals as one image data. The second research thrust presents minimizing missed alarm rate by imposing the penalty of the objective function.

Joowhan Song

This research proposes a deep learning-based method to estimate an intermediate severity fault state of acoustic data using a model trained only with normal and severe fault labels. First, two types of synthesized acoustic faults with five parameters were designed to simulate a gradually increasing fault. Then, a pre-trained CNN model was applied to spectrogram images built from the data. To distinguish intermediate faults, latent space features extracted from the model were shown to gradually change as the severity of the fault increased in the reduced-dimension space. This phenomenon suggests that intermediate-level faults can be distinguished between normal and severe fault clusters on the feature map space.
The method was tested on real data, including non-acoustic vibrational data.

Newly Enrolled

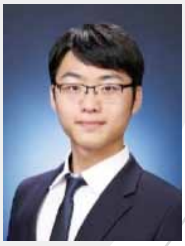
2018 /

Jingyo Jeong
(Currently work at KEPCO
as deputy department head)

Jong Keun Lim
(Currentlly Work at
ILJIN Group as director)

Myeongbaek Youn

Joohyeon Im



Yeong Tak Oh

2019 /

Jinwook Lee

Jong Hyun Choi

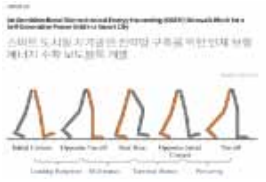
Yongjin Shin

Hyeongmin Kim

5 Press

The issues of the laboratory were published.

News Script



1) An Omnidirectional Biomechanical Energy Harvesting (OBEH) Sidewalk Block for a Self-Generative Power Grid in a Smart City, Korean Society for Precision Engineering News, 2018-06

2) PHM is also a measure of national defense force ... IoT, big data, etc., HelloT, 2018-06

3) One-stop venture company, One Predict, which surpasses global corporation, developed solution for predicting component failure symptom within one year, Digital Times, 2018-07

4) Seoul National University, One Predict, Industrial Information Prediction SW GuardiOne New Product Announcement, Veritas-a, 2018-07

5) Schaeffler Korea launches special lecture at 2018 PHM Leaders Forum, Asioa Today, 2018-07

6) We see hope in venture spirit, Digital Times, 2018-08

7) Collaborate with Seoul National Univ. Of Tech. And Aachen University of Technology, Smart Factory, ZD Net Korea, 2018-10

8) "Development of research industry to make a growth engine" ... Government, establishment of the upbringing strategy, establishment of promotion law, Digital Times, 2018-11

9) Deputy Prime Minister Lee Chung-gu Awarded Prime Minister's Prize for 2018 Promotion of New Technology Commercialization, Energy Daily, 2018-12

10) Mechanical Journal Theme Planning - Introduction of 4th Industrial Revolution and Success Story through PHM Technology, KSME News, 2019-01

11) The Korean Society of Mechanical Engineers Newsletter January - Interview, Byeng D. Youn, OnePredict CEO, KSME News, 2019-01

12) Held a fair Smart Factory Forum (seeking solutions for technological and fiscal difficulties in small and medium-sized enterprises, introducing Korean model vision and case examples), Environment Daily, 2019-02

13) Byeng D. Youn, OnePredict CEO, announced success stories based on industrial artificial intelligence and global commercialization, Environment Daily, 2019-03

14) Development of a magnifying glass material that collects energy that is discarded, DongaScience, 2019-03

15) [Science and Technology] If you miss the Golden Time, you will be a subcontracting country, Sedaily, 2019-03

16) Future answers to industry data, Sedaily, 2019-03

17) [AIMEX 2019] One Predict, Introduction to Data Prediction Diagnosis Software, IndustryNews, 2019-04

18) The government will lead Korea's economy with the world's first 5G ... 5G emphasizes the commemorative ceremony of the 2019 Science and Telecommunications Day (Prof. Youn won the prime minister's prize), AsiaToday, 2019-04

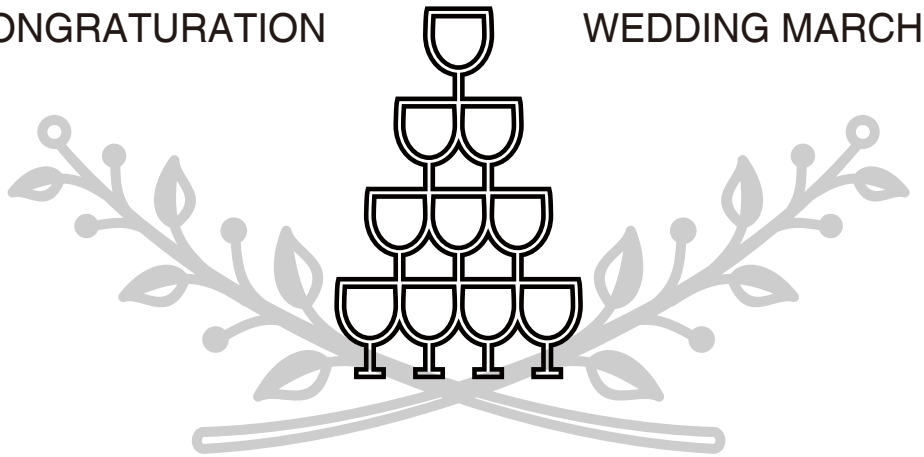
19) [Seoul Forum 2019] "Papers, Patents Qualitatively Vulnerable" 80% ... R & D Can not Connect to Actual Business, Sedaily, 2019-05

5 Other News and Events

News from SHRM Students,
SHRM lab and Prof. Youn are presented with heartfelt greeting and thanks.

Family event

CONGRATURATION WEDDING MARCH!



Myungyon married on 8th September, 2018

CONGRATURATION WEDDING MARCH!

Hwanoh married on 27th October, 2018

Laboratory News

OnePredict

2018

Project - Algorithm API for semiconductor polishing Equipment (KCTech)

PoC - Fault detection algorithm of semiconductor transfer Robot (SK Hynix)

GuardiOne Bearing / Turbine launching show

Project - Wind farm diagnosis system implementation (Korea Western Power)

Project - diagnostics algorithm for battery laminating Equipment (LG Chemical)

PoC - GuardiOne Bearing (Schaeffler)

PoC - Motor quality examiner (Halla-Holdings, Mando)

Project - Wheel bearing fault prognosis system development for autonomous / electric vehicles (ILJIN Global)

Government fund, “Tech Incubator Program for Startups,” Ministry of SMEs and Startups

GuradiOne Wind released

2019

PoC - Oil Refineries (GS Caltex & Lotte Chemical)

Invetment - $4 Million fund (Series A)

KEMIPO GuardiOne Turbine)

INTECO GuardiOne Turbine

Schaeffler HQ GuardiOne Bearing

Schaeffler AP GuardiOne Bearing

ILJIN Global GuardiOne Bearing

Received an order for ADD Unmanned Detection Vehicle Autonomous Diagnosis

LG Electronics/LG CNS GuardiOne Acoustics PoC

Lotte Chemical GuardiOne Transformer PoC

INTECO GuardiOne Transformer PoC

PHM Korea 2019
- Held the first regular academic conference of PHM Korea

PHM KOREA 2019

한국PHM학회 2019년도 정기학술대회

"Toward Industrial PHM"

2019. 4. 10.(수)~12.(금)

르 메르디앙 서울 호텔

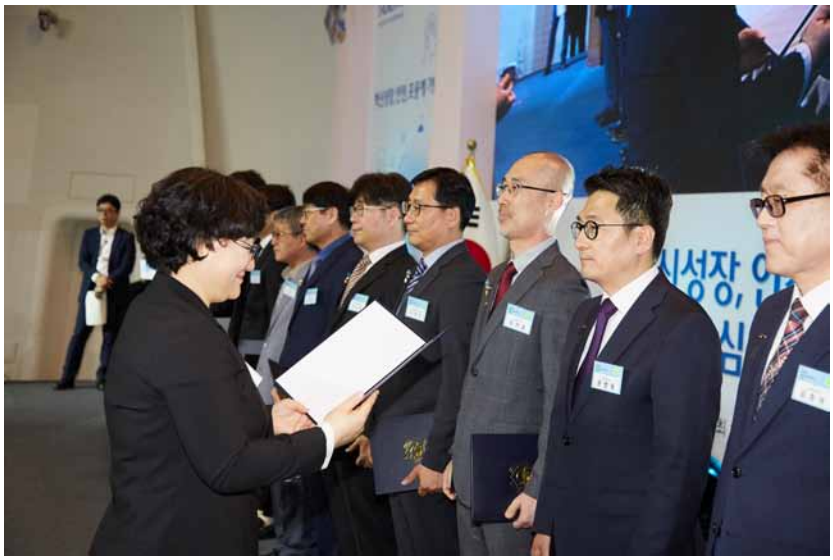
PHM Korea 2019 조직위원장 윤 병 동
사단법인 한국PHM학회 회장 최 주 호

SHRM & OnePredict participates in the PHM Korea 2019!

Smart Factory + Automation World 2019
- Digital Transforming in Manufacturing

OnePredict participates in the Smart Factory + Automation World 2019

CONGRATURATION !
Commendation of Prime Minister



"Commendation of Prime Minister", Ministry of Public Administration and Security
22th April, 2019

Laboratory Photo

SHRM laboratory

SHRM Office

May 2019, Celebrating Party of Prof. Youn's Prime Minister's Award

March 2019, Opening Party at Nakseongdae

OnePredict Photo

October 2018, OnePredict, 2nd anniversary of founding

OnePredict Office