Guest Editorial: Special Section on AI Enhanced Reliability Assessment and Predictive Health Management

TO ACCOMMODATE the increasing interests in the development and implementation of advanced artificial intelligence (AI) and machine learning (ML) methods for tackling the reliability and system health prognostics challenges in various industrial applications, a Special Section on AI Enhanced Reliability Assessment and Predictive Health Management was proposed and the Call for Papers was distributed to a wide audience to solicit high-quality research papers. By the end of April 2022, a total of 55 manuscripts were submitted with 11 papers accepted for publication in this special section. All submission went through a rigorous peer-review process under the management and efforts of the four guest editors.

The topics of the 11 accepted papers are well centered around the theme of this special section, focusing on the state of the art of AI/ML applications in reliability and predictive system health management. Specifically, four papers investigate AI and ML methods for remaining useful life (RUL) prediction. In [A1], Jiang *et al.* proposed an adversarial regressive domain adaptation (ARDA) approach for infrared thermography-based unsupervised RUL prediction, which remedies practical insufficiency of run-to-failure samples. The ARDA supports cross-domain RUL prediction and can mitigate domain shift between simulated and industrial infrared images. In [A2], Lin and Li presented a Bayesian deep learning framework to quantify the epistemic, aleatoric, and predictive uncertainties, which are jointly calibrated by a novel iterative calibration method. In [A3], Xiang *et al.* integrated temporal long short-term memory with spatial convolution neural networks for equipment RUL prediction. The last paper in this category is contributed by Jing *et al.* [A4]. This article proposes a deep learning-based cloud-edge method to predict machinery RUL by incorporating the intra-kernel correlations of sensing data.

Five other papers investigate the fault diagnosis using AI/ML methods. In [A5], Qin *et al.* proposed a novel domain adaptation model that improves the end-to-end diagnosis accuracy of planetary gearbox. In [A6], Wang *et al.* studied a cross-severity bearing fault diagnosis scheme. In [A7], Jiao *et al.* proposed a domain adaption method named Towards Prediction Constraints for the intelligent diagnosis of machinery. In [A8], Xin *et al.* combined Fourier transform with self-calibrated convolution for fault diagnosis.

There are three papers dealing with fault detection and prognosis, pattern recognition of damage. In [A9], Wang *et al.* proposed a recursive hybrid variable monitoring method to tackle the challenges of hybrid variables and non-stationarity. In [A10], Cai *et al.* studied multistage fault prognosis by combining stage identification with Bayesian network and time series approaches. In [A11], Zhou *et al.* proposed a novel framework to characterize the morphological pattern of barely visible impact damage using machine learning.

The 11 accepted papers in this special section well represent the state of the art in reliability assessment and predictive health management for complex industrial systems and processes. We hope this special section will stimulate more research interests and gain momentum to expand the AL/ML applications in the field of system reliability, prognostics, and system health management.

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APPENDIX: RELATED ARTICLES

[A1] Y. Jiang, T. Xia, D. Wang, X. Fang, and L. Xi, "Adversarial regressive domain adaptation framework for infrared thermography-based unsupervised remaining useful life prediction," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3154789.

[A2] Y.-H. Lin and G. -H. Li, "A Bayesian deep learning framework for RUL prediction incorporating uncertainty quantification and calibration," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3156965.

[A3] S. Xiang, Y. Qin, J. Luo, and H. Pu, "Spatiotemporally multi-differential processing deep neural network and its application to equipment remaining useful life prediction," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3121326.

[A4] T. Jing, X. Tian, H. Hu, and L. Ma, "Cloud-edge collaboration framework with deep learning-based for remaining useful life prediction of machinery," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3138510.

[A5] Y. Qin, Q. Qian, Y. Wang, and J. Zhou, "Intermediate distribution alignment and its application into mechanical fault transfer diagnosis," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3149934.

[A6] X. Wang, T. Wang, A. Ming, W. Zhang, A. Li, and F. Chu, "Generalized cross-severity fault diagnosis of bearings via a hierarchical cross-category inference framework," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3116145.

[A7] J. Jiao, K. Liang, C. Ding, and J. Lin, "Towards prediction constraints: A novel domain adaptation method for machine fault diagnosis," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3133938.

[A8] G. Xin et al., "Fault diagnosis of wheelset bearings in high-speed trains using logarithmic short-time fourier transform and modified self-calibrated residual network," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3136144.

[A9] M. Wang, D. Zhou, and M. Chen, "Recursive hybrid variable monitoring for fault detection in nonstationary industrial processes," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2022.3151072.

[A10] B. Cai *et al.*, "Artificial intelligence enhanced two-stage hybrid fault prognosis methodology of PMSM," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3128245.

[A11] J. Zhou, W. Du, L. Yang, K. Deng, S. Addepalli, and Y. Zhao, "Pattern recognition of barely visible impact damage in carbon composites using pulsed thermography," *IEEE Trans. Ind. Informat.*, to be published, doi: 10.1109/TII.2021.3134184.