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EDITORIAL

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AI-Enabled Monitoring, Diagnosis & Prognosis

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The emerging and development of Artificial Intelligence (AI), especially deep learning, has stimulated its application in various engineering domains. Monitoring, diagnosis and prognosis, as the key elements of intelligence maintenance of manufacturing systems in the era of Industry 4.0, has also benefited from the advancement of AI technology. The main objective of this special issue aims at bringing scholars to show their research findings in the field of monitoring, diagnosis and prognosis driven by AI, and promote its application in intelligent maintenance of manufacturing system in China. Ten papers have been selected in this special issue after rigorous review and they represent the latest research outcomes in this active area.

The first paper written by Yan's group provided a systematic overview of the current technologies and research challenges of AI-enabled monitoring, diagnosis, and prognosis. In this paper, open source datasets and codes are also provided so that readers can use them as a starting point for further development. When adopting a deep learning model for a given task, the effect of different network structures and parameters on the model performance should be considered. Zhao et al. reviewed recurrent neural network model and its variants for remaining useful life prediction, with a specific focus on performance comparison study caused by optimisers, activation functions, neuron quantities and input sequence length. Data quality and model interpretability are two important factors for wide application of AI, Zhang and Gao summarized several key techniques related to data quality where advancement in data denoising, outlier detection, imputation, balancing, and semantic annotation were reviewed from the perspective of effective information extraction from measurement data. Also the model interpretation methods that focus on model transparency were highlighted.

Bearings and gears in rotating machinery often generate various faults due to severe work conditions. Timely diagnosing those faults, and, if possible, predicting their remaining useful life can ensure safe production with high quality products in modern manufacturing industry. Ahmed and Nandi proposed a convolutional neural network (CNN)-based bearing fault diagnosis approach using connected components-based image representations with sets of colours and texture features of vibration signals. Li et al. presented a dynamic distribution adaptation based transfer network (DDATN), where instance-weighted dynamic maximum mean discrepancy (IDMMD) was proposed for dynamic distribution adaptation (DDA), so that cross domain bearing fault diagnosis can be achieved. Cheng et al. developed a novel interpretable denoising layer, based on reproducing kernel Hilbert space (RKHS), as the first layer of a standard neural network model. This enabled physical interpretation of the network model with parameter adaption for better bearing and gears fault diagnosis. In another study, Wang et al. studied a novel bearing prognostics approach by using time–frequency representation (TFR) subsequence as input to a three-dimensional CNN model for health indicator construction, and Gaussian process regression (GPR) for subsequent RUL estimation.

Prediction of tool wear is also one of typical applications in modern industry for enabling high quality product manufacturing. Xu et al. developed a multi-scale Convolutional Gated Recurrent Unit network (MCGRU)

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model, where six parallel and independent branches with different kernel sizes were designed to form a multi-scale CNN for adaptive features learning at different time scales, to process raw data for effective tool wear prediction. In some applications, there is an increasing demand for not only diagnosing the known type of fault, but also detecting unknown types of faults. To achieve this goal, Yang et al. presented a sparse autoencoder-based multi-head deep neural network (DNN) model to jointly learn a shared encoding representation for both unsupervised reconstruction and supervised classification of the monitoring data, thus enabling both bearing and belt fault diagnosis with detection of some unknow faults. In other cases, sensors themselves may also produce fault signals, which cause risk for a monitored system. Gao et al. developed a deep learning based data fusion method for sensor fault diagnosis, which can improve reliability of the system.

From the papers published in this Special Issue, we hope they will benefit the intelligence maintenance research community.

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Authors' contributions
All authors read and approved the final manuscript.

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