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Editorial

Key Performance Indicators Relevant Fault Diagnosis and Process Control Approaches for Industrial Applications

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With the development of science and technology, automatic control systems have been widely integrated into complex industrial processes such as chemical, polymers, metallurgy, power systems, and semiconductor manufacturing. In order to meet the ever increasing demands for high production efficiency and product quality as well as for economic and ecological operations, today's industrial processes have become more complex and their degree of automation is significantly growing. This development calls for more system reliability, dependability, and safety. Associated with this, process monitoring and control receive considerably enhanced attention, both in the engineering and in the research domains. However, practical processes still continuously pose new challenges due to quality requirements, safety and complex dynamics, performance evaluation, diagnosis, and maintenance, especially the Key Performance Indicators-(KPI-) relevant issues that call for more accurate and efficient operations which challenge the existing process monitoring and control technologies and meanwhile urgently push scientists and engineers to develop new methodologies to solve the above unsolved issues for complex practical plants. Therefore, the establishment and development of new model-based or data-driven process monitoring and control technologies are urgent issues in both theory and applications.

This special issue provides a forum for researchers and practitioners to exchange their latest achievements and to identify critical points and challenges for future investigation on the modeling, monitoring, and control of complex practical systems. The papers published in this issue provide the latest advances of model-based and data-driven approaches, particularly the novel theoretical-supported ideas and algorithms with practical applications. In total, 21 submissions have been received and carefully evaluated after a rigorous review process. Six of them, that is, 28.6% of all the submitted papers, have been selected covering the subject from different perspectives.

The manuscript "A Subspace Method Aided Data-Driven Fault Detection Based on Principal Component Analysis" by L. Ma and X. Li focuses on developing an alternative fault detection technique for identifying the system models. The paper proposes a subspace method aided data-driven fault detection based on principal component analysis. The basic idea is to use principal component analysis to identify the system observability matrices from input and output data and construct residual generators. The advantage of the proposed method is that we just need to identify the parameterized matrices related to residuals rather than the system models, which reduces the computational steps of the system. The proposed approach is illustrated by a simulation study on the Tennessee Eastman process.

The paper "Active Fault Tolerant Control Based on a Novel Tracking Differentiator for Elevating Stage Control System" by H. Mao et al. is concerned with the speed sensor faults in elevating stage control systems. In this paper, an active fault tolerant control approach based on a novel tracking differentiator is proposed, a novel tracking differentiator based on a hyperbolic tangent function is constructed, and a continuous smooth switching tactic based on an exponential

function is designed. The simulation results show that the fault diagnosis method is simple and efficient, the designed tracking differentiator is fast and effective, and the effect of the fault tolerant control based on smooth switching strategy is also satisfactory.

The paper by X. Yang et al., entitled "Parameter Identification and Control Scheme for Monitoring Automatic Thickness Control System with Measurement Delay," focuses on the automatic thickness control system. Due to the unavoidable time delay and the changing parameters of the system, this paper proposes an identification and control scheme for monitoring the automatic thickness control system that can handle time delay and parameter uncertainty. The cross-correlation function is used to estimate the time delay of the system, while the system parameters are identified using a recursive least squares method. The time delay and parameter estimates are then further refined using the Levenberg-Marquardt algorithm, so as to provide the most accurate parameter estimates for the complete system. Simulation results show that, compared with the standard Proportion Integration Differentiation controller approach, the proposed approach is not affected by changes in the time delay and parameter uncertainties.

The paper entitled "Remaining Useful Life Estimation Based on Asynchronous Multisource Monitoring Information Fusion" by Y. Hu et al. focuses on the performance of remaining useful life estimation for the degradation process with multiple monitoring sensors. In this paper, an asynchronous remaining useful life fusion estimation algorithm is presented for the hidden degradation process with multiple asynchronous monitoring sensors based on multisource information fusion. Due to the noise correlation introduced by the synchronization process, GA algorithm is adopted in this paper to update the estimate of unknown model parameters in the EM algorithm. Simulation results demonstrate that fusion of multisource monitoring information from multiple asynchronous sensors can reduce the uncertainty in the systems and therefore improve the estimation preformation.

The paper "Providing Definitive Learning Direction for Relation Classification System" is authored by P. Qin et al. In this paper, several strategies are proposed to integrate entity pair information into the application of deep learning in the relation classification task, in which way to provide definitive learning direction for neural networks. Without external linguistic features, this paper adequately exploits the implicit value of the information provided by entity pair and further improves the performance of relation classification system. Aiming at the characteristic of relation classification task, the paper specially designs an entity pair based attention mechanism which employs entity pair information to adaptively generate attention weights. Experimental results on the SemEval-2010 Task 8 dataset show that the method outperforms most of the state-of-the-art models, without external linguistic features.

The manuscript "Self-Adaptive Artificial Bee Colony Algorithm for Continuous Function Optimization" by M. Tang et al. focuses on balancing the exploration and exploitation of artificial bee colony algorithm. The paper proposes a self-adaptive artificial bee colony (SABC) algorithm where a modified search equation is applied to guide the search of new candidate solutions in the employed bee phase and the onlookers phase. In addition, the good point set method is introduced to produce the initial population and scout bees. The experimental results tested on a set of 12 benchmark functions show that the proposed SABC algorithm has better search ability when compared with several other ABC-based algorithms.

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