Editorial

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Biographical notes: Dingli Yu received a BE from Harbin Civil Engineering College, China in 1982, an MSc from Jilin University of Technology (JUT), China in 1986, and a PhD from Coventry University, UK in 1995, all in Control Engineering. He was a Lecturer at JUT from 1986 to 1990, a Visiting Researcher at University of Salford in 1991, a Post-Doctoral Research Fellow at Liverpool John Moores University from 1995 to 1998. He joined LJMU in 1998 as a Senior Lecturer and was promoted to a Reader in 2003, and to the Professor of Control Systems in 2006. He is an Associate Editor for two journals, IJISS and IJMIC and, the IFAC SAVEPROCESS Committee Member, and IPC Member for many international conferences. His current research interests include fault detection and fault tolerant control of bilinear and non-linear systems, adaptive neural networks and their control applications, model predictive control for chemical processes and engine systems.

J. Barry Gomm received a BE in Electrical and Electronic Engineering in 1987 and a PhD in Process Fault Detection in 1991 from Liverpool John Moores University (LJMU), UK. He joined as an Academic Staff at LJMU in 1991 and is a Reader in Intelligent Control Systems. He was Coeditor of the book *Application of Neural Networks to Modelling and Control* (London, UK: Chapman and Hall, 1993) and Guest Editor for Special Issues of the journals *Fuzzy Sets and Systems* (Amsterdam, the Netherlands: Elsevier, 1996) and *Transactions of the Institute of Measurement and Control* (London, UK: InstMC, 1998). He has published more than 100 papers in international journals and conference proceedings. He is a Member of the IET and IEEE, and has served on the organising committees of several conferences. His current research interests include neural networks for modelling, control and fault diagnosis of non-linear processes, intelligent methods for control, system identification, adaptive systems, chemical process and automotive applications.

With more and more complicated system configurations and increasingly advanced control techniques applied, condition monitoring and fault diagnosis become necessary for modern industrial systems. This Special Issue collects investigations and new developments in this area and provides ten papers for researchers and engineers.

The paper by V. Chetouani entitled 'Using neural networks and statistical tests for detecting changes in the process dynamics' presents a real-time fault detection scheme based on a feed-forward neural network model. The residual is generated from model prediction error and is further treated with two statistical tests, the Page-Hinkley test and the Bayes classifier for fault diagnosis. The developed method is evaluated experimentally with a glass-jacketed reactor to diagnose two flow rate changes of the cooling liquid. Real data experiments show that the method is effective.

G-S. Wang and G-R. Duan propose a parameterisation approach for reconfiguring second order linear systems using eigenstructure assignment techniques in their paper. The state feedback controller is resynthesised so that the eigenvalues of the reconfigured closed-loop system completely recover those of the original system. A numerical example is used to illustrate the simplicity and effectiveness of the proposed approach.

The paper entitled 'Fault detection in centrifugal pumping systems using neural networks' by S. Rajakarunakaran, D. Devaraj and K.S. Rao investigates fault detection for centrifugal pump systems via neural network method. Twenty faults including shaft wear, etc. have been set up with the centrifugal pump system in the laboratory and eight variables were measured. The training data is dimensionally reduced using the principal component analysis technique. The real data experimental results confirmed the effectiveness of the method.

D.B. Karunakar and G.L. Datta describe their research on fault prediction for castings in their paper entitled 'Prediction of defects in castings using back propagation neural networks'. Their training data were collected from a steel foundry that is used to make railway wagon components. The major defects such as hot cracks, mis-run, scab, blowholes and air lock, etc. are successfully predicted before the pouring stage of the casting.

An application of radial basis function networks for classifying both faults and fault size is described in

‘Neural network fault classification of transient data in an automotive engine air path’ by M.S. Sangha, J.B. Gomm and D.L. Yu. Good fault diagnosis results with low misclassifcation are presented for three different engine operating conditions, which build the complexity of the problem.

In ‘Detection and localisation of damage in bridge model by spatial wavelet-based approach’ by D.M. Reddy, G. Jayaprakash and S. Swarnamani the problem of identifying damage and location in bridges is investigated. Modal data from the bridge structure is analysed by applying spatial wavelet transforms. Examining the wavelet coefficients enables the detection, localisation and quantification of bridge damage.

A statistical approach to fault diagnosis and fault tolerant control is presented in ‘Fault detection, diagnosis and tolerant control for non-Gaussian stochastic distribution systems using a rational square-root approximation model’ by Y. Li-Na, A. Wang and H. Wang. Control of the output probability density functions of a non-linear system is considered. Fault tolerant control, via a controller reconfiguration, for these systems is proposed based on a non-linear adaptive fault observer. The proposed method is illustrated in a simulation example.

H.M. Soliman A.L. Elshafei, K. El-Metwally and E.M.K. Makkawy describe a simple method for ‘Fault-tolerant wide-range stabilisation of a power system’. The problem of maintaining stability of a power system, over a wide range of operating conditions, in the event of controller failure is expressed in terms of stabilising only four Kharitonov polynomials. A model of a single machine infinite bus system is used to demonstrate the suggested technique.

A combination of neural and fuzzy techniques is applied in ‘Fault diagnosis system for a robot manipulator through neuro fuzzy approach’ by M. Dev Anand, T. Selvaraj, S. Kumanan and J. Janarthanan neural network with online learning is used to model the robot behaviour for fault monitoring. A fuzzy inference system provides an adaptive threshold for monitoring the neural model residuals. Results are presented of the method applied to the detection and isolation of faults in a Scorbot ER 5plus manipulator.

A fuzzy observer based method is developed by M. Chadli, A. Akhenak, D. Maquin and J. Ragot in the paper entitled ‘Fuzzy observer for fault detection and reconstruction of unknown input fuzzy models’. In the developed robust observer, the observer gains are determined with Linear Matrix Inequalities (LMI) based on Lyapunov function. The observer is used for fault detection and reconstruction of the faulty system with fuzzy models. The method is demonstrated with simulations of detecting faults for an automatic steering vehicle.

Looking through all papers collected in this issue we feel that the fault detection and diagnosis methods and techniques described or developed in these papers are almost all application oriented and have a great potential of real world applications. We hope that this Special Issue will contribute to bridging the gap between methodology development and practical applications and to motivation of more real applications in industries.

As guest editors, we would like to thank all the authors for their contributions to this Special Issue, and all the reviewers for their useful work in supporting the editorial process.