Editorial

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Biographical notes: Satish Chand received his PhD from MNNIT, Allahabad, India. He is currently a Senior Professor in the Department of Mechanical Engineering MNNIT, Allahabad, India. His research interests are neural networks and fuzzy logic, fracture mechanics, gears and mechanism analysis. He has number of publications in reputed international journals. He has supervised quite good number of PhD and MTech students. He is also a reviewer for several journals.

Uday Shanker Dixit is currently a Professor in the Department of Mechanical Engineering at Indian Institute of Technology, Guwahati, India. Before completing his PhD from Indian Institute of Technology, Kanpur, he has worked in two industries – HMT, Ltd. Pinjore, India and Indomag Steel Technology, New Delhi, India. His PhD work was in the area of application of finite element method and fuzzy set theory in the modelling of cold rolling process. Currently, he is taking active interest in applying finite elements and soft computing techniques in the number of problems of mechanical engineering. He has authored two books and several research papers related to finite element method and soft computing.

Bhartendu Seth served as a Professor of Mechanical Engineering at the Indian Institute of Technology Bombay, India since August 1995 till Feb 2010. He earned his Doctorate in Mechanical Engineering from the Massachusetts Institute of Technology, Cambridge, USA in 1987. He has served as a member of Faculty of Mechanical Engineering in Worcester Polytechnic Institute (1986–1989), IIT Delhi (2001–2002) and IIT Bombay (1989–2010). His professional interests include mobile robotics and other computer controlled systems, neural/fuzzy controls, kinematics and dynamics. He has published more than 50 papers and has several patents to his credit in the areas of automotive transmissions, motion tracking and MEMS devices.

The ability of neural networks and fuzzy logic to represent non-linear systems is most exploited in the synthesis of non-linear controllers. One of the main advantages of these techniques is that they do not require the exact determination of system. This enables these techniques to be used for the design of robust controllers. Further, their abilities to adapt make them suitable to be used for adaptive controllers. This special issue focuses on the promise of artificial neural networks (ANN) and fuzzy logic in the realm of modelling, identification and control of mechatronic systems.

In the paper by Jie, Yong and Chengliang an adaptive fuzzy sliding mode control scheme is designed for hybrid electric bus. The trajectory tracking control for stopping the bus in a bus station is proposed. The adjustment scheme to the regenerative braking torque is also developed by considering the variation of SOC and braking jerk. The proposed adaptive fuzzy control scheme can recognise the external disturbance and model uncertainties, and then make a compensation control to achieve good tracking performance. The stability and convergence properties of the longitudinal brake control system are

analytically proved by using Lyapunov stability theory and Barbalat's lemma. The simulation results demonstrate that the proposed controller shows an improved dynamic performance and can recover more kinetic energy than the conventional sliding mode controller.

In the paper by Sun and Zhu a decoupling control approach based on ANN inverse system method has been developed for the innovative five degrees of freedom (DOF) bearingless induction motor, which is multi-variable, non-linear and coupled system. Combining the ANN inverse system with the five DOF bearingless induction motor, the system is decoupled into five independent 2-order linear displacement subsystems, a 1-order linear speed subsystem and a 1-order linear magnetic linkage subsystem. The system is implemented on MATLAB 7.0/Simulink. The simulation results have showed that this kind of control strategy can realise dynamic decoupling control between torque force and radial suspension forces, and the control system is able to give fine dynamic and static performance.

The paper written by Dhumal, Narayanan and Kumar focuses at developing an expert system based on ANN model to predict the tensile and deep drawing behaviour of welded blanks made of steel grade and aluminium alloy base materials. The important tensile and deep drawing characteristics of TWB are predicted within wide range of varied blank and weld conditions. The tensile test (sample with a notch) and square cup deep drawing test are simulated in finite element codes ABAQUS 6.7 and PAM STAMP 2G respectively for generating the required output data for ANN modelling. Predicted results from ANN model are compared and validated with simulation results for two different intermediate TWB conditions. It is observed that the results obtained from ANN are encouraging with acceptable prediction errors.

In the paper by Akmeliawati, Raafat and Martono a new intelligent identification method of uncertainty bound which utilises an adaptive neuro-fuzzy inference system (ANFIS) in a feedback scheme is proposed. The proposed ANFIS feedback structure performs better than the typical direct implementation of ANFIS. The proposed ANFIS feedback structure performs better in determining the uncertainty bounds with minimum number of iterations and error. In the proposed technique, the intelligent identified uncertainty weighting function is validated utilising ν-gap to ensure the stability of the designed H_∞ controlled system. The proposed intelligent identification of uncertainty bound is demonstrated on a servo positioning system. Simulation and experimental results show that the new ANFIS identifier is more reliable and highly efficient in estimating the best uncertainty weighting function for robust controller design.

The paper written by Kankar, Sharma and Harsha presents the vibration analysis of the healthy and cracked rotor supported on various faulty bearings. In rotating machines, one of the main causes of breakdown is faults in ball bearings. This study is mainly focused on fault diagnosis of rotor bearing system using ANN and support vector machine (SVM). The vibration response is obtained and analysed for the healthy and cracked rotor with the various defects of ball bearings. The specific defects considered on bearings are: crack in outer race, inner race with spall and corrosion pitting in balls. Statistical methods are used to extract features and to reduce the dimensionality of original vibration features. A comparative experimental study of the effectiveness of ANN and SVM is carried out. The results show that for this study, ANN is a better classifier than SVM.

The paper by Mohan and Ghosh presents mathematical models for fuzzy two-term (PI/PD) controllers which employ N_1 ($\geq$3) number of symmetric fuzzy sets for the input variable displacement, N_2 ($\geq$3) number of symmetric fuzzy sets for the input variable velocity and $N_1 + N_2 - 1$ number of symmetric fuzzy sets for the output variable. These models are derived via triangular membership functions for fuzzification of the inputs and output variables, linear control rules, minimum/algebraic product triangular norm, different triangular conforms, different interference methods and centre of sums (COS) defuzzification method. Properties of such models are investigated. Using the well-known small-gain theorem bounded-input bounded-output (BIBO) stability analysis of feedback systems involving fuzzy PD controller as a subsystem is presented. Next, mathematical models with N_1 and N_2 number of asymmetric input fuzzy sets and $N_1 + N_2 - 1$ number of asymmetric output fuzzy sets (both triangular and trapezoidal) are also presented. Finally, some numerical examples along with their simulation results are included to demonstrate the effectiveness of the fuzzy two-term controllers.

In the paper by Yang and Zhao a new method for building time series model to predict machine vibration values has been proposed. Instead of building a time series model based on the raw machine vibration signal, they decomposed the vibration signal into different levels using wavelet packet decomposition (WPD). Further, sub-signals are reconstructed from those wavelet packet coefficients. Time series model is built for each of those sub-signals, using ANFIS. The final prediction value is the sum of the prediction values of all the models. Comparing to the other two methods, which are building ANFIS model based on the raw vibration signal and building ANFIS models based on the sub-signals generated with discrete wavelet decomposition, experimental results show that the method using ANFIS and WPD outperforms the other two methods.

The papers on wide variety of mechatronics engineering problems published in this issue bring out the potential of applicability of fuzzy and neural networks.

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