Editorial

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Hongnian Yu is a Professor of Computer Science and Head of the MCDS Research Group at Staffordshire University. He has extensive research experience in modelling, robot control, mechatronics, and neural networks. His other research interests include mobile computing, modelling, scheduling, planning, simulations, RFID, supply chains, transportation, and computer networks. He has published over 150 journal and conference papers, and held several research grants from EPSRC, the Royal Society, and the EU, and industry. He was a Program Chair of the *IEEE Conf. on Networking, Sensing and Control* (2007, 2009), in addition to serving on various other conferences.

Yi Zhang received his MSc from Hefei University of Technology, Hefei, China, in 1997, and his PhD from Huazhong University of Science & Technology, Wuhan, China, in 2002. He is currently a Professor with the College of Automation, Deputy Dean of Automation College, Director of Intelligent Systems and Robotics Research Centre, Chongqing University of Posts and Telecommunications, Chongqing, China. His research interests include robotics and intelligent system, multi-sensor fusion, signal processing, and tele-rehabilitation.

As part of academic activities of the China-EU Science and Technology Year (CESTY), the first *Sino-European Workshop on Intelligent Robots and Systems (SEIROS'08)* was held at Chongqing, China on 11–13 December 2008. The workshop was jointly organised by the Chongqing University of Posts and Telecommunications (CQUPT), the University of Essex, Staffordshire University, Chinese University of Hong Kong, University of Hamburg, etc., and was financially sponsored by the Ministry of Science and Technology, China and CQUPT.

The *SEIROS'08* received around 300 papers from China, Europe and India, and only 70 papers were accepted for presentation. Ten keynote talks and three parallel sessions were held during the event. This special issue contains 13 invited papers, mainly from *SEIROS'08* through a rigorous review process. The emphasis of this special issue is on sharing the experiences on building biologically inspired systems and robots toward real-world applications. Here, we would like to express our sincere appreciation to all authors and reviewers.

Humans and animals are able to accommodate external environmental changes while regulating their internal life cycle operations effectively, i.e., with strong adaptive mechanisms. This has been of huge interest to robotics researchers worldwide to apply similar biologically inspired mechanisms to man-made systems such as mechatronic systems, service robots, unmanned air vehicles, and numerous autonomous systems. These intelligent systems and robots are rapidly advanced in both theory and practice as technology advances, and will become part of our everyday lives in the very near future. The contents of these papers are briefly outlined as follows.

The first paper in this special issue is on 'Mobile robot localisation using ZigBee wireless sensor networks and a vision sensor'. The positioning is one of important basic functions for autonomous mobile robots to complete their missions. Inspired by human navigation principle, this paper presents a hybrid positioning scheme based on ZigBee wireless sensor networks and a vision sensor. To obtain relative positioning, a vision sensor is deployed to recognise ceiling lights for position prediction. Then, using the ZigBee network nodes as beacons, an autonomous mobile robot can decide its global position with a reasonable accuracy.

The second paper in this special issue is on 'Parameter optimisation of human-simulated intelligent controller for a cart-double pendulum system'. Using a hierarchical and multi-mode control structure, a human-simulated intelligent controller (HSIC) successfully realises the swing-up and stabilisation control for a cart-double pendulum system. In order to effectively optimise several parameters in control laws and advance the further application space of HSIC, a hybrid simplex-genetic algorithm (HSGA) is proposed in this paper. The two different strategies, which are HSGA strategy and manual adjustment method, are performed the simulation experiments, respectively. The simulation results show that it has the better response of HSIC obtained by the proposed HSGA strategy.

The third paper in this special issue is on 'A fast handover scheme based on multiple mobile router cooperation for a train-based mobile network'. Since true broadband access for high-speed train passengers has become a new trend, a fast handover scheme for train-based mobile networks, which is based on multiple mobile router cooperation, is proposed in this paper. It provides high-speed train passengers with continuous internet connection. It takes the advantage of fixed line features and the routine information in a high-speed passenger train to configure the next care-of-address of mobile routes.

The fourth paper in this special issue is on 'An intelligent hand motion tracking system for home-based rehabilitation'. Rehabilitation is a dynamic process, which allows patients to restore their motor functions to normal. To reach this target, patients' activities need to be monitored continuously, and corrected subsequently. This paper introduces a real-time visual tracking system to track human hand motion. It is a hybrid approach based on an improved Camshift algorithm and a Kalman filter. Comparing with commercial marker-based motion tracking systems, the proposed system offers a cheap and flexible solution.

The fifth paper in this special issue is on 'Small UAV controlled by an online adaptive fuzzy control system'. Motivated by human decision mechanism, an online fuzzy attitude control system of a small unmanned helicopter is proposed in this paper by using only qualitative knowledge of the helicopter. An online adaptive fuzzy control system (AFCS) is designed in a way that a process model of the plant or its approximation in the form of a Jacobian matrix is not required. An online AFCS implements a simultaneous online tuning of fuzzy rules and the output scale factors of the system. A two-cascade controller is designed with an inner (attitude controller) and outer controller (navigation controller) of the small unmanned helicopter. The flight experiments show that the proposed fuzzy logic controller provides quick response, small overshoot, high accuracy, robustness and adaptive ability.

The sixth paper in this special issue is on 'A novel information fusion based FFT algorithm for a driver fatigue monitoring system'. A novel feature triangle tracking algorithm is proposed to track eyes, mouth and head gesture of a fatigue driver. It uses motion information to localise the face region at an YCrCb colour space to determine the locations of eyes and mouth. According to geometrical relationships of facial components and various head gestures of a driver, the system derives from both the isosceles feature triangle and the right feature triangle. The FTT algorithm effectively removes the confusing triangle from the tracking of the video sequence. The experimental results show that the proposed algorithm precisely tracks the various head gestures of a fatigue driver in real-time video frames.

The seventh paper in this special issue is on 'Distributed model predictive control for multi-agent systems with coupling constraints'. It proposes an improved distributed model predictive control (DMPC) scheme for multi-agent systems with coupling constraints by applying compatibility constraint and deviation penalisation. Firstly, a sufficient condition based on the compatibility constraint to satisfying cooperative coupling constraints is given, which enables control performance and coupling constraints dependent on the compatibility constraint. Then, in order to optimise the control trajectory and improve the consistency of the actions between agents, the deviation between what an agent is actually doing and what its neighbours believe it is doing is penalised in the cost function. At each sampling instant, the compatibility constraint of each agent is set tighter than the previous sampling instant. The optimal control problem is formulated as quadratic programming with quadratic constraints.

The eighth paper in this special issue is on 'Gearbox incipient fault diagnosis using feature sample selection and principal component analysis'. Inspired by the research of kernel function approximation (KFA), a novel kernel principal component analysis (KPCA) method is proposed in this paper and applied in gearbox incipient fault

detection. The proposed KPCA is realised by feature sample selection and principal component analysis，which can also be called FSS-PCA. The key issues studied in this paper are non-linear feature extraction, optimal feature sample selection, and diagnostic performance assessment. Firstly, the integral operator Gaussian kernel function is used to realise the non-linear map from the raw input space of gearbox vibration features to a high dimensional space, where appropriate feature samples are selected to construct the feature subspace. Then, PCA is used to classify two kinds of gearbox running conditions: normal and tooth crack. The quantity of selected samples is much fewer than that of whole sample sets, which has quickly expedited the computation process.

The ninth paper in this special issue is on 'Study of weak high-frequency CW signal detection based on stochastic resonance'. The traditional method based on time-frequency transformation for detecting high-frequency CW signal has a poor performance in strong noise environment. In this paper, an advanced detecting method that combines non-linear bi-stable stochastic resonance model and time frequency analysis is proposed to upgrade the detecting performance. Firstly, the received CW signal is modulated to low frequency, and filtered by stochastic resonance model to restore its time domain waveform from strong noise environment. Secondly, the WVD transformation and Hough transformation are respectively utilised to extract its time domain features of the restored waveform. Thus, the detection of CW telegraph signal with low signal noise ratio can be easily implemented by detecting the peak values in parameter space.

The tenth paper in this special issue is on 'Real-time gait classification based on fuzzy associative memory'. It describes a method for classifying the gaits of human bodies in video sequences and deals with the classification of human gait types based on the notion that gait types can be analysed into a series of consecutive postures types. First, according to the different sorts of movements, we make a set of standard image contours using recursion method and put them into the database. Through the hidden Markov models (HMM), different behaviour matrices based on spatio-temporal are acquired. Then, according to the video sequence, silhouettes are extracted using the background subtraction. A moment distance method is presented to obtain the similarity degree of silhouettes, which is estimated by comparing the incoming silhouettes to the database silhouettes. Finally, fuzzy associative memory (FAM) classifier is proposed to infer the gait classification of a walker. An evaluation of ten kinds of gaits involving walk, stand, faint, sit, run, bench, jump, crouch, wander and punch are given.

The 11th paper in this special issue is on 'Natural ceiling features based self-localisation for indoor mobile robots'. When a mobile robot navigates in an indoor environment using visual dead reckoning method, its positioning accuracy suffers from accumulated errors. Therefore, it is necessary to use landmarks to make correction. This paper investigates the natural landmark-based localisation for an indoor mobile robot. The landmarks used here include smoke detection sensors, speakers and lights on the ceiling that are widely available in many offices and corridors. To improve the real-time performance, the proposed method utilises global and local strategies to search lines on the ceiling, as well as the line fitting algorithm based on Hough transform and random sample consensus. The pose of mobile robot is estimated with visual dead reckoning method, and then corrected via PnP-based positioning method with natural landmarks. Experimental results verify the effectiveness of the proposed methods.

The 12th paper in this special issue is on 'Aggregation behaviour analysis, modelling and control of anisotropic stochastic swarm systems'. The swarm foraging behaviour control scheme of stochastic swarm systems is investigated in this paper, whose agents are moving in n-dimensions Euclidean space with a family of attractant/repellent profile based on artificial potential functions under the m-dimensional standard Gauss white noise jamming. The corresponding M-member 'individual-based' Lagrangian isotropic/anisotropic continuous time social foraging swarms model is proposed. Furthermore, formation control is considered as a special form of swarm aggregation, where the final aggregated form of the swarm is desired to constitute a particular predefined arbitrary polygonal geometrical configuration that is defined by a set of desired inter-agent distance values. Through numerical simulations, the stability and validity of the proposed-foraging swarm's behaviour control scheme is illustrated.

The 13th paper in this special issue is on 'Application of advanced fault diagnosis technology in electric locomotives'. As the continuous development of intelligent mechatronic systems and robots, the fault diagnosis technology is making full advances in many practical applications. In this paper, an advanced fault diagnosis system, which consists of logical control units, micro-controllers, colour display screens and an industry PC, is developed for SS7E locomotives in China. Based on thoroughly analysing the structures and control principles, a full set of digital check points and fault points of SS7E are presented. The method to obtain diagnosis rules from the fault tree is described, and the high-efficiency reasoning mechanism is deduced. The intelligent fault diagnosis knowledge base of SS7E is constructed and the data structure is explained. Finally, an online instance of the SS7E locomotive fault diagnosis system interface is shown.