Special Issue on Intelligent Control and Robotics

The momentum of real industrial applications has accelerated the development of fuzzy control, neural-network based control, evolutionary control etc. During the last decade, several computational intelligence techniques haven been also incorporated into the intelligent robotics research domain. The Sixth International Conference on Intelligent Systems Design and Applications (ISDA 2006) gathered individual researchers who are also the world's most respected authorities on intelligent control, robotics etc. This special issue comprising of 11 papers is focused on the various aspects of intelligent control, robotics and their applications. Papers were selected on the basis of fundamental ideas/concepts rather than the thoroughness of techniques deployed. The papers are organized as follows.

In the first paper, *Li et al.* [1] propose a specialized genetic algorithm for optimum path planning of mobile robots. The algorithm consists of an obstacle avoidance scheme that is introduced to generate efficient initial population and domain heuristic knowledge based crossover, mutation, refinement and deletion operators that are tailored to fit path planning for mobile robots. Furthermore, a fuzzy logic control approach is then incorporated into the proposed genetic algorithm to self-adaptively adjust the probabilities of crossover and mutation. Simulations on both off-line and on-line planning with static obstacles are reported in this paper.

Wang et al. [2] in the second paper introduce a novel indirect method of measuring cutting force, in which the current signal of the servo motor is measured instead of cutting force. The relationship between the cutting force and the current signal of the servo motor is analyzed in detail. After the analysis in the frequency and the time domain, the current Eigen value of the servo motor is found with the various load torque and the mathematical models are created. Based on the current restriction, an adaptive cutting force control for numerical control machine is also proposed. Practical experiments have proved that this indirect measurement is reasonable and effective.

In the third paper, *He et al.* [3] propose a method to perceive collision by detecting the vibration of robot with a two-dimensional accelerometer on a differential drive wheeled mobile robot. The features of acceleration signal caused by pure collision is analyzed, and the rules to determine impact direction are set up based on the resultant impact force. Since the accelerometer is sensitive to gravity and may confuse the impact acceleration with other running accelerations, the accelerometer information is processed to identify whether a collision occurs and a detecting window based on median filter is designed to extract pure collision information. A responding strategy is established to avoid further impact as soon as possible and manage to find the object. The experiments illustrate that the robot could perceive impacts on several typical situations and make response within an acceptable degree.

Wang et al. **Error! Reference source not found.** in the fourth paper focus on omni-directional vision system applied in autonomous soccer robot and its imaging model. According to international soccer robot game rules, this paper designs the omni-directional vision sensor system and builds its mathematical model. The moving object detected technology based on omni-directional vision is introduced. The simulation and real image experiments results illustrate that the model is very practical and the presented method for recognition and detecting a moving object based on omni-directional vision is fast and effective.

In the fifth paper, *Chen et al.* [5] propose an adaptive feedback linearization control strategy for the large-angle rotational maneuver and vibration suppression of a flexible spacecraft. The model estimator provides the approximate model through the measure of system input variable, output variable (pitch angle) and its time derivative. The integral actions included not only can compensate of the entire dynamics of the system which is assumed to be unknown, but also ensure that the steady state error in the regulation of pitch angle is equal to zero. In addition, the control law is easy to implement. Simulation results are presented to show that, compared with differential geometric feedback linearization control and variable structure adaptive control, the designed

adaptive feedback linearization control is superior in resisting external disturbances and adapting the uncertainties of system model.

Gao et al. [6] in the sixth paper introduce a new artificial immune network (AIN) model for the multi-robot system. Based on the AIN model, the multi-robot task allocation algorithm is designed. A dynamic task allocation method is developed and extended by integrating the cooperative idea into the antigen stimulus. By the self-reinforcement learning of the antigen stimulus, the autonomous cooperation among robots is realized and deadlock situation is avoided. Based on the committed/opportunistic attribute of the robots, three different methods are proposed to implement the autonomous cooperation among robots. In the simulation, the immune based allocation method is further analyzed from the communication and computation aspects and is verified.

In the seventh paper, *Tian et al.* [7] present an intelligent optimized control system based on genetic wavelet neural network. The parameters of flocculation process are measured using multi sensors; so that the control system can control the flocculation process in real-time. The system is used in the sewage treatment plant. The experimental results prove that this system is feasible.

Liu et al. [8] in the eighth paper, develop a stable robust adaptive control approach for a class of unknown nonlinear systems in the strict-feedback form with disturbances. By combining neural network technique with backstepping method and introducing a special type of Lyapunov functions, the controller singularity problem is avoided perfectly. As the estimates of unknown neural network approximation error bound and external disturbance bound are adjusted adaptively, the robustness of the closed-loop system is improved and the application scope of nonlinear systems is extended. The overall neural network control systems can guarantee that all the signals of the closed-loop system are uniformly ultimately bounded and the tracking error converges to a small neighborhood of zero by suitably choosing the design parameters. The feasibility of the control approach is demonstrated through simulation results.

In the ninth paper, *Chen et al.* [9] propose a Shunt Active Power Filter (SAPF) model based on Average Power Algorithm (APA) and Recursive Least Squares (RLS) Self-adaptive Algorithm. Compared with SAPF's based on instantaneous reactive power theory and Fourier transform, the proposed model requires less calculation and possess a good dynamic response.

Yang et al. [10] in the tenth paper presents a class of end-to-end rate-based congestion control algorithms with communication delays. Based on the Lyapunov-Razumikhin theorem, the Lyapunov stability of the algorithm is analyzed. The global attractability of the algorithm is proved by applying Barbalat Lemma. A more concise criterion to ensure the global asymptotical stability (GAS) is obtained. The new result presents a simple upper delay bound, and enlarges the admissible upper delay bound. Finally, an example is provided to support the new results.

Xue et al. [11] in the last paper present a new kind of spiral tube compound gas-liquid separator. The numerical simulations validate the design of the structure of the spiral tube separator. With the comparison of three control plans, the plan to keep liquid level stable through controlling gas exit out flux is chosen. The manual and the automatic experiments prove that the proposed method is feasible. Fuzzy-PID controller is designed according to Ziegler-Nichols step response method and manual experience. Experiments depict that the fuzzy-PID controller has excellent anti-jamming performance. Experiments on oil-gas-water separation prove that the separator is three times as efficient as the same size gravity separator in practical separation.

The editors wish to thank the referees who have critically evaluated the papers within the short stipulated time. Finally we hope the reader will share our joy and find this special issue very useful. We would like to take this opportunity to thank Professor M. Sambandham, Editor-in-chief, Journal of Neural, Parallel and Scientific

Computations for all the timely advices and help and also for the opportunity for editing this important scientific work.

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[3] Fujun He, Zhijiang Du, Lining Sun, Rui Lin, Collision Signal Processing and Response in an Autonomous Mobile Robot.
[4] Yu Wang, Yue Liu, Yongtian Wang, Design, Modeling and Moving Object Detection of Omni-directional Vision System Applied in Autonomous Soccer Robot
[5] Jinli Chen, Donghai Li, Wenxiao Shan and Xianfang Sun, Design of Adaptive Feedback Linearization Control for Spacecraft with Flexible Appendages using Model Estimation.
[6] Yunyuan Gao, Wei Wei, Immune based Task Allocation Method for Muti-Robot System.
[7] Jingwen Tian, Meijuan Gao, Hao Zhou, Jin Li, The Intelligent Control System of Flocculation Process Based on Genetic Wavelet Neural Networks for Sewage Treatment.
[8] Yisha Liu, Wei Wang, Yanjun Liu, Robust Adaptive Neural Network Control for a Class of Nonlinear Sstems.
[9] Yiguang Chen, Qun Kong, Houlong Qian, Shengzhi Xing, Shunt Active Power Filter using Average Power and RLS Self-adaptive Algorithms.
[10] Hong-yong Yang, Fu-sheng Wang, Si-ying Zhang, Stability of Rate based Congestion Control Algorithm with Communication Delays.
[11] Guomin Xue, Yi Shen, Study on Spiral Tube Compound Gas-liquid Separator with Fuzzy PID Control.

Editor Biographies

Fuchun Sun is a professor in the Department of Computer Science and Technology, Tsinghua University, Beijing, China. His research interests include intelligent control, networked control system and management, neural networks, fuzzy systems, nonlinear systems and robotics. He has authored or coauthored two books and over 100 papers which have appeared in various journals and conference proceedings. Dr. Sun proposed the new design of the neural network (NN) variable structure control with a sector, developed systematic design approaches for the discrete-time adaptive control of (rigid and flexible link) robotic manipulators. Unlike the conventional NN control using variable structure control, the NN variable structure control with a sector can guarantee the system stability outside the network approximation region, and further improve the system dynamic performance within the network approximation region. Control approaches proposed have changed the existing design modes of neuro-adaptive control systems, i.e. existing neuro-adaptive control is only used in network approximation region, if outside the network approximation region, variable structure control is used, while NN variable structure control is used in the whole control process. Besides, Dr. Sun also carried out research on observer-based adaptive control for nonlinear systems using neural networks, neuro-fuzzy adaptive control for nonlinear systems based on dynamic inversion, fuzzy variable structure control, and inter-networked control systems. His current research interests are in stability synthesis and control for FSPMs and their application in the modeling, control and filtering for spacerobots with flexible arms and flexible spacecrafts. Dr. Sun is the recipient of the excellent Doctoral Dissertation Prize of China in 2000 and the Choon-Gang Academic Award by Korea in 2003. He has been a member of the Technical Committee on Intelligent Control of the IEEE Control System Society since 2006. He serves as a member of the Editorial Board of the International Journal of Soft Computing - A Fusion of Foundations, Methodologies and Applications.

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Ajith Abraham is currently a Visiting Professor in the Centre for Quantifiable Quality of Service in Communication Systems, Norwegian University of Science and Technology, Norway. His primary research interests are in computational intelligence with application areas include network security, Web services, Web intelligence, financial modeling, multi criteria decision-making, data mining etc. He has authored/co-authored over 275 research publications in peer reviewed reputed journals, book chapters and conference proceedings of which five have won 'best paper' awards. He is an editor of the Journal of Neural, Parallel and Scientific Computations (NPSC) and also serves the editorial board of over a dozen International Journals. He has guest edited 20 special issues for reputed International Journals. Since 2001, he is actively involved in the Hybrid Intelligent Systems (HIS) and the Intelligent Systems Design and Applications (ISDA) series of International conferences. During the last five years, he has also served the technical committee of over 100 International conferences and has also given a number of conference tutorials and plenary lectures. He is a senior member of IEEE and IEEE (CS) and a member of ACM, IEE (UK), IEAust and also works closely with several academic working groups like EvoNet, EUSFLAT, WFSC, etc. He received PhD degree from Monash University, Australia. More information at: http://www.softcomputing.net