Abstract

There are two different ways to integrate intelligence in robotic systems. One is intelligent design for robotic systems (embedding intelligence in the design process), and the other is embedding intelligence in physical robotic systems. The former emphasizes using intelligent design methods to conceive conceptual designs of robotic systems, and the latter focuses on implementing an intelligent ‘brain’ to enable intelligent behaviors for robotic systems. Robotic systems are typical mechatronic systems. Mechatronic systems are becoming increasingly intelligent, and embedded intelligence in mechatronic systems also helps them to find new applications continuously. This presentation addresses the issue of embedding intelligence in robotic systems in two thrusts. The first thrust deals with applying computational intelligence in design automation and optimization of mechatronic systems. An approach called GPBG that combines the strength of Genetic Programming (GP) to explore the open-ended design space and Bond Graph (BG) as a unifying modeling tool for mixed-domain systems is introduced, and five case studies are presented to demonstrate the effectiveness of the GPBG approach. It is argued that with proper extension of this approach can lead to an emerging research direction of mechatronic design automation (MDA). This approach can also be applied to design automation of robotic systems, which is widely considered as typical mechatronic systems.

The second thrust presents two robotic systems where intelligent approaches or algorithms are embedded directly in the industrial prototypes to enhance their performance. The first application presents results from an industrial PhD project in which a special type of hybrid metric-topological map is combined with a ‘divide-and-conquer’ approach to improve the scalability, reliability and adaptability of a mobile robot system for hospital transportation. Field tests demonstrate the effectiveness of the proposed approach, and it is believed that proper extension of the system can lead to commercialized application of mobile robots in hospitals. The second application relates to a project in which robot vision and machine learning techniques are used to improve the welding quality of welding robot. Active contour models are first utilized to track seams and welding pools. Selected features of welding pools are then extracted so that machine learning can be applied to predict quality of welding. The information is also expected to feedback to a robot control system so that it can online improve the welding quality. The presentation is concluded with reflections and discussions for future research directions.
**Speaker’s Bio**

Zhun Fan is a Professor at the Department of Electronic Engineering of Shantou University, Guangdong Province, China. Currently, He is also the Director of the Key Lab of Digital Signal and Image Processing of Guangdong Province. He holds a Ph.D. in Electrical and Computer Engineering from the Michigan State University (MSU), USA, a Master’s Degree and a Bachelor’s Degree in Control Science and Engineering from the Huazhong University of Science and Technology, China. Prof. Fan’s research interests include Artificial Intelligence for System Modeling, Mechatronics Design Automation and Optimization, Robotics, Evolutionary Computation and Machine Learning. He published more than 100 papers, and one research monograph. He has been principal investigator for a number of research projects sponsored by Danish Agency of Science, Technology and Innovation, National Science Foundation of USA, and Natural Science Foundation of China. He is a member of the “Thousand Youth Talent” plan of china, a member of the “Yang Fan” Plan of Guangdong Province, and an IEEE senior Member.
Plenary Talk II
Early Warning System for Crowd Stampede

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Abstract
Nowadays, emergencies occurred frequently in public mass gathering, and lead to a series of public safety issues resulting in a large number of casualties and bad social impact. For example, in the last day of 2014 in Shanghai in China, a terrible crowd stampede took place which took 39 peoples’ life and turned 49 people. Therefore, the research of early warning system for crowd stampede is of great significance. We propose a crowd stampede early warning paradigm with four dimensions: quantity-density, direction-speed, terrain-circumstance, and psychology-behavior. We also propose a EPP policy for crowd stampede early warning management: early warning, pre-control, and protocol. Based on the big data video observation, we find out the three effects about the crowd movement: proximity effect, sideway effect, and conformity effect. We set the early warning threshold via system analysis and simulate trigger factors of crowd stampede risk by using the software Pathfinder. Finally, we propose some strategies for crowd evacuation based on early warning.

Speaker’s Bio
Kefan Xie is a professor of Management School, Wuhan University of Technology (WHUT), and deputy director of Institute of Systems Science and Engineering of WHUT. He worked at University of Kyoto in Japan as a post-doctoral fellow from 2000 to 2003, and studied at University of Toronto in Canada in 2014. He has published over 170 papers and over 10 books, and has presided more than 30 research projects, including 5 from NSFC (National Natural Science Foundation of China) and 1 key project from NSSFC. He was the winner of Huo Yingdong educational funds, excellent young teachers support project from Ministry of Education of PRC, and Twilight Program of Wuhan Government. Meanwhile, he has been awarded more than 11 ministerial level and provincial prizes. His principal research interests include risk management, emergency management, and industry-university alliances.