# GUEST EDITORIAL

## Special Edition on Recent Advances in Power System Control

It is our honor and privilege to serve as Guest Editors of the special edition on Recent Advances in Power System Control for the International Journal of Control, Automation, and Systems (http://www.ijcas.com).

High quality power supply is of vital importance in today's global economy. With the development of modern power systems and the increasing demand for power supply, the electric power industry is facing a great challenge in meeting the ever increasing load demand with high reliability and minimum transmission expenditure.

Power system stability analysis and control are among the most significant issues being dealt with by the sophisticated power systems of today. The ability of a power system to maintain stability and to provide high quality power supply depends to a large extent on the controls available within the system. Analysis and design of power system controls are indeed important and essential for modern power systems. This special edition on recent advances in power system control is dedicated to the state-of-the-art of research achievements, findings and results in addressing today's needs.

Out of 26 submissions from 11 countries across America, Asia and Europe, this special edition selects 15 representative nations addressing a number of burning technical issues owing to limited space. All of the submissions were peer reviewed according to the journal guidelines. The papers published in the special edition describe the latest research findings and ideas in the areas of power system control. The papers cover a wide range of interesting issues in power system control, which can be broadly divided into five subjects.

The first subject is stabilization and control. There are four papers addressing related issues on this subject. Mei *et. al.* discuss robust design, in the sense of $L_2$-gain, of nonlinear disturbance attenuation control for STATCOM. A novel recursive approach is applied to construct the energy storage function of power systems such that the solution of the control problem is acquired, which avoids the difficulty from solving the dissipative inequality. Jung *et. al.* propose decentralized control for multimachine power systems with nonlinear interconnections and disturbances. The authors first employ a direct feedback linearization compensator to cancel most of the nonlinearities in the system model, and then apply backstepping to deal with the interconnection terms and to reduce the effects of a disturbance that does not satisfy the matching condition. The proposed decentralized scheme is applied to a three-machine example power system to demonstrate its effectiveness. Psillakis and Alexandridis present a new excitation control for multimachine power systems. Their paper consists of two parts: (i) decentralized nonlinear adaptive control design and stability analysis, and (ii) robustness and disturbance attenuation analysis. The applications of the proposed control scheme to an example system, a two-generator infinite bus power system, are shown to confirm the theoretical results. Peng and Cheng design a nonlinear PID controller for a power system with superconducting magnetic energy storage (SMES). The application of the proposed nonlinear PID control to an example shows satisfactory performance and good robustness of the controller. The feasibility of the controller is testified as well through the simulation.

The second subject of the special issue is on transient stabilization and voltage regulation with two dedicated works. Jalili-Kharaajoo and Mohammadi-Milasi propose a neuro-controller for global power system transient stabilization and voltage regulation. The proposed controller consists of two independent controllers, *i.e.* transient controller and voltage regulator. A simple neuron structure is used in the controller design. It shows that the proposed controller guarantees both transient stability and voltage regulation. Jiao *et. al.* present an adaptive controller design for a synchronous generator with unknown perturbation in mechanical power. The transient stabilization with voltage regulation problem for synchronous generators is considered in the paper. The adaptive excitation control is designed based on the backstepping method with the tuning functions. Simulation results are given to

demonstrate the effectiveness of the proposed controller for the transient stabilization and voltage regulation.

The third subject in this special issue is coordinated control in power systems. There are four papers on the subject. Wang and Jazaeri analyze the control conflict between the series and shunt parts of a UPFC. The interaction indicator proposed can depict the direction and amount of active power flow through the internal link of the UPFC series and shunt parts at steady-state operation of the power system. By using the indicator, the interactions among multiple control functions of the UPFC caused by badly set controller's parameters are avoided. In the case of So *et. al.*, a control scheme using projective controls is developed for the simultaneous coordination of a Thyristor Controlled Series Capacitor (TCSC) and a Static Var Compensator (SVC) to enhance the damping performance of a power system. The approach presented demonstrates the control action of the TCSC in conjunction with the control action of the SVC to increase system damping and power transfer capabilities. Xue *et. al.* propose optimization of transient stability control for power systems. This two-part paper develops a globally optimal control scheme for transient stability control to coordinate preventive actions and emergency actions. In the first part, a control algorithm is proposed for a set of contingencies with the same unstable mode. In the second part of the paper, the cases of several subsets of contingencies with different unstable modes are dealt with. An application is shown to demonstrate the global coordination algorithm. Lastly, Hashmani *et. al.* suggest a nonlinear coordinated excitation and Thyristor Controlled Phase Shifter (TCPS) controller in power systems. The proposed controller is able to control three main parameters affecting A.C. power transmission: excitation voltage, phase shift angle and reactance in a coordinated manner. An example is presented to demonstrate the effectiveness of the proposed control scheme.

The fourth subject is deregulated and re-structured power systems presented by two papers. Dong *et. al.* presents the techniques of computing the sensitivity matrix of the critical system eigenvalues to nondeterministic random variables of the power system in a deregulated environment. Both analytical and numerical methods are investigated and compared. Case studies based on the New England system are presented to further justify the techniques. Feliachi suggests control issues and potential solutions for the challenge of controls of re-structured electric power systems. The paper presents some of the problems that are of primary importance in re-structured power systems, such as what the control and information structure is, what challenges exist, and what the economics of control are, etc.

Last but not least, this special edition presents a paper that is closely related to the area of power system control, yet provides an additional dimension in providing solutions to industrial problems. Sidhu *et. al.* offer a modern automatic bus transfer scheme. The scheme proposed in this paper includes the development of a new algorithm for determining the type of bus transfer required and the realization of the scheme by using modern protection devices and intra-substation communication facilities.

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Guest Editors

Youyi Wang
School of Electrical and Electronic Engineering
Nanyang Technological University
Singapore 639798
Email: eyywang@ntu.edu.sg

Shuzhi Sam Ge
Department of Electrical & Computer Engineering
The National University of Singapore
Singapore 117576
Email: elegesz@nus.edu.sg

**Youyi Wang** received his B.Eng. degree from Beijing University of Science and Technology in 1982, the M. Eng. degree from Tsinghua University, China, in 1984, and the PhD degree from the University of Newcastle, Australia, in 1991, all in electrical engineering. Currently he is an associate professor in the School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore.

Since he joined Nanyang Technological University in 1991, Dr Wang has published over 200 international journal and conference papers on power system control, stability analysis, FACTS, voltage stability, electric drive control, information storage system and control theory. Dr Wang is the principal investigator for more than 20 industrial projects. His main research interests are in the area of nonlinear control, robust control, adaptive control, $H_\infty$ control and applications of control theory to power systems, electric drive systems, information storage systems and electric vehicles. Dr Wang is Program Director (Flexible Transmission-Distribution Systems), the Centre for Advanced Power Electronics, and Principal investigator, the Centre for Mechanics of Micro-Systems. Currently, Dr Wang is senior members of IEEE Control Systems Society and IEEE Power Engineering Society and Chairman of IEEE Singapore Control Systems Chapter.

**Shuzhi Sam Ge** received the B.Sc. degree from Beijing University of Aeronautics and Astronautics (BUAA), and the Ph.D. degree and the Diploma of Imperial College (DIC) from Imperial College of Science, Technology and Medicine, University of London. He did his postdoctoral research at Leicester University, England.

He has been with the Department of Electrical & Computer Engineering, the National University of Singapore since 1993, where he is currently a Professor. He has (co)-authored three books: *Adaptive Neural Network Control of Robotic Manipulators* (World Scientific, 1998), *Stable adaptive Neural Network Control* (Kluwer, 2001) and *Switched Linear Systems: Control and Design* (Springer-Verlag, 2005), and over 200 international journal and conference papers. He has been serving as Editor of this journal since 2003, and associate editors for a number of IEEE Transactions. Dr Ge is the recipient of the 1999 National Technology Award, (2001 University Young Research Award, 2002 Temasek Young Investigator Award, Singapore, and 2004 Outstanding Overseas Young Researcher Award from National Science Foundation, China. His current research interests are control of nonlinear systems, hybrid systems, neural/fuzzy systems, sensor fusion, and system development.