3rd Japan-China Joint Workshop on Control

—Theory and Applications of Complex Systems

Final Program

18, August,2009
Fukuoka International Congress Center,
Fukuoka, Japan

Sponsored by:

Control Division, SICE

Technical Committee on Control Theory, CAA

3rd Japan-China Joint Workshop on Control — Theory and Applications of Complex Systems

August 18, 2009 in Fukuoka International Congress Center
Fukuoka, Japan

Sponsors: Control Division, The Society of Instrument and Control Engineers (SICE), Japan.
Technical Committee on Control Theory, Chinese Association of Automation (CAA), China.

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Greeting from Chairs:

Dear Colleagues and Friends,

Welcome to the third Japan-China Joint Workshop on Control: Theory and Applications of Complex Systems!

The first China-Japan Joint Workshop on Control (Advanced Robust Control and Adaptive Control: Theory and Applications) and the second China-Japan Joint Workshop on Control (Control of Non-smooth, Switched, and Hybrid Systems) were held in Beijing, China, on September 22-26, 2004, and in Harbin, China, on August 6, 2006, respectively. After two successful workshops, the third Japan-China Joint Workshop on Control will be held in Fukuoka, Japan, on August 18, 2009. It is a pre-conference workshop of the ICCAS-SICE 2009.

The purpose of this series of joint workshops is to provide a forum for scientists and engineers on automatic control from both Japan and China to exchange contemporary research results and to promote the applications of advanced control theory to practical engineering problems so that to enhance the development and spread of new theory and control technologies for the complex systems. The workshop will focus on the control of hybrid systems and networked system and other high tech oriented system and control problems. The workshop program consists of some keynote addresses, regular lecture presentations, and a free panel discussion.

As in previous J-C workshops, a selected set of the papers presented in this workshop will be edited and then published as a Book by, most likely, Tsinghua University Press and Springer.

Wish we have a successful Workshop, and wish you a happy and fruitful staying in Fukuoka!

Yoshito Ohta and Jie Huang
August 18, 2009

Technical Program

8:50-9:00	**Opening Speech**	Chair: Tielong Shen
	Yoshito Ohta	On behalf of CD, SICE
	Daizhan Cheng	On behalf of TCCT,CAA
9:00-9:45	**Keynote Address I**	Chair: Jie Huang
	A Unified Approach to Consensus and Cooperation in Multi-Agent Dynamical Systems: Systems with Generalized Frequency Variables	
	Shinji Hara, The University of Tokyo, Japan	
9:45-10:30	**Keynote Address II**	Chair: Yoshido Ohta
	Decoupling of Boolean Networks	
	Daizhan Cheng, Chinese Academy of Science, China	
10:30-10:40	**Coffee Break**	
10:40-12:20	**Lecture Session I**	Chair: Qianchuan Zhao
10:40-11:00	Stability Analysis for a Class of Networked/Embedded Control Systems: Continuous-and Discrete-Time Approaches	
	Hisaya Fujioka, Kyoto University, Japan	
11:00-11:20	Multi-Agent Tracking of a High-Dimensional Active Leader with Switching Interaction Topology	
	Yiguang Hong, Chinese Academy of Sciences, China	
11:20-11:40	On Implicit Feedback Structure in Biological Control System	
	Koichi Osuka, Osaka University, Japan	
	Ishiguro Akio, Tohoku University, Japan	
	XinZhi Zheng, ASTEM, Japan	
11:40-12:00	Robust Adaptive Control of Multi-Output-Delay Systems	
	Yingmin Jia, Beihang University, China	
12:00-12:20	A Robust Adaptive $\mathcal{H}_\infty$ Control for Robotic Manipulators with Input Uncertainties	
	Kazuya Sato, Saga University ,Japan	
12:20-13:30	**Lunch**	
13:30-14:15	**Keynote Address III**	Chair: Seiichi Shin
	Adaptation in Nonequilibrium Dynamic Games	
	Lei Guo, Chinese Academy of Science, China	

14:15-15:00	**Keynote Address IV**	Chair: Daizhan Cheng
	Brain Science and Control Theory	
	Hidenori Kimura, RIKEN, Japan	
15:00-15:10	**Coffee Break**	
15:10-16:30	**Lecture Session II**	Chair: Yi Huang
15:10-15:30	Stochastic Optimal Control for A Class of Manufacturing Systems Based on Event-Based Optimization	
	Qianchuan Zhao, Tsinghua University , China	
15:30-15:50	Model-Based Development for Automotive Control Systems	
	Akira Ohata, Toyota Motor Corporation, Japan	
15:50-16:10	Stability Analysis of Extended State Observer Based Control for Nonlinear Time-varing Systems with Uncertain Dynamics and Disturbances	
	Wenchao Xue, Yi Huang, Chinese Academy of Sciences, China	
16:10-16:30	Neo-Robust Control Theory Beyond the Small-Gain and Passivity Paradigms	
	Kangzhi Liu, Chiba University, Japan	
16:30-16:40	**Coffee Break**	
16:40-17:40	**Lecture Session III**	Chair: Kangzhi Liu
16:40-17:00	Measuring Software Dynamics in Embedded Control Systems	
	Shigeru Oho, Central Research laboratory, Hitachi, Ltd., Japan	
17:00-17:20	Estimation of LISS Properties via a Quadratic Form LISS-Lyapunov Function	
	Shengyu Wu, Shengwei Mei, Tsinghua University, China	
17:20-17:40	An Algebraic Solution Method of the Hamilton-Jacobi Equation	
	Toshiyuki Ohtsuka, Osaka University, Japan	
18:00-	**Welcome Reception**	
20:00-	**Banquet**	
	Closing Speach	Qianchuan Zhao
	Closing Speach	Tielong Shen

Abstract of oral presentation

Keynote Address I:

Title: **A Unified Approach to Consensus and Cooperation in Multi-Agent Dynamical Systems: Systems with Generalized Frequency Variables**

Speaker: **Shinji Hara, The University of Tokyo, Japan**

Abstract: This talk is concerned with consensus and decentralized cooperative control for multi-agent dynamical systems. We first propose a theoretical framework, namely a class of linear time-invariant systems with generalized frequency variables, for the purpose of consensus and cooperation. We then show several theoretical results on stability and stabilization. Specifically, we propose a systematic way of deriving a Hurwitz type stability criterion, which can be reduced to a linear matrix inequality (LMI) feasibility problem involving generalized Lyapunov inequalities. Regarding the stabilizability, we show that the cooperative stabilization problem by constant output feedback can be reduced to a stabilization problem with complex gain feedback and examine the properties. The last part is devoted to several applications including analysis of oscillatory behaviors in a class of gene regulatory networks.

Shinji Hara received the B.S., M.S., and Ph.D. degrees in engineering from Tokyo Institute of Technology, Tokyo, Japan, in 1974, 1976, and 1981, respectively. In 1984 he joined Tokyo Institute of Technology as an Associate Professor and had served as a Full Professor for 10 years. Since 2002 he has been a Full Professor of Department of Information Physics and Computing, The University of Tokyo. He received George S. Axelby Outstanding Paper Award from IEEE Control System Society in 2006 and Best Paper Awards from SICE several times. His current research interests are in robust control, multi-resolved dynamical system, decentralized multi-agent control and its applications, quantum control, and computational aspects of control system design. Dr. Hara is a Fellow of IEEE and SICE. He was the General Chair of the CCA'04, the Program Co-Chair of the 2008 IFAC World Congress. He is currently Vice President of IEEE CSS and President of SICE.

Keynote Address II:

Title: **Disturbance Decoupling of Boolean networks**

Speaker: **Daizhan Cheng, Chinese Academy of Science, China**

Abstract: Boolean network is a proper tool to describe the cellular network. The rising of Systems Biology stimulates the investigation of Boolean networks. Because of the short of proper tools the study of the Boolean networks, particularly the control of Boolean networks, becomes a challenging and hard topic. Using semi-tensor product of matrix and the matrix expression of logical functions, the dynamics of a Boolean network can be converted into a discrete-time linear system. Using this framework the state space and subspaces of a Boolean network are clearly defined. The coordinate transformation of the state space is also firstly defined. Using then the (control) invariant subspace and its verifiable conditions are presented. As an application the problem of disturbance decoupling (PDD) of Boolean control systems is investigated. The necessary and sufficient condition for the solvability of PDD is obtained. Some illustrative examples are included.

Daizhan Cheng graduated from Dept. of Mechanics, Tsinghua University in 1970, received M.S. from Graduate School, Chinese Academy of Sciences in 1981, Ph.D. from Washington University, St. Louis,

in 1985. Since 1990, he is a professor with Institute of Systems Science, AMSS, CAS. His research interests include nonlinear control systems, switched systems, Hamiltonian systems and numerical realization for control design. He is the author/coauthor of 200 journal papers, 8 books and 100 conference papers. He was Associate Editor of "International Journal of Mathematical Systems, Estimation and Control" (90-93); "Automatica" (99-02); "Asian Journal of Control" (01-04), Subject Editor of International Journal of Robust and Nonlinear Control (05-08). He is the Editor-in-Chief of "J. Control Theory and Applications", Deputy Editor-in-Chief of "Control and Decision". He is currently Chairman of Technical Committee on Control Theory, Chinese Association of Automation, Chairman of IEEE CSS Beijing Chapter(2006-2008), IEEE Fellow (2005-) and IFAC Fellow (2008-). He is the Co-Chairman of Program Committee, CDC-CCC'09.

Keynote Address III:

Title: **Brain Science and Control Theory**

Speaker: **Hidenori Kimura, RIKEN, Japan**

Abstract: One of the major functions of the brain is to control motions and physiological processes of body. The motion control of body is called motor control in neuroscience. It has been widely known that motor control is superior to the most advanced robot control in many respects. Many attempts have been done to understand the mechanisms of motor control in terms of control theory. Some interesting common features have been found between human motor control and control of artifacts. Recently, increasing demand for enhancing the performance of robot control has renewed the interest in human motor control from control theoretic point of view. In this talk, the past interplay between control theory and motor control is briefly reviewed. It is argued that the control theory must make substantial innovations in order to incorporate the recent advances of motor control to extend its scope beyond engineering systems.

Hidenori Kimura He obtained the Degree of Doctor of Engineering from the University of Tokyo in 1970. He worked at Osaka University for 25 years where he was engaged in the research and education of control theory and its applications. He stayed in UK during 1974-75 academic year as a fellow of British Council. In 1995, he joined the Faculty of Engineering, the University of Tokyo, where he was engaged in the research of control biology and complex behavioral control. In 2003, he was appointed to be a leader of the laboratory of biological control systems at RIKEN, where he is now the Director of BSI/Toyota Collaboration Center since 2007. He is the recipient of many awards both domestic and international. In 1984 and 1990, he was awarded the Paper Prize from IFAC, and in 1985, he received George Axelby Award and Distiguished Member Award from CSS, IEEE. He received Paper Awards from SICE six times. He has been a Fellow of IEEE scince 1990.

Keynote Address IV:

Title: **Adaptation in Non-equilibrium Dynamic Games**

Speaker: **Lei Guo, Chinese Academy of Science, China**

Abstract: In this talk, we consider the adaptation in a non-equilibrium dynamic game. To be precise, we consider the optimization and identification problems in the infinitely repeated games between a

human and a machine based on the standard Prisoners' Dilemma model. The machine's strategy is assumed to be fixed with k-step memory, which may be unknown to the human. By analyzing the state transfer graph, it will be shown that the optimal strategy that maximizes the human's averaged payoff is actually periodic after finite steps. Moreover, when k=1, the human will not lose to the machine while optimizing his averaged payoff; but when k¿1, he may indeed lose if he focuses on optimizing his own payoff only. The same problems are considered for other games, like the Snowdrift game and the game of the Battle of Sex, while the results are a little different. Identifiability problem will also be investigated when the machine's strategy is unknown to the human.

Lei Guo Lei GUO was born in China in 1961. He received the B.S. degree in mathematics from Shandong University in 1982, and the Ph.D. degree in control theory from the Chinese Academy of Sciences in 1987. He was a postdoctoral fellow at the Australian National University (1987-1989), and a visiting professor at several universities in the US and Europe. Since 1992, he has been a Professor of the Institute of Systems Science at the Chinese Academy of Sciences (CAS), where he had been the Director of the Institute (1999-2002). He is currently the President of the Academy of Mathematics and Systems Science, CAS.

Dr. Guo was elected Fellow of the IEEE in 1998, Member of the Chinese Academy of Sciences in 2001, Fellow of the Academy of Sciences for the Developing World (TWAS) in 2002, Foreign Member of the Royal Swedish Academy of Engineering Sciences in 2007, and Fellow of the International Federation of Automatic Control (IFAC) in 2007 "for fundamental contributions to the theory of adaptive control and estimation of stochastic systems, and to the understanding of the maximum capability of feedback". He has twice received, in 1987 and 1997, the National Natural Science Prize of China. He was also the recipient of the 1993 IFAC World Congress Young Author Prize "for solving a long standing problem in control theory concerning convergence and convergence rate for the least-squares-based self-tuning regulators". He was invited to give lectures at various international conferences, including Plenary Lecture at the 1999 International Federation of Automatic Control (IFAC) World Congress, and Invited Lecture at the 2002 International Congress of Mathematicians (ICM).