The 33rd Chinese Control Conference (CCC2014)

The 33rd Chinese Control Conference (CCC2014) was held July 28–30, 2014 at the Nanjing International Conference Hotel, Nanjing, Jiangsu Province, China. As one of the four great ancient capitals of China, Nanjing is rich in sightseeing resources featuring culture and history and is known for its local handicrafts such as yunjin, or cloud brocade. Registration was over 1700, including 60 faculty and staff volunteers and over 180 student volunteers from Nanjing University of Science and Technology, over 2000 attended the conference.

The CCC is an annual international conference initiated by the Technical Committee on Control Theory (TCCT) of the Chinese Association of Automation (CAA). More information on the current and past CCCs can be found at the TCCT Web site http://tcct.amss.ac.cn. The 33rd CCC was jointly sponsored by the TCCT and the Systems Engineering Society of China and was locally organized by Nanjing University of Science and Technology. The conference was also cosponsored by several organizations, both domestic and international: the Academy of Mathematics and Systems Science of the Chinese Academy of Sciences (AMSS, CAS), Automatic Control Specialty Committee of the China Ordnance Society, China Society for Industrial and Applied Mathematics, Jiangsu Society for Electrical Engineering, IEEE Control Systems Society (CSS), the Institute of Control, Robotics and Systems (ICROS) of Korea, and the Society of Instrument and Control Engineers (SICE) of Japan.

Yunjin, or cloud brocade, is a famous local handicraft specialty of Nanjing, the host city of CCC2014 (from http://www.cityof-nanjing.com/gallery/).


General Chair Han-Fu Chen addresses the opening ceremony of the conference.

Several distinguished guests from these cosponsoring organizations attended the conference, including Prof. Xiaoshan Gao, vice-president of AMSS, CAS; Prof. Jay Farrell, president of IEEE CSS; Prof. Sangchul Won, president of Asian Control Association; Ryuichi Nakata, president of SICE; and Prof. Keum-Shik Hong, president-elect of ICROS.

THE TECHNICAL PROGRAM

This year, 2377 papers were submitted with authors from 27 countries and regions, including Australia, Canada, Chile, China, France, Germany, Hong Kong, India, Iran, Italy, Japan, South Korea, Luxembourg, Macau, Mexico, Pakistan, Poland, Romania, Russia, Singapore, Sri Lanka, Sweden, Taiwan, Tunisia, Ukraine, the United Kingdom, and the United States. After the peer review process organized by the Confer-
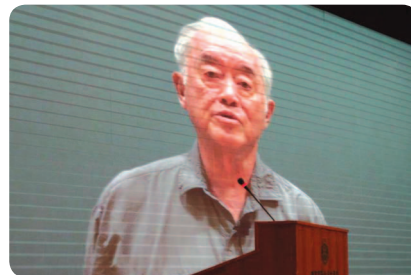
Prof. Yu-Chi Ho won the first Chen Han-Fu Award. The video of his acceptance speech was played at the conference's opening ceremony.

Er-Wei Bai delivers his plenary talk, "Big Data: The Curse of Dimensionality and Variable Selection in Identification for a High-Dimensional Nonlinear Nonparametric System."

Vijay Kumar gives his plenary talk, "Aerial Robot Swarms."

ence Program Committee, 1634 papers were accepted and included in the conference proceedings. The proceedings will be included in the IEEE Conference Publication Program with the IEEE catalog number CFP1440A-USB.

Kameshwar Poolla presents his plenary talk, "The Future Grid: Renewables, Regulation, and Control."

Frank Doyle delivers his plenary talk, "Engineering the Artificial Pancreas."

Gang Feng gives his plenary talk, "Intelligent Control: A Fuzzy Dynamic-Model-Based Approach."

Yi Huang delivers her plenary talk, "Active Disturbance Rejection Control: Methodology, Practice, and Analysis."

Karl Henrik Johansson presents his plenary talk, "Cooperative Driving for Road Goods Transportation: Optimization and Control."

An oral session in progress.

A poster session in progress.

It was our great honor to have seven distinguished plenary speakers. Their speeches on timely topics were as follows:

» "Big Data: The Curse of Dimensionality and Variable Selection in Identification for a High-Dimensional Nonlinear Nonparametric System" by Er-Wei Bai, University of Iowa, United States

» "Aerial Robot Swarms" by Vijay Kumar, University of Pennsylvania, United States

» "The Future Grid: Renewables, Regulation, and Control" by Kameshwar Poolla, University of California at Berkeley, United States

» "Engineering the Artificial Pancreas" by Frank Doyle, University of California at Santa Barbara, United States

» "Intelligent Control: A Fuzzy Dynamic Model Based Approach" by Gang Feng, City University of Hong Kong, China

» "Active Disturbance Rejection Control: Methodology, Practice, and Analysis" by Yi Huang, AMSS, CAS, China

» "Cooperative Driving for Road Goods Transportation: Optimization and Control" by Karl Henrik Johansson, Royal Institute of Technology, Sweden.

These plenary sessions were respectively chaired by Han-Fu Chen, Lihua Xie, Zidong Wang, Daizhan Cheng, Ben M. Chen, Yun Zou, and Zongli Lin.

In addition to these plenary speeches, there were 133 oral sessions, including 64 invited sessions, arranged in 22 parallel tracks, and four poster sessions. Among the 1634 papers presented at the conference, 804 were in the oral sessions, and the rest in the poster sessions. The conference languages are Chinese and English. Papers in English sessions were presented in English, and papers in other sessions could be presented either in English or in Chinese.

AWARDS

To recognize and honor scholars who have made outstanding contributions to the field of control and systems

Jay Farrell (left), president of IEEE Control Systems Society, presents the IEEE CSS Beijing Chapter Young Author Prize.

Lei Guo (second from right), chair of the Evaluation Committee for the Guan Zhao-Zhi Award, presents the award.

Han-Fu Chen (second from right), general chair of the conference, presents the Poster Award.

sciences, to inspire and stimulate innovative and original research, and to advance control and systems sciences in China, the TCCT established the Chen Han-Fu Award in early 2014. At the opening ceremony of CCC2014, Prof. Lei Guo of AMSS, CAS, chair of the Evaluation Committee of the Chen Han-Fu Award, announced the award's first winner, Prof. Yu-Chi Ho, for his "pioneering contributions to optimal control, perturbation analysis, and discrete event dynamic systems." Prof. Frank L. Lewis, on behalf of the Evaluation Committee, made a brief introduction to Prof. Ho's work. Because of the short notice, Prof. Ho was unable to attend the awards ceremony. His acceptance speech video was played, in which he extended his appreciation to the Evaluation Committee and reiterated his commitment to contributing to the bilateral academic exchanges between the United States and China.

At the closing ceremony, the following awards were presented: the 20th Guan Zhao-Zhi Award, the Eighth Poster Paper Award, the IEEE CSS Beijing Chapter Young Author Prize, and the Outstanding Volunteers Award. The winning papers for the 20th Guan Zhao-Zhi Award were "Stabilization of Nonlinearly Parameterized Discrete-Time Systems by NLS Algorithm" by Chanying Li and Michael Z.Q. Chen and "Guidance, Navigation and Control of an Unmanned Helicopter for Automatic Cargo Transportation," by Fei Wang, Peidong Liu, Shiyu Zhao, Ben M. Chen, Swee King Phang, Shupeng Lai, Tong H. Lee, and Chenxiao Cai. Two papers received the Eighth Poster Paper Award: "Empirical Study of Pilot Time Delay in Flight Control Systems and Its Safety Margin," by Zhengxiang Cai, Dan Huang, and Shan Fu, and "Energy-Equality-Based Detumbling Control for Picosatellites," by Fucheng Liu, Haifeng Zhu, Yong Liu, Qian Feng, and Quan Pan. The winner for IEEE CSS Beijing Chapter Young Author Prize was Dong Shen of Beijing University of Science and Technology with the paper "ILC for Networked Discrete Systems with Random Data Dropouts: A Switched System Approach" coauthored by Youqing Wang. Twenty-eight students from the School of Automation, Nanjing University of Science and Technology were recognized with the Outstanding Volunteers Award.

PANEL DISCUSSIONS

Jie Huang of the Chinese University of Hong Kong and Jie Chen of the Beijing Institute of Technology organized two plenary panel discussions at the conference. The panel Distinguished Young Scholars Forum featured Long Wang of

Ji-Feng Zhang (first from right), general cochair, and Yuming Bo (first from left), Organizing Committee chair, present the Outstanding Volunteers Award to student volunteers from Nanjing University of Science and Technology, China.

Peking University, Wei Wang of Dalian University of Technology, Shengyuan Xu of Nanjing University of Science and Technology, and Chunhua Yang of Central South University. All these panelists were winners of the Distinguished Young Scholars Award of National Science Foundation of China. The year 2014 also marks the 20th anniversary of the Guan Zhao-Zhi Award, the Best Paper Award of CCC. On behalf of Prof. Huashu Qin, a former president of TCCT,

Prof. Han-Fu Chen made the presentation "20 Years of Guan Zhao-Zhi Award" to commemorate the start of the award at the panel discussion. The second panel session, "Women in Control," featured Zhixin Liu of AMSS, CAS, Hong Qiao of the Institute of Automation of CAS, Yongchun Xie of the Beijing Institute of Control Engineering of Chinese Academy of Space Technology, and Yingwei Zhang of Northeastern University as panelists. The panelists shared their

views on academic research as well as on life in general and offered many insightful perspectives to the audiences.

PRECONFERENCE WORKSHOPS

Two preconference workshops, organized by Ben M. Chen of the National University of Singapore, Singapore, and Qingwei Chen of Nanjing University of Science and Technology, China, were held at the Academic Exchange Center of the Nanjing University of

A panel discussion at the Distinguished Young Scholars' Forum.

Haoping Wang presents his preconference workshop, "Biogas from Organic Waste: Process Description, Mathematical Modeling, Estimation, and Composed Recursive Model-Free Control."

The panel discussion "Women in Control."

The registration desk.

Cheng Xiang presents his preconference workshop, "Data-Driven Identification and Control of Nonlinear Systems Using Multiple Models."

Student volunteers in yellow provided thoughtful service throughout the conference.

An exhibition of robots attracts conference attendees.

Science and Technology. The workshop, "Theory and Applications of Multiple Models and Multiagent Systems," consisted of two sections: "Data-Driven Identification and Control of Nonlinear Systems Using Multiple Models" by Cheng Xiang of the National University of Singapore and "Multirobot Cooperation for Mapping and Intervention in Hazardous Environments" by Guowei Cai of Khalifa University, United Arab Emirates. The workshop "Renewable Energy Systems: Modeling, Estimation, and Control" also had two sections: "Vehicle Dynamics and Renewable Energy Systems" by Ahmed El Hajjaji of the University of Picardie Jules Verne, France, and "Biogas from Organic Waste: Process Description, Mathematical Modeling, Estimation, and Composed Recursive Model-Free Control" by Haoping Wang of Nanjing University of Science and Technology, China.

CONCLUDING REMARKS AND INVITATION TO CCC AND SICE 2015

Many individuals, the authors, members of the conference committees, and the attendees, made great contributions to the success of the conference in many ways. The program committee of over 400 members undertook the task of reviewing papers, compiling the final program, and editing the book of abstracts and the proceedings.

Nine program regional chairs were responsible for promoting the conference within their respective regions and for organizing invited sessions. These chairs are Tongwen Chen, University of Alberta, Canada; Shuzhi Sam Ge, National University of Singapore, ASEAN; Daniel W.C. Ho, City University of Hong Kong, Hong Kong; Xiaoming Hu, KTH, Sweden; Tielong Shen, Sophia University, Japan; Zidong Wang, Brunel University, UK; Xiaolan Xie, ENSM.SE, France; Xinghuo Yu, RMIT University, Australia; and Mengchu Zhou, New Jersey Institute of Technology, United States. Moreover, the organizing committee successfully completed the daunting task of local arrangements. There were over 60 faculty and staff volunteers in red shirts and over 180 student volunteers in yellow shirts serving throughout the conference. Their smiles and considerate service provided a pleasant experience for the conference attendees and helped the conference run smoothly.

Members of the TCCT after their meeting at CCC2014.

Welcome to CCC and SICE 2015 in Hangzhou.

The next CCC2015 and SICE Annual Conference 2015 will be held jointly on July 28–30, 2015 in Hangzhou, the "paradise on Earth." At the closing ceremony of CCC2014, Xiaoping Lai, National Organizing Committee chair, reported on the progress of the preparation work for CCC and SICE 2015. SICE President Ryuichi Nakata extended a warm invitation to colleagues to participate in the coming conference. More information on CCC and SICE 2015 is available on the conference Web site: http://ccc-sice2015.hdu.edu.cn/index.php?lang=en. We look forward to seeing you in Hangzhou next July!

Zongli Lin
Poster Sessions Chair,
CCC 2014

Yanlong Zhao
General Secretary,
TCCT and CCC 2014

Ningzhe Wu
Secretary, TCCT and
CCC Secretariat

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minimum interaction among the loops. However, there are a number of practical cases where the standard configuration of Fig. 1 cannot deal adequately with robustness issues. In particular, when the inner part, $H(s)$, of the process is subject to structural and/or parametric variations, the classical structure does not guarantee that the outer control loop can maintain acceptable performance.

This paper presents a new approach to cascade control aimed at improving control system robustness via complete decoupling of the design and performance of two (or more) cascaded control loops.

CLASSICAL STRUCTURE

The classical structure to control the system illustrated in Fig. 1, where $R_1(s)$ and $R_2(s)$ are the transfer functions of the controllers. The typical procedure to design the classical structure consists of two sequential steps:

1) Choose the controller $R_1(s)$ so that the closed-loop transfer function $F_1(s)$ has a bandwidth B_1, sufficiently larger than the bandwidth B_2, which is desired for the overall control system.

$$F_1(s) = \frac{V(s)}{W(s)} = \frac{R_1(s)H(s)}{1 + R_1(s)H(s)}. \tag{2}$$

2) Choose $R_2(s)$ according to classical design criteria for stability, performance, and robustness, under the ideal assumption that

$$F_1(s) = 1. \tag{3}$$

Step 2 of the preceding procedure can be performed by initially assigning an
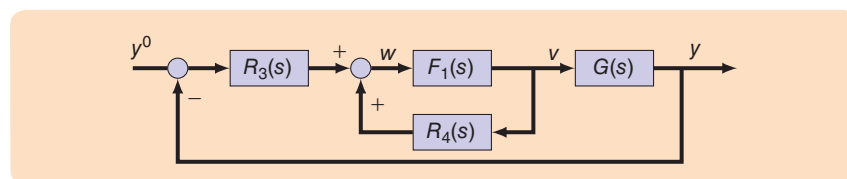

FIGURE 2 Block diagram of robust structure.

"ideal" value $F_{2i}(s)$ to the transfer function $F_2(s)$ between $y^0(t)$ and $y(t)$, which meets all the design specifications.

$$F_2(s) = \frac{Y(s)}{Y^0(s)} = F_{2i}(s). \tag{4}$$

Whenever Step 1 of the algorithm is not completed successfully, the validity of Eq. (3) cannot be assumed in synthesizing $R_2(s)$.

ROBUST STRUCTURE

A possible alternative to the control scheme of Fig. 1, called robust structure, is illustrated in Fig. 2. The configuration in Fig. 2 satisfies the Eq. (4) provided that

$$R_3(s) = \frac{F_{2i}(s)}{G(s)} \tag{8a}$$

$$R_4(s) = F_{2i}(s). \tag{8b}$$

There is a basic difference between the scheme of Fig. 1 and that of Fig. 2, which renders the second scheme advantageous for practical applications. The design of the pair $R_3(s)$, $R_4(s)$ is completely independent of the design of $R_1(s)$ and does not require any assumption on $F_1(s)$. This fact confers peculiar robustness properties to the robust structure.

CONCLUSIONS

With the aim of devising a new control concept, combining good performance in nominal conditions with enhanced robustness to process parameter variations, a cascade control structure has been proposed, endowed with the following basic properties:

1) Independent design of cascaded control loops;
2) Ability to make outer loop stability (and response) independent of the possible parameter variations affecting the inner loops;
3) Intrinsic avoidance of windup problems for the upstream controllers in the cascade; and
4) Robustness with respect to single-loop model errors comparable with classical design (e.g., PID control).

In addition to these basic properties, it is shown in an application that the complexity of the resulting controller is comparable with that of classical cascade controllers. Finally, it is worth noting that the design method can be applied directly to deal with any number of nested cascaded control loops.

REFERENCE
[1] P. Harriott, *Process Control*. New York: McGraw-Hill, 1964.