AGENDA

2012 CINS Annual Seminar

Session Two

Date: 17 August 2012

Venue: Broad Room, Building 18, Rockhampton Campus

Agenda and Title	Presenter	Time Slot
1. On Sampled-Data Fuzzy Control Design for T-S Model-Based Fuzzy Systems	Dr Xiefu Jiang	8:30am-9:20am
2. Distributed Fault Detection Filtering for Sensor-Network-Based Systems	Mr Xiaohua Ge	9:20am-10:10am
Morning Tea		10:10am-10:30am
3. Network-Based H_∞ Fault Tolerant Control for Superheated Steam Temperature System	Dr Gu Zhou	10:30am-11:20am
4. Event-Triggered L_2 Controller Design of Networked Control Systems with Quantized Measurement	Mr Yanpeng Guan	11:20am-12:10pm
Lunch		12:10pm-1:30pm
5. Network-Based H_∞ Filtering for Stochastic Linear Systems	Dr Xian-Ming Zhang	1:30pm-2:20pm
6. Networked Control and Filtering Based on Network Dynamics	Mr Yufeng Lin	2:20pm-3:10pm
Afternoon Tea		3:10pm-3:30pm
7. Network-Based Leader-Following Consensus of Multi-Agent Systems	Mr Lei Ding	3:30pm-4:20pm
Group Discussion		4:20pm-5:00pm

Abstracts

Presenter: Dr Xiefu Jiang

Title: On Sampled-Data Fuzzy Control Design for T-S Model-Based Fuzzy Systems

Abstract: A sampled-data fuzzy controller design method for Takagi-Sugeno (T-S) model-based fuzzy systems is given. The T-S model-based fuzzy system is approximated by T-S model-based discrete fuzzy systems with parameter uncertainties. A sufficient condition on the existence of the sampled-date fuzzy controller for the fuzzy system is formulated in the form of linear matrix inequalities. No slack matrix variable is introduced. Finally, a simulation example is discussed to show the effectiveness of the obtained design approach.

Biography: Xiefu Jiang obtained his PhD from Southeast University, Nanjing, China. He is a professor at Hangzhou Dianzi University. He is specialized and experienced in research and teaching in the areas of analysis and synthesis of time-delay systems, sampled-data systems, networked control systems and fuzzy systems. His publication has attracted significant interest with 547 SCI citations (sum of times cited without self-citations is 525) and h-index of 9.

Presenter: Mr Xiaohua Ge

Title: Distributed Fault Detection Filtering for Sensor-Network-Based Systems

Abstract: Sensor networks are composed of a broad variety of sensor nodes which are usually deployed densely either inside the phenomenon or very close to it, with limited power, limited sensing, computation, communication capabilities, and frequently changed or random sensing topology. The problem of fault detection (FD) is motivated by the need to develop more autonomous and intelligent systems that operate reliably in the presence of system faults which are characterized by critical and unpredictable changes in the system dynamics and network components. Compared with traditional fault detection filtering (FDF) schemes, an effective distributed fault detection filtering (DFDF) algorithm (1) can be suitable in many practical network-based and/or physically distributed systems; (2) can effectively ease the computational burden in the so-called fusion center of the traditional ones; (3) can significantly reduce the communication bandwidth requirement. For the first time, attention of this paper is focused on the DFDF problem for a class of sensor-network-based system framework. Due to random network dynamics and sensor node mobilities, the system behaviour changes and sensing topology are modelled by a Markovian process. Then each sensor node can effectively communicate with certain finite nodes, typically those that lie in its vicinity or in its neighbouring set, and switch among certain sensing modes via the Markovian switching rule. Intensive stochastic analysis and design procedures are finally carried out in order to establish a unified framework that caters the simultaneous presence of randomly sensing topology, uncertain network-induced delays and consecutive data packed dropouts.

Biography: Xiaohua Ge was born in Jiangxi, P.R. China, in 1987. He received the B.Eng. degree in Electronic Information Engineering from Nanchang Hangkong University, Nanchang, P.R. China, in 2008 and the M.Eng. degree in Control Theory and Control Engineering from Hangzhou Dianzi University, P.R. China, in 2011. He is currently working toward the Ph.D. degree in the School of Information and Communication Technology, the Centre for Intelligent and Networked Systems, Central Queensland University, Rockhampton, Australia. He has authored and co-authored 10 papers published in refereed journals and conference proceedings. His research interests include robust control, H-infinity filtering/state estimation, as well as time-delay/sampled-data/network-based systems.

Presenter: Dr Gu Zhou

Title: Network-Based H_∞ Fault Tolerant Control for Superheated Steam Temperature System

Abstract: This presentation is concerned with the problem of network-based fault tolerant control for superheated steam temperature system with limited network bandwidth. A novel network data-transmitting mechanism that mainly depends on the relative error between the current sampled-data and the last released data is put forward, thereby reducing the amount of

released packets greatly, and thus the network load decreases dramatically. Combining the proposed network data-transmitting mechanism and stochastic actuator fault model, a comprehensive model is developed for network-based superheated steam temperature control system. Then fault tolerant *H*∞ controllers within the framework of cascade control strategy are derived in terms of linear matrix inequities, which guarantee the requirement of H_∞ performance criterion under the possible actuator fault cases. Finally, a superheated steam model is used to demonstrate the effectiveness of our proposed design techniques.

Biography: Zhou Gu received the B.S. degree from North China Electric Power University, Beijing, China in 1997 and the M.S. and Ph.D. degrees from Nanjing University of Aeronautics and Astronautics, Nanjing, China, in 2007 and 2010, respectively. Currently, he is an associate professor at Nanjing Normal University. From September 2011 to September 2012, he was a visiting associate professor with Central Queensland University, Rockhampton, Qld., Australia. His current research interests include networked control systems, Takegi–Sugeno (T–S) fuzzy systems, and fault tolerant control.

Presenter: Mr Yanpeng Guan

Title: Event-Triggered L_2 Controller Design of Networked Control Systems with Quantized Measurement

Abstract: This presentation considers L_2 control for a networked control system with quantized measurement. The system state is periodically sampled and quantized. An event-triggered transmitter is introduced to determine whether or not the current quantized measurement should be transmitted through the communication channel to the controller. In this new event-triggered networked control system framework, a networked controller is designed to guarantee the L_2stability of the closed-loop system. A numerical example is given to demonstrate the effectiveness of the proposed method. It is shown that the average transmission interval could be increased substantially while the control performance is maintained.

Biography: Yanpeng Guan received his B.Sc. degree in Mathematics and M.Sc. degree in Control Theory & Control Engineering in 2005 and 2010, respectively. Since March 2010, he has been a PhD student in CQUniversity. He works at the Centre for Intelligent and Networked Systems. His research interests include networked control systems, time-delay systems, sampled-data systems and fuzzy systems.

Presenter: Dr Xian-Ming Zhang

Title: Network-Based H_∞ Filtering for Stochastic Linear Systems

Abstract: This paper is concerned with network-based H-infinity filtering for a stochastic system, where data transmission from the stochastic system to a filter is completed via a communication network. Network-induced delays, packet dropouts and packet disorders are unavoidable due to the use of the network. First, a logic zero-order-hold (ZOH) is designed to discard the disordered packets actively. The network-induced delays and packet dropouts are modeled as an interval time-varying delay. By decomposing the delay interval into *N* subintervals uniformly, the filter to be designed is modeled as *a Markov jumping filter* with *N* modes governed by a Markov chain. In order to work out the transition rate from one mode to another, a *logic jumping-like trigger* is embedded into the logic ZOH to *simulate* the switching of the Markov process. Second, based on the Markov jumping filter model together with a new integral inequality in the stochastic setting, a novel bounded real lemma is presented to ensure that the resultant filtering error system is mean exponentially stable with a prescribed H-infinity performance. Then, a sufficient condition on the existence of desired Markov jumping filters is provided in terms of a set of linear matrix inequalities. Finally, an air vehicle system is employed to show effectiveness of the proposed design method.

Biography: Xian-Ming Zhang received the M.S. degree in applied mathematics and the Ph.D. degree in control theory and engineering from the Central South University, Changsha, China, in 1991 and 2006, respectively. He is currently a Senior Post-Doctoral Research Fellow with the Centre for Intelligent and Networked Systems, Central Queensland University, Rockhampton, Australia. He has published more than 40 research articles/papers in referred journals and conferences in the area of control theory and control engineering. His publications have attracted significant interest with 429 citations and h-index

of 10 (According to ISI Web of Science, access date: 30 Jul 2012). His current research interests include networked control systems, time-delay systems, neural networks, and robust filtering.

Presenter: Mr Yufeng Lin

Title: Networked Control and Filtering Based on Network Dynamics

Abstract: This presentation is concerned with control and filtering of networked control systems by constructing a novel middleware framework of scheduling information. In this middleware framework, an event-triggered scheme is developed to abstract the characteristics of the network and the control requirement to reduce the communication bandwidth, and a fluid-flow model reflecting network dynamics characteristics is addressed to regulate traffic congestion and manage network-induced time delays as well as mapping time delay influence. Based on this middleware framework of scheduling information, the problems of control and filtering of networked control systems are investigated by using Lyapunov-Krasovskii functional theory. Some numerical and practical examples are given to illustrate the merits and effectiveness of the proposed results.

Biography: Yufeng Lin received B.Sc. degree in Information and Computing Science in 2005 and M.Sc. degree in Operational Research and Cybernetics in 2008, both from Northeastern University, Shenyang, China. Currently, he is pursuing his Ph.D. degree in Central Queensland University, Australia. Yufeng Lin's research interests include networked control systems, information scheduling, control and filtering.

Presenter: Mr Lei Ding

Title: Network-Based Leader-Following Consensus of Multi-Agent Systems

Abstract : Consensus of multi-agent systems, which means that all agents' states converge to the same vector under agents' interactions, has recently drawn considerable attention due to it wide applications in many fields such as formation control, sensor networks, attitude of spacecraft alignment, and so on. This paper is to investigate network-based leader-following consensus of multi-agent systems, where a communication network is utilized to transmit the data information among agents and to support feedback control for each agent. A network-based consensus control protocol under a directed graph is proposed. With this protocol, each agent in the distributed multi-agent system can be remotely controlled via a communication network. A new delay-dependent stability criterion for an error system is derived by constructing a novel Lyapunov-Krosovskii functional with digraph information. Then, employing this stability criterion, a delay-dependent sufficient condition for the existence of network-based consensus controllers, which ensure that the following-agent's states can reach an agreement on the leader's state, is formulated in terms of linear matrix inequalities. A numerical example is given to illustrate the effectiveness of the obtained results.

Biography: Lei Ding received the B.S. and M.S degree in control theory and control engineering from Dalian Maritime University, Dalian, China, in 2007 and 2009, respectively. He is currently pursuing a Ph.D degree in control theory and control engineering at Dalian Maritime University, Dalian, China. Since 2010.12-present, he has been visiting Centre for Intelligent and Network Systems, Central Queensland University, Rockhampton, QLD, Australia. His research interests include consensus of multi-agent systems, formation control and underactuated ship control.