PUBLISHED VERSION

Yun-Bo Zhao, Xi-Ming Sun, Jinhui Zhang, and Peng Shi
Recent advances on the theory and applications of networked control systems
Mathematical Problems in Engineering, 2015; 2015:239620-1-239620-2

Copyright © 2015 Yun-Bo Zhao et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Originally published at:
http://doi.org/10.1155/2015/239620

PERMISSIONS

http://creativecommons.org/licenses/by/3.0/

17 August 2016

http://hdl.handle.net/2440/99145

Hindawi Publishing Corporation
Mathematical Problems in Engineering
Volume 2015, Article ID 239620, 2 pages
http://dx.doi.org/10.1155/2015/239620

Editorial

Recent Advances on the Theory and Applications of Networked Control Systems

Yun-Bo Zhao,[1] Xi-Ming Sun,[2] Jinhui Zhang,[3] and Peng Shi[4,5]

[1]*Department of Automation, Zhejiang University of Technology, Hangzhou 310023, China*
[2]*Research Center of Information and Control, Dalian University of Technology, Dalian 116024, China*
[3]*College of Information Science and Technology, Beijing University of Chemical Technology, Beijing 100029, China*
[4]*College of Automation, Harbin Engineering University, Harbin, Heilongjiang 150001, China*
[5]*School of Electrical and Electronic Engineering, University of Adelaide, Adelaide, SA 5005, Australia*

Correspondence should be addressed to Yun-Bo Zhao; yunbo.zhao@imperial.ac.uk

Received 10 March 2015; Accepted 10 March 2015

Copyright © 2015 Yun-Bo Zhao et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Networked control systems (NCSs) are control systems whose control links are closed via some form of communication networks [1, 2]. These communication networks can be either control-oriented, such as the control area network and the DeviceNet, or data networks such as the Internet which are not particularly optimized for real-time control systems. The former type of NCSs, often referred to as remote control systems, has long been an active topic in control theory and has already been successfully implemented in various industrial applications. However, it is the latter that has made NCSs an emerging research field in the recent decades, posing a number of great challenges for the control community as well as proposing even more potentially exciting applications in the future [3, 4]. Indeed, the data networks used in NCSs are featured by ubiquitous access and high throughput but have no real-time transmission or data consistency guarantee. These features have made NCSs cost-effective, maintainness-friendly, readily extendible, and reconfigurable but left a number of open questions to deal with as well [5–7].

The interest in NCSs originates with the control community, and therefore it is no wonder why NCSs have usually been regarded as control systems with only some special features, that is, the use of the data networks. With this perspective, various conventional control methods have found their applications to NCSs, contributing a major part in the early days to the research on NCSs [8]. People soon realized that the communication networks should not be only modelled as given parameters to the control systems. The active use of, or even the modification of, the communication networks can potentially give rise to much better systems performance. In fact, the codesign approach, that is, the integration of both control and communication, can be the ideal approach to NCSs [9–12].

In this special issue, a dozen of research works on NCSs and the related topics are reported. We are proud to notice that these limited numbers of research works have shown a great variety and in a sense give a fairly complete picture of the state-of-the-art research on NCSs. In addition, a brief tutorial on NCSs from the Editorial Board is also included in this special issue.

This special issue is organized in the following way.

First, theoretical studies constitute the major part of the works reported here. Various control methods have been used, for example, H_∞ output feedback control (S. H. Kim), guaranteed cost fault tolerant control (Y. Zhu et al.), and model predictive control (Q. Chen et al. and M. Li et al.). The authors have also considered different design and analysis issues in NCSs, for example, the stability of the closed-loop system (S. W. Yun et al. and A. F. Khalil and J. Wang), the robust design of NCSs (Z. Lu et al.), and the quantization effect (S. W. Yun et al.).

These theoretical studies from mainly the control perspective are then balanced with research works that have taken active consideration of the communication networks

in NCSs. These include, for example, a codesign approach which integrates an event generator and a dynamic output feedback controller (D. Ma et al.) and the energy balanced redeployment algorithm for the wireless version of NCSs (G. Ye et al.). This type of works then further leads to a more network-based perspective, as seen in the works done by M. Manzano et al. and L. Du et al., where access control in ad hoc networks and pinning synchronization of switched complex dynamical networks are considered.

Finally, the special issue is concluded by the exciting applications of NCSs, which include, for example, distributed fault estimation applied to robotic manipulator (J. Chen et al.), banknote validation using RFID and NFC techniques (M. H. Eldefrawy and M. K. Khan), and the control and optimization of smart homes (J. Lai et al.).

To conclude, we believe that this Special Issue contains sufficiently interesting materials on NCSs and the related topics, both in theory and in applications. We hope this special issue will be a useful reference for people working on NCSs, and more fruitful results will be obtained in the time ahead based on the published works.

Acknowledgment

We are very grateful to the great support and encouragement from publishing and Editorial Board of this journal, which have made this project possible and successful.

Yun-Bo Zhao
Xi-Ming Sun
Jinhui Zhang
Peng Shi

References

[1] J. P. Hespanha, P. Naghshtabrizi, and Y. Xu, "A survey of recent results in networked control systems," *Proceedings of the IEEE*, vol. 95, no. 1, pp. 138–172, 2007.

[2] F.-Y. Wang and D. Liu, Eds., *Networked Control Systems: Theory and Applications*, Springer, London, UK, 1st edition, 2008.

[3] J. Baillieul and P. J. Antsaklis, "Control and communication challenges in networked real-time systems," *Proceedings of the IEEE*, vol. 95, no. 1, pp. 9–28, 2007.

[4] G. N. Nair, F. Fagnani, S. Zampieri, and R. J. Evans, "Feedback control under data rate constraints: an overview," *Proceedings of the IEEE*, vol. 95, no. 1, pp. 108–137, 2007.

[5] R. A. Gupta and M.-Y. Chow, "Networked control system: overview and research trends," *IEEE Transactions on Industrial Electronics*, vol. 57, no. 7, pp. 2527–2535, 2010.

[6] Y.-B. Zhao and G.-P. Liu, "Packet-based communication and control co-design for networked control systems," in *Frontiers of Intelligent Control and Information Processing*, chapter 5, pp. 151–174, World Scientific Publishing, Singapore, 2014.

[7] M. Zhu and S. Martinez, "On the performance analysis of resilient networked control systems under replay attacks," *IEEE Transactions on Automatic Control*, vol. 59, no. 3, pp. 804–808, 2014.

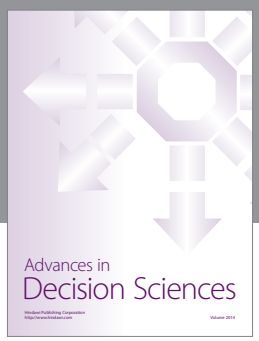
[8] T. C. Yang, "Networked control system: a brief survey," *IEE Proceedings: Control Theory and Applications*, vol. 153, no. 4, pp. 403–412, 2006.

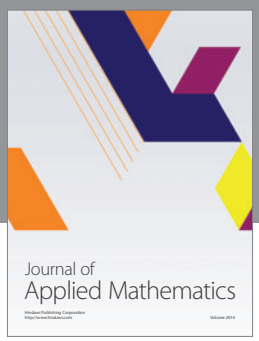
[9] Y. B. Zhao, G. P. Liu, and D. Rees, "Integrated predictive control and scheduling co-design for networked control systems," *IET Control Theory & Applications*, vol. 2, no. 1, pp. 7–15, 2008.

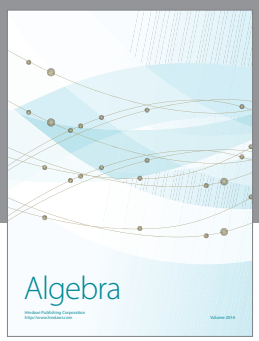
[10] S.-L. Dai, H. Lin, and S. S. Ge, "Scheduling-and-control codesign for a collection of networked control systems with uncertain delays," *IEEE Transactions on Control Systems Technology*, vol. 18, no. 1, pp. 66–78, 2010.

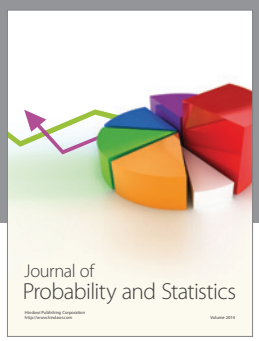
[11] S. Longo, G. Herrmann, and P. Barber, "Robust scheduling of sampled-data networked control systems," *IEEE Transactions on Control Systems Technology*, vol. 20, no. 6, pp. 1613–1621, 2012.

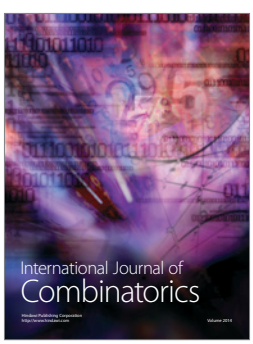
[12] R. Postoyan and D. Nesic, "A framework for the observer design for networked control systems," *IEEE Transactions on Automatic Control*, vol. 57, no. 5, pp. 1309–1314, 2012.

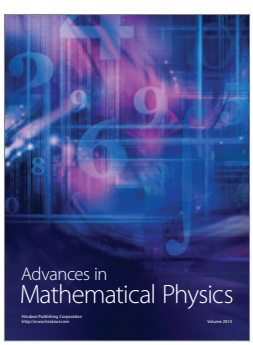


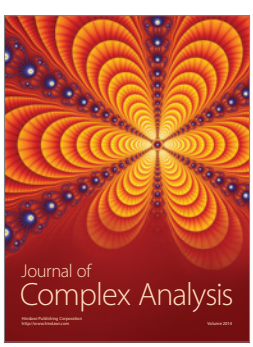


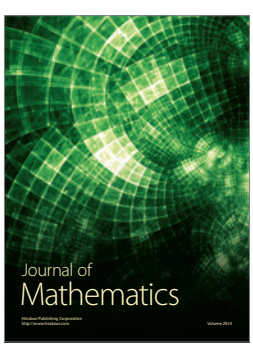


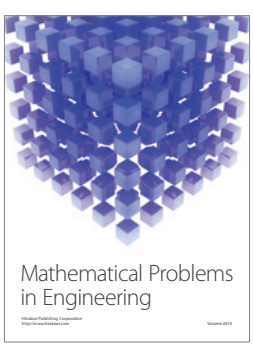


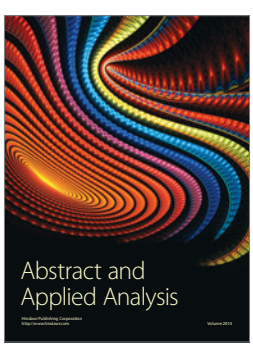


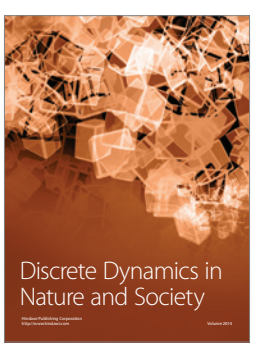


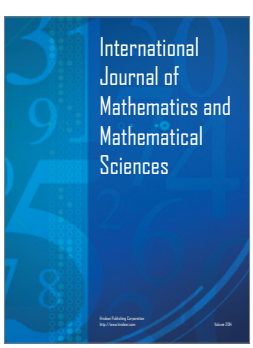


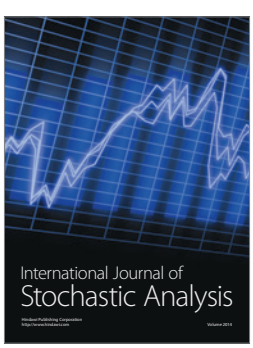












Hindawi

Submit your manuscripts at
http://www.hindawi.com