

Resume

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Education:

1988 Ph. D. in Systems Engineering, Xi'an Jiaotong University, Xi'an, China
1985 M. S. in Systems Engineering, Xi'an Jiaotong University, Xi'an, China
1982 B. S. in Electrical Engineering, Anhui University of Technology, Huainan, China

Research interests:

- Intelligent manufacturing
- Discrete event systems, and Petri net theory and applications
- Production planning, scheduling and control
- Intelligent logistics and transportation
- Energy systems

Experience:

JAN. 2021 - present Macau University of Science and Technology, Chair Professor at the Institute of Systems Engineering
JUL. 2013 - Dec. 2020 Macau University of Science and Technology, Professor at the Institute of Systems Engineering
SEP. 1998 - 2013 Guangdong University of Technology, Professor & Head of the Department of Industrial Engineering
JUN. 2010 - OCT. 2011 Visiting Professor, Laboratoire Informatique, Biologie Integrative et Systemes Complexes (IBISC), Universite d'Evry Val d'Essonne, France
JAN. 2007 -MAR. 2009 Visiting Professor, University of Technology of Troyes, France
MAY. 2004-AUG. 2004 Visiting professor, Department of Electrical and Computer Engineering, New Jersey Institute of Technology
AUG. 1999-DEC. 1999 Visiting professor, Department of Industrial Engineering, Arizona State University
MAY 1995- AUG. 1998 Shantou University, Shantou, China, Associate Professor of department of Mechatronics Engineering
AUG. 1993-MAY 1995 Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang, P. R. China, Associate Professor
OCT. 1991-OCT. 1992 School of Industrial Engineering, Purdue University, West Lafayette, Indiana, USA, Visiting Scholar
MAY 1988-JUL. 1993 Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang, P. R. China, Assistant Professor

Affiliations:

- [1] *Fellow* of IEEE, IEEE Systems, Man, and Cybernetics Society, and IEEE Robotics and Automation Society

Honors and Awards:

- [1] Third Class Award of Natural Science, Macau, 2018.
[2] Third Class Award of Technological Invention, Macau, 2016.
[3] Highly cited researchers in Thomson Reuters' Highly Cited Researchers 2012.
[4] First Class Prize of Natural Science of Guangdong Province, China, 2010.
[5] *Who's Who* in Science and Engineering (Marquis *Who's Who*), 7th Edition (2003-2004).
[6] *Who's Who* in Science and Engineering (Marquis *Who's Who*), 8th Edition (2005-2006).
[7] International Scientist of the Year 2004, The International Biographical Centre (IBC) of Cambridge, England.
[8] *Who's Who* in the World (Marquis *Who's Who*), 8th Edition (2007-2008).
[9] 2011 QSI Best Application Paper Award Finalist, for the paper "Modeling and Analysis of Dual-Arm Cluster Tools for Wafer Fabrication with Revisiting," by Y. Qiao, N. Wu, and M. C. Zhou, *2011 IEEE International Conference on Automation Science and Engineering*, Trieste, Italy, August 24 - 27, 2011.
[10] Best student paper award, for the paper "Real-time control policy for single-arm cluster tools with residency time constraints and activity time variation by using Petri net," By Y. Qiao, N. Q. Wu, and M. C. Zhou, *2012 IEEE International Conference on Networking, Sensing and Control*, Beijing, China, April 11-13, 2012.
[11] 2016 Best Conference Paper Award Finalist, for the paper "Optimizing close-down processes of single-robot cluster tools via linear programming," by Y. Qiao, M. C. Zhou, N. Q. Wu, Q. H. Zhu, and Z. W. Li, *2016 IEEE International Conference on Automation Science and Engineering*, Fort Worth, TX USA, August 21-24, 2016.

Professional Activities and Services:

[1] Conferences Served/Serving

- ◆ Editor in Chief of 2019 IEEE International Conference on Networking, Sensing and Control, Banff, Canada, May 9-11, 2019.
- ◆ General Cochair of 15th International Conference on Networking, Sensing and Control, Zhuhai, China, March 27-29, 2018.
- ◆ Editor of 2016 IEEE Conference on Automation Science and Engineering, Fort Worth, TX, USA, August 21-24, 2016.
- ◆ Program Chair, 2013 IEEE International Conference on Networking, Sensing and Control, Evry-Paris, France, April 10-12, 2013.
- ◆ Program Co-Chair, 2012 IEEE International Conference on Networking, Sensing and Control, Beijing, China, April 11-13, 2012.

[2] Editor

- ◆ Associate Editor: Information Sciences, 2017-
- ◆ Associate Editor: IEEE/CAA Journal of Automatica Sinica, 2015-
- ◆ Associate Editor: IEEE Transactions on Systems, Man, & Cybernetics, Part C, 2007-2012.
- ◆ Associate Editor: IEEE Transactions on Automation Science and Engineering, 2009-2012.
- ◆ Editor in Chief: Industrial Engineering Journal, 2009-2014.
- ◆ Associate Editor: IEEE Transactions on Systems, Man, & Cybernetics: Systems, 2013-2016.

[3] Serving as a Referee for funding agencies

- ◆ Chinese National Nature Scientific Foundation, Panel member, 2010-2012.

- ◆ Chinese National Nature Scientific Foundation, Reviewer, 2003-
- ◆ The Georgian National Science Foundation, Reviewer, 2009-

[4] *Invited lectures supported internationally*

- ◆ France: University of Technology of Troyes, 2004.
- ◆ China: Xidian University, 2006 and 2010.
- ◆ China: Southeast University, 2010.
- ◆ China: Northwestern Polytechnical University, 2015.

Selected Projects (as PI):

- [1] Optimal Scheduling and Control of Cluster Tools for Wafer Fabrication with Strict Process Constraints in Semiconductor Manufacturing, FDCT.
- [2] Maximally Permissive Supervisory Control of Resource Allocation Systems Based on Resource-Oriented Petri Nets, FDCT.
- [3] Short-Term Scheduling Optimization for Continuous Process Industry by Using Hybrid System Control Theory, FDCT.

Publications:

Book and book chapters:

- [1] **N. Q. Wu** and M. C. Zhou, *System modeling and control with resource-oriented Petri nets*, CRC Press, Taylor & Francis Group, New York, October 2009.
- [2] **N. Q. Wu** and M. C. Zhou, Resource-oriented Petri nets in deadlock prevention and avoidance, in M. C. Zhou and M. P. Fanti (Ed.), *Deadlock Resolution in Computer-Integrated Systems*, Marcel Dekker, NY, January 2005.
- [3] **N. Q. Wu** and M. C. Zhou, A resource-oriented Petri net approach to scheduling and control of time-constrained cluster tools in semiconductor fabrication, in Z. W. Li and A. M. Al-Ahmari (Ed.), *Formal Methods in Manufacturing Systems: Recent Advances*, IGI Global, New York, May, 2013.
- [4] Y. Qiao, **N. Q. Wu**, and M. C. Zhou, Real-time scheduling and control of single-arm cluster tools with residency time constraint and activity time variation by using resource-oriented Petri nets, in Z. W. Li and A. M. Al-Ahmari (Ed.), *Formal Methods in Manufacturing Systems: Recent Advances*, IGI Global, New York, May, 2013.
- [5] **N. Q. Wu**, M. C. Zhou, F. Chu, and S. Mammari, Modeling and scheduling of crude oil operations in refinery: a hybrid timed Petri net approach, in M. Khalgui, O. Mosbahi, and A. Valentini (Ed.), *Embedded Computing Systems: Applications, Optimization, and Advanced Design*, IGI Global, New York, May, 2013.
- [6] **N. Q. Wu**, M. C. Zhou, F. Chu, and S. Mammari, Modeling, Analysis, Scheduling and Control of Cluster Tools in Semiconductor Fabrication, in *Contemporary Issues in Systems Science and Engineering*, Edited by M. C. Zhou, H.-X. Li and M. Weijnen, Wiley/IEEE Press, Hoboken, NJ, pp. 289-315, 2015.

Selected journal articles:

2020

- [1] Q. L. Wei, X. Wang, X. N. Zhong, and **N. Q. Wu**, Consensus control of leader-following multi-agent systems in directed topology with heterogeneous disturbances, *IEEE/CAA journal of Automatica Sinica*, Accepted.
- [2] Y. H. Pan, **N. Q. Wu**, T. Qu, P. Z. Li, K. Zhang, and H. F. Guo, Digital-twin-driven production logistics synchronization system for vehicle routing problems with pick-up and delivery in industrial

- park, *International Journal of Computer Integrated Manufacturing*, online, DOI: [10.1080/0951192X.2020.1829059](https://doi.org/10.1080/0951192X.2020.1829059).
- [3] W. Q. Xiong, C. R. Pan, Y. Qiao, **N. Q. Wu**, M. X. Chen, and P. H. Hsieh, Reducing wafer delay time by robot idle time regulation for single-arm cluster tools, *IEEE Transactions on Automation Science and Engineering*, online, DOI: 10.1109/TASE.2020.3014078.
- [4] Y. H. Pan, T. Qu, **N. Q. Wu**, H. F. Guo, M. Khalgui, and G. Q. Huang, Digital twin based real-time production logistics synchronization system in a multi-level computing architecture, *Journal of Manufacturing Systems*, accepted.
- [5] J. Liu, **N. Q. Wu**, Y. Qiao, and Z. W. Li, Short-term traffic flow forecasting using ensemble approach based on deep belief networks, *IEEE Transactions on Intelligent Transportation Systems*, online, DOI: 10.1109/TITS.2020.3011700.
- [6] G. H. Zhu, L. Feng, Z. W. Li, and **N. Q. Wu**, An efficient fault diagnosis approach based on integer linear programming for labeled Petri nets, *IEEE Transactions on Automatic Control*, online, DOI: 10.1109/TAC.2020.3008712.
- [7] X. B. Li, Z. H. Yu, Z. W. Li, and **N. Q. Wu**, Group consensus via pinning control for a class of heterogeneous multi-agent systems with input constraints, *Information Sciences*, Accepted.
- [8] Z. C. Liu, **N. Q. Wu**, Y. Qiao, Z. W. Li, Performance evaluation of public bus transportation by using DEA models and Shannon's entropy: an example from a company in a large city of China, *IEEE/CAA Journal of Automatica Sinica*, accepted.
- [9] Z. Y. Yang, **N. Q. Wu**, Y. Liang, H. Zheng, and Y. Q. Ren, SMSPL: Robust multimodal approach to integrative analysis of multi-omics data, *IEEE Transactions on Cybernetics*, online, DOI: 10.1109/TCYB.2020.3006240.
- [10] F. J. Yang, **N. Q. Wu**, Y. Qiao, M. C. Zhou, R. Su, and C. J. Zhang, (Digital Twin) Wafer sojourn time fluctuation analysis for time-constrained dual-arm multi-cluster tools with activity time variation, *International Journal of Computer Integrated Manufacturing*, online, DOI: 10.1080/0951192X.2020.1718767, 2020.
- [11] Y. Qiao, M. C. Zhou, **N. Q. Wu**, Z. W. Li, and Q. H. Zhu, Closing-down optimization for single-arm cluster tools subject to wafer residency time constraints, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, online, DOI: 10.1109/TSMC.2020.2964032.
- [12] Q. H. Zhu, M. C. Zhou, Y. Qiao, **N. Q. Wu**, and Y. Hou, Multiobjective scheduling of dual-blade robotic cells in wafer fabrication, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, online, DOI: 10.1109/TSMC.2019.2944866.
- [13] H. F. Chen, **N. Q. Wu**, Z. W. Li, and T. Qu, Decision on maximal permissiveness of linear constraints via structural analysis of a subclass of Petri nets, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, online, DOI: 10.1109/TSMC.2019.2930736.
- [14] Y. Qiao, S. W. Zhang, **N. Q. Wu**, M. C. Zhou, Z. W. Li, and T. Qu, Efficient approach to failure response of process module in dual-arm cluster tools with wafer residency time constraints, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, online, DOI: 10.1109/TSMC.2019.2899590.
- [15] O. Karoui, Y. F. Chen, Z. W. Li, **N. Q. Wu**, and M. Khalgui, On hierarchical construction of the state space of an automated manufacturing system modeled with Petri nets, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 50, no. 10, 3613-3627, Oct. 2020.
- [16] F. J. Yang, Y. Qiao, K. Z. Guo, **N. Q. Wu**, Y. T. Zhu, I. W. Simon, and R. Su, Efficient approach to scheduling of transient processes for time-constrained single-arm cluster tools with parallel chambers, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 50, no. 10, 3646-3657, Oct. 2020.

- [17] Z. P. Xu, Y. Wang, **N. Q. Wu**, and X. C. Fu, Propagation dynamics of a periodic epidemic model on weighted interconnected networks, *IEEE Transactions on Network Science and Engineering*, vol. 7, no. 3, 1545-1556, Sep. 2020.
- [18] F. J. Yang, X. Tang, **N. Q. Wu**, C. J. Zhang, and L. Gao, Wafer residency time analysis for time-constrained single-robot-arm cluster tools with activity time variation, *IEEE Transactions on Control Systems Technology*, vol. 28, no. 4, 1177-1188, Jul. 2020.
- [19] I. Saadaoui, Z. W. Li, and **N. Q. Wu**, Current-state opacity modeling and verification in partially observed Petri nets, *Automatica*, vol. 116, Article 108907, Jun. 2020.
- [20] Y. Hou, **N. Q. Wu**, Z. W. Li, and Y. X. Zhang, T. Qu, and Q. H. Zhu, Many-objective optimization for scheduling of crude oil operations based on NSGA-III with consideration of energy efficiency, *Swarm and Evolutionary Computation*, vol. 57, Paper NO. 100714, Sep. 2020.
- [21] Q. H. Zhu, Y. Qiao, **N. Q. Wu**, and Y. Hou, Post-processing time-aware optimal scheduling of single robotic cluster tools, *IEEE/CAA Journal of Automatica Sinica*, vol. 7, no. 2, 597-605, Feb. 2020.
- [22] F. J. Yang, **N. Q. Wu**, Y. Qiao, M. C. Zhou, R. Su, and T. Qu, Modeling and optimal cyclic scheduling of time-constrained single-robot-arm cluster tools via Petri nets and linear programming, *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 50, no. 3, 871-883, Mar. 2020.
- [23] G. Y. Liu, L. C. Zhang, L. Chang, A. Al-Ahmari, and **N. Q. Wu**, Robust deadlock control for automated manufacturing systems based on elementary siphon theory, *Information Sciences*, vol. 510, 165-182, 2020.

2019

- [24] Y. T. Li, L. Yin, Y. F. Chen, Z. H. Yu, and **N. Q. Wu**, Optimal Petri net supervisor synthesis for forbidden state problems using marking mask, *Information Sciences*, vol. 505, 183-197, Dec. 2019.
- [25] Y. Qiao, S. W. Zhang, **N. Q. Wu**, X. Wang, Z. W. Li, M. C. Zhou, and T. Qu, Data-driven approach to optimal control of ACC systems and layout design in large rooms with thermal comfort consideration by using PSO, *Journal of Cleaner Production*, vol. 236, Article 117578, Nov. 2019.
- [26] X. Y. Cong, A. R. Wang, Y. F. Chen, **N. Q. Wu**, T. Qu, M. Khalgui, and Z. W. Li, Most permissive liveness-enforcing Petri net supervisors for discrete event systems via linear monitors, *ISA Transactions*, vol. 92, 145-154, Sep. 2019.
- [27] G. Y. Liu, P. Li, Z. W. Li, and **N. Q. Wu**, Robust deadlock control for automated manufacturing systems with unreliable resources based on Petri net reachability graphs, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 49, no. 7, 1371-1385, Jul. 2019.
- [28] H. F. Chen, **N. Q. Wu**, Z. W. Li, and T. Qu, On a maximally permissive deadlock prevention policy for automated manufacturing systems by using resource-oriented Petri nets, *ISA Transactions*, vol. 80, 67-76, Jun. 2019.
- [29] Y. Qiao, **N. Q. Wu**, F. J. Yang, M. C. Zhou, Q. H. Zhu, and T. Qu, Robust scheduling of time-constrained dual-arm cluster tools with wafer revisiting and activity time disturbance, *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 49, no. 6, 1228-1240, Jun. 2019.
- [30] C. F. Zhong, W. L. He, Z. W. Li, **N. Q. Wu**, and T. Qu, Deadlock analysis and control using Petri net decomposition techniques, *Information Sciences*, vol. 482, 440-452, May 2019.
- [31] J. Wang, Y. F. Zhang, Y. Liu, and **N. Q. Wu**, Multiagent and bargaining-game-based real-time scheduling for Internet of Things-enabled flexible job shop, *IEEE Internet of Things Journal*, vol. 6, no. 2, 2518-2531, Apr. 2019.

- [32] Q. H. Zhu, Y. Qiao, and **N. Q. Wu**, Optimal integrated schedule of entire process of dual-blade multi-cluster tools from start-up to close-down, *IEEE/CAA Journal of Automatica Sinica*, vol. 6, no. 2, 553-565, Mar. 2019.
- [33] G. H. Zhu, Z. W. Li, **N. Q. Wu** and A. Al-Ahmari, Fault identification of discrete event systems modeled by Petri nets with unobservable transitions, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 49, no. 2, 333-345, Feb. 2019.

2018

- [34] C. Gu, X. Wang, Z. W. Li, and **N. Q. Wu**, Supervisory control of state-tree structures with partial observation, *Information Sciences*, vol. 465, 523-544, Oct. 2018.
- [35] Z. Y. Jiang, Z. W. Li, **N. Q. Wu**, and M. C. Zhou, A Petri net approach to fault diagnosis and restoration for power transmission systems to avoid the output interruption of substations, *IEEE Systems Journal*, Vol. 12, no. 3, 2566-2579, Sep. 2018.
- [36] G. H. Zhu, Z. W. Li, and **N. Q. Wu**, Model-based fault identification of discrete event systems using partially observed Petri nets, *Automatica*, vol. 96, 201-212, Jul. 2018.
- [37] F. J. Yang, **N. Q. Wu**, K. Z. Gao, C. J. Zhang, Y. T. Zhou, R. Su, and Y. Qiao, Efficient approach to cyclic scheduling of single-arm cluster tools with chamber cleaning operations and wafer residency time constraint, *IEEE Transactions on Semiconductor Manufacturing*, vol. 31, no. 2, 196-205, May 2018.
- [38] C. R. Pan, M. C. Zhou, Y. Qiao, and **N. Q. Wu**, Scheduling cluster tools in semiconductor manufacturing: recent advances and challenges, *IEEE Transactions on Automation Science and Engineering*, vol. 15, no. 2, 586-601, Apr. 2018.
- [39] Y. Qiao, **N. Q. Wu**, F. J. Yang, M. C. Zhou, and Q. H. Zhu, Wafer sojourn time fluctuation analysis of time-constrained dual-arm cluster tools with wafer revisiting and activity time variation, *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 48, no. 4, 622-636, Apr. 2018.
- [40] Q. H. Zhu, M. C. Zhou, Y. Qiao, and **N. Q. Wu**, Petri net modeling and scheduling of a close-down process for time-constrained single-arm cluster tools, *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 48, no. 3, 389-400, Mar. 2018.
- [41] F. J. Yang, **N. Q. Wu**, Y. Qiao, and M. C. Zhou, Optimal one-wafer cyclic scheduling of hybrid multirobot cluster tools with tree topology, *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 48, no. 2, 289-298, Feb. 2018.
- [42] H. M. Zhang, L. Feng, **N. Q. Wu**, and Z. W. Li, Integration of learning-based testing and supervisory control for requirements conformance of black-box reactive systems, *IEEE Transactions on Automation Science and Engineering*, vol. 15, no. 1, 2-15, Jan. 2018.
- [43] X. Wang, Y. Qiao, **N. Q. Wu**, Z. W. Li, and T. Qu, On optimization of thermal sensation satisfaction rate and energy efficiency of public rooms: A case Study, *Journal of Cleaner Production*, vol. 176, 990-998, Jan. 2018.
- [44] F. J. Yang, **N. Q. Wu**, Y. Qiao, and M. C. Zhou, Polynomial approach to optimal one-wafer cyclic scheduling of treelike hybrid multi-cluster tools via Petri nets, *IEEE/CAA Journal of Automatica Sinica*, vol. 5, no. 1, 270-280, Jan. 2018.
- [45] S. H. Teng, **N. Q. Wu**, H. B. Zhu, L. Y. Teng, and W. Zhang, SVM-DT-Based adaptive and collaborative intrusion detection, *IEEE/CAA Journal of Automatica Sinica*, vol. 5, no. 1, 108-118, Jan. 2018.

2017

- [46] M. Liu, S. G. Wang, M. C. Zhou, D. Liu, A. Al-Ahmari, T. Qu, **N. Q. Wu**, and Z. W. Li, Deadlock and liveness characterization for a class of generalized Petri nets, *Information Sciences*, vol. 420, 403-416, Dec. 2017.
- [47] F. J. Yang, **N. Q. Wu**, Y. Qiao, and M. C. Zhou, Optimal one-wafer cyclic scheduling of time-constrained hybrid multicluster tools via Petri nets, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 47, no. 11, 2920-2932, Nov. 2017.
- [48] **N. Q. Wu**, Z. W. Li, and T. Qu, Energy efficiency optimization in scheduling crude oil operations of refinery based on linear programming, *Journal of Cleaner Production*, vol. 166, 49-57, Nov. 2017.
- [49] S. W. Zhang, **N. Q. Wu**, Z. W. Li, T. Qu, and C. D. Li, Petri net-based approach to short-term scheduling of crude oil operations with less tank requirement, *Information Sciences*, vol. 417, 247-261, Nov. 2017.
- [50] Y. Qiao, M. C. Zhou, **N. Q. Wu**, and Q. H. Zhu, Scheduling and control of startup process for single-arm cluster tools with residency time constraints, *IEEE Transactions on Control Systems Technology*, vol. 25, no. 4, pp. 1243-1256, Jul. 2017.
- [51] Q. H. Zhu, M. C. Zhou, Y. Qiao, and **N. Q. Wu**, Scheduling transient processes for time-constrained single-arm robotic multi-cluster tools, *IEEE Transactions on Semiconductor Manufacturing*, vol. 30, no. 3, 261-269, Aug. 2017.
- [52] Y. Hou, **N. Q. Wu**, M. C. Zhou, and Z. W. Li, Pareto-optimization for scheduling of crude oil operations in refinery via genetic algorithm, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 47, no. 3, 517-530, Mar. 2017.
- [53] F. J. Yang, **N. Q. Wu**, Y. Qiao, M. C. Zhou, and Z. W. Li, Scheduling of single-arm cluster tools for an atomic layer deposition process with residency time constraints, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 47, no. 3, 502-516, Mar. 2017.
- [54] Y. F. Chen, Z. W. Li, A. Al-Ahmari, N. Q. Wu, and T. Qu, Deadlock recovery for flexible manufacturing systems modeled with petri nets, *Information Sciences*, vol. 381, pp. 290-303, Mar. 2017.
- [55] Y. F. Chen, Z. W. Li, K. Barkaoui, **N. Q. Wu**, M. C. Zhou, Compact supervisory control of discrete event systems by Petri nets with data inhibitor arcs, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 47, no. 2, pp. 364-379, Feb. 2017.

2016

- [56] Y. M. Zhao, **N. Q. Wu**, Z. W. Li, and T. Qu, A novel solution approach to a priority-slot-based continuous-time mixed integer nonlinear programming formulation for a crude-oil scheduling problem, *Industrial & Engineering Chemistry Research*, vol. 55, no. 41, 10955-10967, Oct. 2016.
- [57] L. P. Bai, **N. Q. Wu**, Z. W. Li, and M. C. Zhou, Optimal one-wafer cyclic scheduling and buffer space configuration for single-arm multicluster tools with linear topology, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 46, no. 10, 1456-1467, Oct. 2016.
- [58] Y. F. Zhang, W. B. Wang, **N. Q. Wu**, and C. Qian, IoT-enabled real-time production performance analysis and exception diagnosis model, *IEEE Transactions on Automation Science and Engineering*, vol. 13, no. 3, 1318-1332, June 2016.
- [59] H. F. Chen, **N. Q. Wu**, and M. C. Zhou, A novel method for deadlock prevention of AMS by using resource-oriented Petri nets, *Information Sciences*, vol. 363, 178-189, Oct. 2016.
- [60] **N. Q. Wu**, M. C. Zhou, L. P. Bai, and Z. W. Li, Short-term scheduling of crude oil operations in refinery with high fusion point oil and two transportation pipelines, *Enterprise Information Systems*, vol. 10, no. 6, 581-610, May 2016.

- [61] **N. Q. Wu**, L. P. Bai, and M. C. Zhou, An efficient scheduling method for crude oil operations in refinery with crude oil type mixing requirements, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 46, no. 3, 413-426, Mar. 2016.

2015

- [62] C. R. Pan, Y. Qiao, **N. Q. Wu**, and M. C. Zhou, A novel algorithm for wafer sojourn time analysis of single-arm cluster tools with wafer residency time constraints and activity time variation, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 45, no. 5, 805-818, May 2015.
- [63] C. R. Pan, Y. Qiao, M. C. Zhou, and **N. Q. Wu**, Scheduling and analysis of start-up transient processes for dual-arm cluster tools with wafer revisiting, *IEEE Transactions on Semiconductor Manufacturing*, vol. 28, no. 2, 160-170, May 2015.
- [64] Y. Qiao, C. R. Pan, **N. Q. Wu**, and M. C. Zhou, Response policies to process module failure in single-arm cluster tools subject to wafer residency time constraints, *IEEE Transactions on Automation Science and Engineering*, vol. 12, no. 3, 1125-1139, Jul. 2015.
- [65] **N. Q. Wu**, M. C. Zhou, and Z. W. Li, Short-term scheduling of crude-oil operations: Petri net-based control-theoretic approach, *IEEE Robotics and Automation Magazine*, vol. 22, no. 2, 64-76, Jun. 2015.
- [66] Y. Qiao, **N. Q. Wu**, and M. C. Zhou, Schedulability and scheduling analysis of dual-arm cluster tools with wafer revisiting and residency time constraints based on a novel schedule, *IEEE Transactions on Systems, Man, & Cybernetics: Systems*, vol. 45, no. 3, 472-484, Mar. 2015.
- [67] Q. H. Zhu, **N. Q. Wu**, Y. Qiao, and M. C. Zhou, Scheduling of single-arm multi-cluster tools with wafer residency time constraints in semiconductor manufacturing, *IEEE Transactions on Semiconductor Manufacturing*, vol. 28, no. 1, 117-125, Feb. 2015.
- [68] Y. Qiao, **N. Q. Wu**, Q. H. Zhu, and L. P. Bai, Cycle time analysis of dual-arm cluster tools for wafer fabrication processes with multiple wafer revisiting times, *Computers & Operations Research*, vol. 53, 252-260, Jan. 2015.

Patents:

- [1] **N. Q. Wu**, F. J. Yang, Y. Qiao, M. C. Zhou, and Z. W. Li, Cluster tool apparatus and a method of controlling a cluster tool apparatus, *US Patent* 10,643,873 B2, Application No. 15/263,615, Granted May 5, 2020.
- [2] **N. Q. Wu**, F. J. Yang, L. P. Bai, M. C. Zhou, and Z. W. Li, Multi-cluster tool system and a method of controlling a multi-tool cluster system, *US Patent* 10,520,914 B2, Application No. 15/268,851, Granted Dec. 31, 2019.
- [3] L. P. Bai, **N. Q. Wu**, Z. W. Li, and M. C. Zhou, Optimal Buffer Space Configuration and Scheduling for Single-Arm Multi-cluster Tools, *Chinese Patent*, ZL201610018548.4, Granted Mar. 2019.
- [4] **N. Q. Wu**, F. J. Yang, Y. Qiao, and M. C. Zhou, System and method for determining an optimal schedule of a production line, *US Patent*, 10,101,721 B2, Application No. 14/920,026, October 16, 2018 (confirmed 2019).
- [5] Y. Qiao, M. C. Zhou, **N. Q. Wu**, Z. W. Li, and Q. H. Zhu, A cluster tool apparatus and a method of controlling a cluster tool apparatus, *US Patent*, 10,134,613 B2, Application No. 15/272,706, November 20, 2018.
- [6] **N. Q. Wu**, F. J. Yang, Y. Qiao, and M. C. Zhou, Petri net-based optimal one-wafer cyclic scheduling of treelike hybrid multi-cluster tools, *US Patent*, 10,073,444 B2, Application No. 62/221,038, September 11, 2018.

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