ZHE WU

Contact Information

Department of Chemical & Biomolecular Engineering
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Research Interests

Data science and machine learning; dynamics, control and optimization; chemical process control, safety and cybersecurity; artificial intelligence for engineering

Professional Experience

Department of Chemical & Biomolecular Engineering **Sept. 2021 – Present**
NUS Artificial Intelligence Institute **2024 – Present**
Assistant Professor, National University of Singapore, Singapore

Department of Computer Science **Oct. 2020 – Sept. 2021**
Postdoctoral Researcher, University of California, Los Angeles, CA, USA
Advisors: Prof. Quanquan Gu, Prof. Panagiotis D. Christofides

Education

University of California, Los Angeles, CA, USA **Sept. 2016 – Oct. 2020**

Ph.D., Chemical Engineering

- Advisor: Prof. Panagiotis D. Christofides

Zhejiang University, Hangzhou, China **Sept. 2012 – June 2016**

B.S., Control Science and Engineering (Ranking: 1/142)

- Advisors: Prof. Dong Ni, Prof. Panagiotis D. Christofides (UCLA)

Teaching and advising experience

Department of Chemical & Biomolecular Engineering **Sept. 2021 – Present**
Instructor, National University of Singapore

- CN3121 Process Dynamics & Control (Semester 2, 2022, 2023)
- SH5209 Process Safety Digitalization (Semester 2, 2023, 2024, 2025)
- CN5111 Optimization of Chemical Processes (Semester 2, 2024)
- CN4101 Process Control & Safety (Semester 2, 2024, 2025)
- CN5202 Machine Learning in Chemical Engineering (Semester 2, 2025)

Department of Chemical & Biomolecular Engineering **Sept. 2021 – Present**
Supervisor, National University of Singapore

- Instructed CN5555 MSc Chemical Engineering students
- Instructed FYP / UROP undergraduate students
- Supervised junior college students (UG outreach with Nanyang Junior College)

Department of Chemical & Biomolecular Engineering **Sept. 2016 – June 2020**
Teaching Fellow, *Seminar Lecturer*, University of California, Los Angeles

- Instructed undergraduate and graduate courses: *Process Dynamics and Control*, *Numerical and Mathematical Methods*, *Thermodynamics I*, *Advanced Process Control* (Winter 2017–Winter 2019)

Professional Appointments

Editorial Board, Digital Chemical Engineering **2021 – Present**
Associate Editor, American Control Conference **2024, 2025**
Early Career Advisory Board, ACS Chem & Bio Engineering **2024 – Present**
Chair of "Data-driven Modeling, Estimation and Optimization" session, AIChE Meeting **2024**
Chair of "Advances in Machine Learning and Intelligent Systems" session, AIChE Meeting **2024**
Co-Chair of "Data science and analytics for process applications" session, AIChE Meeting **2024**
Guest editor for Special Issues in Processes, and Digital Chemical Engineering **2022**
Co-Chair of "Advances in Process Control II" session, AIChE Meeting **2023**
Co-Chair of "ML and Data Analytics in Process Control" session, IFAC World Congress **2023**
Chair of "Model Predictive Control" session, 13th IFAC DYCOPS, Busan, Korea **2022**
Chair of "Energy Systems" session, 7th AdCONIP, Vancouver, Canada **2022**
Committee for Cybersecurity Standard for Chemical Industry, Singapore **2022 – Present**
MSc ChemEng committee, PG committee (2024 -), ChBE, NUS **2022 – Present**

Awards and Honors

Best Paper Award, Mathematics **2019, 2021**
Top Reviewer Award, Chemical Engineering Research & Design **2020, 2021, 2023**
Top Reviewer Award, Digital Chemical Engineering **2021**
Outstanding PhD in Chemical Engineering Award, UCLA **05/2020**
Dissertation Year Fellowship, UCLA **09/2019 – 06/2020**
CAST Director's Student Presentation Award Finalists, AIChE **11/2019**
Engineering PhD Summit (11 recipients worldwide), EPFL, Switzerland **10/2019**
Travel Award, Machine Learning in Science and Engineering Conference, Atlanta **06/2019**
Graduate Division Fellowship, UCLA **09/2016 – 06/2018**
National Scholarship for Undergraduate Student (Top 2%), China **09/2015 – 06/2016**

Books

1. **Wu, Z.**, and P. D. Christofides, "Process Operational Safety and Cybersecurity: A Feedback Control Approach," *Advances in Industrial Control Series*, 277 pages, Springer, London, England, 2021.

Referred Chapters

1. Wu, G., and **Z. Wu**, "Perspectives towards AI and ML in biomolecular crystallization," *Advances in Biochemical Engineering/Biotechnology: Biomolecular Crystallization Across Experimentation and Modeling*, Ferreira, J., and F. Castro (Eds.), in press, Springer Nature, Germany, 2025.
2. Wang, Y., and **Z. Wu**, "Machine learning in optimal control and process modeling," *High-Performance Computing and Artificial Intelligence in Process Engineering*, Li, M., and Y. Heng (Eds.), in press, IOP Publishing, United Kingdom, 2025.
3. Wang, Y., Y. Kadakia, **Z. Wu** and P. D. Christofides, "An Overview of Control Methods for Process Operational Safety and Cybersecurity," *Methods in Chemical Process Safety*, Khan, F., E. N. Pistikopoulos and Z. Sajid (Eds.), in press, Elsevier, Netherlands, 2025.
4. **Wu, Z.**, and P. D. Christofides, "Smart Manufacturing: Machine Learning-Based Economic MPC and Preventive Maintenance," *Smart Manufacturing*, M. Soroush, M. Baldea and T. F. Edgar (Eds.), Chapter 14, 21 pages, Elsevier, Netherlands, 2020.

Publications

1. Wang, Y., and **Z. Wu***, "Physics-Informed Reinforcement Learning for Optimal Control of Nonlinear Systems," *AIChE J.*, e18542, 2024.
2. Xu, Z., and **Z. Wu***, "Privacy Preserving Federated Machine Learning Modeling and Predictive Control of Heterogeneous Nonlinear Systems," *Comp. & Chem. Eng.*, **187**, 108749, 2024.
3. **Wu, Z.**, C. Lee, and E. Ventura-Medina, "Integrating Cybersecurity into the Chemical Engineering Curriculum," *Feature Series Digitalisation In Education, The Chemical Engineer (IChemE)*, page 46, 2024.
4. Wang, W, Y. Wang, Y. Tian, and **Z. Wu***, "Explicit Machine Learning-Based Model Predictive Control of Nonlinear Processes via Multi-Parametric Programming," *Comp. & Chem. Eng.*, **186**, 108689, 2024.
5. Xiao, M., K. Vellayappan, PS Pravin, K. Gudena, and **Z. Wu***, "Optimization-Based Multi-Source Transfer Learning for Modeling of Nonlinear Processes," *Chem. Eng. Sci.*, **295**, 120117, 2024.
6. Wu, G., Y. Wang, and **Z. Wu***, "Physics-Informed Machine Learning in Cyber-Attack Detection and Resilient Control of Chemical Processes," *Chem. Eng. Res. & Des.*, **204**, 544-555, 2024.
7. Tan, W., and **Z. Wu***, "Robust Reduced-Order Machine Learning Modeling of Nonlinear Processes Using Noisy Data," *Dig. Chem. Eng.*, **11**, 100145, 2024.
8. Wang, Y., and **Z. Wu**, and D. Ni* "Real-time Optimization of Heliostat Field Aiming Strategy via an IUPSO Algorithm," *Appl. Sci.*, **14**, 416, 2024.
9. Wang, Y., and **Z. Wu***, "Control Lyapunov-Barrier Function-Based Safe Reinforcement Learning for Nonlinear Optimal Control," *AIChE J.*, **70**, e18306, 2024.
10. Yang, X., Y. Ni, **Z. Wu**, W. Yang, and F. Liu*. "Optimal Denial-of-Service Attack Scheduling for Remote State Estimation With Time-Varying Interference Power," *Inter. J. Rob. & Non. Contr.*, **34**, 1-13, 2024.

11. Wang, Z., W. Tan, G. P. Rangaiah* and **Z. Wu***, "Machine Learning aided Model Predictive Control with Multi-Objective Optimization and Multi-Criteria Decision Making," *Comp. & Chem. Eng.*, **179**, 108414, 2023.
12. Tan, W., and **Z. Wu***, "Robust Machine Learning Modeling for Predictive Control Using Lipschitz-Constrained Neural Networks," *Comp. & Chem. Eng.*, **180**, 108466, 2024.
13. Hu, C., and **Z. Wu***, "Machine Learning-Based Model Predictive Control of Hybrid Dynamical Systems," *AIChE J.*, **69**, e18210, 2023.
14. Wang, C., C. Hu, Y. Zheng, H. Jin*, and **Z. Wu***, "Predictive control of reactor network model using machine learning for hydrogen-rich gas and biochar poly-generation by biomass waste gasification in supercritical waste," *Energy*, **282**, 128441, 2023.
15. Xiao, M. and **Z. Wu***, "Modeling and Control of a Chemical Process Network Using Physics-Informed Transfer Learning," *Ind. & Eng. Chem. Res.*, **62**, 17216–17227, 2023.
16. Zheng, Y., C. Hu, X, Wang, and **Z. Wu***, "Physics-Informed Recurrent Neural Network Modeling for Predictive Control of Nonlinear Processes," *J. Proc. Contr.*, **128**, 103005, 2023.
17. Wu, G., W. Tan, K. Le, and **Z. Wu***, "Physics-Informed Machine Learning for MPC: Application to a Batch Crystallization Process," *Chem. Eng. Res. & Des.*, **192**, 556-569, 2023.
18. Parker, S., **Z. Wu** and P. D. Christofides, "Cybersecurity in Process Control, Operations, and Supply Chain," *Comp. & Chem. Eng.*, **171**, 108169, 2023
19. Xiao, M., C. Hu, and **Z. Wu***, "Modeling and Predictive Control of Nonlinear Processes Using Transfer Learning Method," *AIChE J.*, **69**, e18076, 2023.
20. Hu, C., S. Chen, and **Z. Wu***, "Economic Model Predictive Control of Nonlinear Systems Using Online Learning of Neural Networks," *Processes*, **11**, 342, 2023.
21. Zheng, Y., and **Z. Wu***, "Physics-Informed Online Machine Learning and Predictive Control of Nonlinear Processes With Parameter Uncertainty," *Ind. & Eng. Chem. Res.*, **62**, 2804–2818, 2023.
22. Zheng, Y., S. Li, R. Wan, **Z. Wu**, and Y. Zhang, "Distributed Model Predictive Control For Reconfigurable Systems Based on Lyapunov Analysis," *J. Proc. Contr.*, **123**, 1-11, 2023.
23. Zhao, T., Y. Zheng, and **Z. Wu***, "Feature Selection-Based Machine Learning Modeling for Distributed Model Predictive Control of Nonlinear Processes," *Comp. & Chem. Eng.*, **169**, 108074, 2023.
24. Hu, C., Y. Cao, and **Z. Wu***, "Online Machine Learning Modeling and Predictive Control of Nonlinear Systems With Scheduled Mode Transitions," *AIChE Journal*, **69**, e17882, 2023.**(Top Downloaded Paper)**
25. Ren, Y. M., M. Alhajeri, J. Luo, S. Chen, F. Abdullah, **Z. Wu** and P. D. Christofides, "A Tutorial Review of Neural Network Modeling Approaches for Model Predictive Control," *Comp. & Chem. Eng.*, **165**, 107956, 2022.
26. Wang, Z., J. Li, G. P. Rangaiah*, and **Z. Wu***, "Machine Learning aided Multi-Objective Optimization and Multi-Criteria Decision Making: Framework and Two Applications in Chemical Engineering," *Comp. & Chem. Eng.*, **165**, 107945, 2022.
27. Pravin P S , J. Tan, K. S. Yap, and **Z. Wu***, "Hyperparameter optimization strategies for machine learning-based stochastic energy efficient scheduling in cyber-physical production systems," *Digit. Chem. Eng.*, **4**, 100047, 2022.
28. Zheng, Y., X. Wang*, and **Z. Wu***, "Online Learning-Based Predictive Control of Crystallization Processes under Batch-to-Batch Parametric Drift," *AIChE J.*, **68**, e17815, 2022.
29. Zhang, H., P. Lu, Z. Ding, Y. Li, H. Li, C. Hua*, and **Z. Wu***, "Design Optimization and Control of Dividing Wall Column for Purification of Trichlorosilane," *Chem. Eng. Sci.*, **257**, 117716, 2022.
30. Zhao, T., Y. Zheng, and **Z. Wu***, "Improving Computational Efficiency of Machine Learning Modeling of Nonlinear Processes Using Sensitivity Analysis and Active Learning," *Digit. Chem. Eng.*, **3**, 100027, 2022.
31. Zheng, Y., X. Wang*, and **Z. Wu***, "Machine Learning Modeling and Predictive Control of Batch Crystallization Process," *Ind. & Eng. Chem. Res*, **61**, 5578–5592, 2022.

32. Zhao, T., Y. Zheng, J. Gong, and **Z. Wu***, "Machine Learning-Based Reduced-Order Modeling and Predictive Control of Nonlinear Processes," *Chem. Eng. Res. & Des*, **179**, 435-451, 2022.
33. **Wu, Z.**, A. Alnajdi, Q. Gu and P. D. Christofides, "Statistical Machine-Learning-based Predictive Control of Uncertain Nonlinear Processes," *AIChE J.*, **68**, e17642, 2022.

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34. Alhajeri, M., F. Abdullah, **Z. Wu**, and P. D. Christofides, "Physics-informed Machine Learning Modeling for Predictive Control Using Noisy Data," *Chem. Eng. Res. & Des*, **186**, 34-49, 2022.
35. Chen, S., **Z. Wu** and P. D. Christofides, "Statistical Machine-Learning-based Predictive Control Using Barrier Functions for Process Operational Safety," *Comp. & Chem. Eng.*, **163**, 107860, 2022.
36. Chen, S., **Z. Wu**, and P. D. Christofides, "Statistical Machine-Learning-based Predictive Control Using Barrier Functions for Process Operational Safety," *Comp. & Chem. Eng.*, **163**, 107860, 2022.
37. Abdoullah, F., **Z. Wu** and P. D. Christofides, "Handling noisy data in sparse model identification using subsampling and co-teaching," *Comp. & Chem. Eng.*, **157**, 107628, 2022.
38. Luo, J., V. Canuso, J. B. Jang, **Z. Wu**, C. Morales-Guio and P. D. Christofides, "Machine Learning-Based Operational Modeling of an Electrochemical Reactor: Handling Data Variability and Improving Empirical Models," *Ind. & Eng. Chem. Res*, **61**, 8399-8410, 2022.
39. Alhajeri, M., J. Luo, **Z. Wu**, F. Albalawi and P. D. Christofides, "Process structure-based recurrent neural network modeling for predictive control: A comparative study," *Chem. Eng. Res. & Des*, **179**, 77-89, 2022.
40. Chen, S., **Z. Wu** and P. D. Christofides, "Barrier-Function-Based Distributed Predictive Control for Operational Safety of Nonlinear Processes," *Comp. & Chem. Eng.*, **159**, 107690, 2022.
41. Xiao, T., **Z. Wu** P. D. Christofides, A. Armaou and D. Ni, "Recurrent neural network based model predictive control of a plasma etch process," *Ind. & Eng. Chem. Res*, **61**, 638-652, 2022.
42. Chen, S., **Z. Wu** and P. D. Christofides, "Machine-Learning-Based Construction of Barrier Functions and Models for Safe Model Predictive Control," *AIChE J.*, **68**, e17456, 2022.
43. **Wu, Z.**, D. Rincon, Q. Gu and P. D. Christofides, "Statistical Machine Learning in Model Predictive Control of Nonlinear Processes," *Mathematics*, **9**, 1912, 2021. **(Best Paper Award)**
44. Dodhia, A., **Z. Wu** and P. D. Christofides, "Machine Learning-Based Predictive Control of Diffusion-Reaction Processes," *Chem. Eng. Res. & Des.*, **173**, 129-139, 2021.
45. Abdullah, F., **Z. Wu** and P. D. Christofides, "Sparse Identification-Based Model Predictive Control of Two-Time-Scale Processes," *Comp. & Chem. Eng.*, **153**, 107411, 2021.
46. Wu, Z., J. Luo, D. Rincon, and P. D. Christofides,, "Machine Learning-based Predictive Control Using Noisy Data: Evaluating Performance and Robustness via a Large-Scale Process Simulator," *Chem. Eng. Res. & Des.*, **148**, 107267, 2021.
47. Alhajeri, M., Z. Wu, D. Rincon, F. Albalawi and P. D. Christofides, "Machine Learning-Based State Estimation and Predictive Control of Nonlinear Processes," *Chem. Eng. Res. & Des.*, **167**, 268-280, 2021.
48. **Wu, Z.**, D. Rincon, J. Luo and P. D. Christofides, "Machine Learning Modeling and Predictive Control of Nonlinear Processes Using Noisy Data," *AIChE Journal*, **67**, e17164, 2021.
49. Abdullah, F., **Z. Wu** and P. D. Christofides, "Data-Based Reduced-Order Modeling of Nonlinear Two-Time-Scale Processes," *Chem. Eng. Res. & Des.*, **166**, 1-9, 2021.
50. Chen, S., **Z. Wu** and P. D. Christofides, "Cyber-Security of Centralized, Decentralized, and Distributed Control-Detector Architectures for Nonlinear Processes," *Chem. Eng. Res. & Des.*, **165**, 25-39, 2020.
51. Chen, S., **Z. Wu**, D. Rincon and P. D. Christofides, "Machine Learning-Based Distributed Model Predictive Control of Nonlinear Processes," *AIChE Journal*, **66**, e17013, 2020.
52. Chen, S., **Z. Wu** and P. D. Christofides, "Decentralized Machine Learning-Based Predictive Control of Nonlinear Processes," *Chem. Eng. Res. & Des.*, **162**, 45-60, 2020.

53. **Wu, Z.**, D. Rincon, and P. D. Christofides, "Process Structure-based Recurrent Neural Network Modeling for Model Predictive Control of Nonlinear Processes," *J. Proc. Contr.*, **89**, 74-84, 2020.

54. **Wu, Z.**, S. Chen, D. Rincon, and P. D. Christofides, "Post Cyber-Attack State Reconstruction for Nonlinear Processes Using Machine Learning," *Chem. Eng. Res. & Des.*, **159**, 248-261, 2020.

55. Wang, Y., Y. Zhang, **Z. Wu**, H. Li and P. D. Christofides, "Operational Trend Prediction and Classification for Chemical Processes: A Novel Convolutional Neural Network Method Based on Symbolic Hierarchical Clustering," *Chem. Eng. Sci.*, **224**, 115796, 2020.

56. Zhang, J., P. D. Christofides, X. He, **Z. Wu**, Y. Zhao and D. Zhou, "Robust Detection of Intermittent Sensor Faults in Stochastic LTV Systems," *Neurocomputing*, **388**, 181-187, 2020.

57. Chen, S., **Z. Wu**, and P. D. Christofides, "Cyber-attack Detection and Resilient Operation of Nonlinear Processes under Lyapunov-Based Economic Model Predictive Control," *Comp. & Chem. Eng.*, **136**, 106806, 2020.

58. **Wu, Z.**, D. Rincon, and P. D. Christofides, "Real-time Machine Learning-Based Predictive Control of Nonlinear Processes," *Ind. & Eng. Chem. Res.*, **59**, 2275 - 2290, 2020.

59. **Wu, Z.**, D. Rincon, and P. D. Christofides, "Real-time Machine Learning for Operational Safety of Nonlinear Processes via Barrier-Function Based Predictive Control," *Chem. Eng. Res. & Des.*, **155**, 88-97, 2020.

60. Chen, S., **Z. Wu**, and P. D. Christofides, "A Cyber-secure Control-Detector Architecture for Nonlinear Processes," *AIChE Journal*, **66**, e16907, 2020.

61. **Wu, Z.**, and P. D. Christofides, "Control Lyapunov-Barrier Function-Based Predictive Control of Nonlinear Processes Using Machine Learning Modeling," *Comp. & Chem. Eng.*, **134**, 106706, 11 pages, 2020.

62. **Wu, Z.**, and P. D. Christofides, "Optimizing Process Economics and Operational Safety via Economic MPC Using Barrier Functions and Recurrent Neural Network Models," *Chem. Eng. Res. & Des.*, **152**, 455-465, 2019.

63. Zhang, Z., **Z. Wu**, D. Rincon and P. D. Christofides, "Real-Time Optimization and Control of Nonlinear Processes Using Machine Learning," *Mathematics*, **7(10)**, 890, 25 pages, 2019.

64. **Wu, Z.**, F. Albalawi, Z. Zhang, J. Zhang, H. Durand and P. D. Christofides, "Control Lyapunov-Barrier Function-Based Model Predictive Control of Nonlinear Systems," *Automatica*, **109**, 108508, 2019.

65. **Wu, Z.**, A. Tran, D. Rincon, and P. D. Christofides, "Machine Learning-Based Predictive Control of Nonlinear Processes. Part I: Theory," *AIChE Journal*, **65**, e16729, 2019. **(Top Downloaded Paper)**

66. **Wu, Z.**, A. Tran, D. Rincon, and P. D. Christofides, "Machine Learning-Based Predictive Control of Nonlinear Processes. Part II: Computational Implementation," *AIChE Journal*, **65**, e16734, 2019. **(Top Downloaded Paper)**

67. Zhang, Z., **Z. Wu**, D. Rincon and P. D. Christofides, "Operation Safety via Model Predictive Control: The Torrance Refinery Accident Revisited," *Chem. Eng. Res. & Des*, **149**, 138-146, 2019.

68. **Wu, Z.**, and P. D. Christofides, "Economic Machine-Learning-Based Predictive Control of Nonlinear Systems," *Mathematics*, **7(6)**, 494, 20 pages, 2019. **(Best Paper Award)**

69. Zhang, Z., **Z. Wu**, D. Rincon and P. D. Christofides, "Operational Safety of an Ammonia Process Network via Model Predictive Control," *Chem. Eng. Res. & Des*, **146**, 277-289, 2019.

70. Zhang, Z., **Z. Wu**, D. Rincon, C. Garcia and P. D. Christofides, "Operational Safety of Chemical Processes via Safeness-Index Based MPC: Two Large-Scale Case Studies," *Comp. & Chem. Eng.*, **125**, 204-215, 2019.

71. Ding, Y., Y. Zhang, K. Kim, A. Tran, **Z. Wu**, D. Rincon and P. D. Christofides, "Microscopic Modeling and Optimal Operation of Thermal Atomic Layer Deposition," *Chem. Eng. Res. & Des*, **145**, 159-172, 2019.

72. **Wu, Z.**, A. Tran, Y. M. Ren, C. S. Barnes, S. Chen and P. D. Christofides, "Model Predictive Control of Phthalic Anhydride Synthesis in a Fixed-Bed Catalytic Reactor via Machine Learning Modeling," *Chem. Eng. Res. & Des.*, **145**, 173-183, 2019.

73. **Wu, Z.**, and P. D. Christofides, "Handling Bounded and Unbounded Unsafe Sets in Control Lyapunov-Barrier Function-Based Model Predictive Control of Nonlinear Processes," *Chem. Eng. Res. & Des*, **143**, 140-149, 2019. **(Cover Figure)**
74. **Wu, Z.**, H. Durand, and P. D. Christofides, "Safeness Index-Based Economic Model Predictive Control of Stochastic Nonlinear Systems," *Mathematics*, **6(5)**, 69, 2018.
75. **Wu, Z.**, F . Albalawi, J. Zhang, Z. Zhang, H. Durand and P. D. Christofides, "Detecting and Handling Cyber-attacks in Model Predictive Control of Chemical Processes," *Mathematics*, **6(10)**, 173, 2018.
76. **Wu, Z.**, J. Zhang, Z. Zhang, F. Albalawi, H. Durand, M. Mahmood, P. Mhaskar, and P. D. Christofides, "Economic Model Predictive Control of Stochastic Nonlinear Systems," *AIChE Journal*, **64**, 3312-3322, 2018.
77. **Wu, Z.**, H. Durand, and P. D. Christofides, "Safe Economic Model Predictive Control of Nonlinear Systems," *System & Control Letters*, **118**, 69-76, 2018.
78. Zhang, Z., **Z. Wu**, H. Durand, F. Albalawi and P. D. Christofides, "On Integration of Feedback Control and Safety Systems: Analyzing Two Chemical Process Applications," *Chem. Eng. Res. & Des*, **132**, 616-626, 2018.
79. Zhang, J., P. D. Christofides, X. He, **Z. Wu**, Z. Zhang and D. Zhou, "Event-triggered Filtering and Intermittent Fault Detection for Time-varying Systems with Stochastic Parameter Uncertainty and Sensor Saturation," *Inter. J. Rob. & Non. Contr.*, **28**, 4666-4680, 2018.
80. **Wu, Z.**, A. Aguirre, A. Tran, H. Durand, D. Ni and P. D. Christofides, "Model Predictive Control of a Steam Methane Reforming Reactor Described by a CFD Model," *Ind. & Eng. Chem. Res.*, **56**, 6002-6011, 2017.
81. Lao, L., A. Aguirre, A. Tran, **Z. Wu**, H. Durand and P. D. Christofides, "CFD Modeling and Control of a Steam Methane Reforming Reactor," *Chem. Eng. Sci.*, **148**, 78-92, 2016.

(* denotes corresponding author)

Patents

1. J. Tan, K. S. Yap, and **Z. Wu** "Algorithm for multistage real-time resource scheduling," Singapore patent, submitted.

Editorials

1. **Wu, Z.**, and H. Durand "Special issue on Autonomy, Safety, and Security for Cyber-Physical Systems in the Process Industries", Editorial to the Special Issue of Digital Chemical Engineering, 100117, 2023.

Conference Publications

1. Wu, W., Y. Wang, H. Zhang, M. Chiu and **Z. Wu***, "Phased LSTM-Based MPC for Modeling and Control of Nonlinear Systems Using Asynchronous and Delayed Measurement Data," Proceedings of the Conference on Decision and Control, in press, Milan, Italy, 2024.
2. Wang, Y., Ming, X., and **Z. Wu***, "Fast Reinforcement Learning For Optimal Control of Nonlinear Systems Using Transfer Learning," Proceedings of the Conference on Decision and Control, in press, Milan, Italy, 2024.
3. Tan, W., M. Xing, G. Wu and **Z. Wu***, "Machine Learning Modeling of Nonlinear Processes with Lyapunov Stability Guarantees," Proceedings of the American Control Conference, in press, Toronto, Canada, 2024.
4. Wang, Y., and **Z. Wu***, "Optimal Control of Nonlinear Systems With Input and State Constraints Using Koopman Operator," Proceedings of the American Control Conference, in press, Toronto, Canada, 2024.
5. Xu, Z. and **Z. Wu***, "Federated Learning-Based Distributed Model Predictive Control of Nonlinear Systems," Proceedings of the American Control Conference, in press, Toronto, Canada, 2024.
6. Wu, G. and **Z. Wu***, "Machine Learning-Based MPC of Batch Crystallization Process Using Physics-Informed RNNs," Proceedings of 22nd International Federation of Automatic Control World Congress, 56, 2, 2846-2851, Yokohama, Japan, 2023.
7. Hu, C. and **Z. Wu***, "Online-Learning-Based Economic MPC of Switched Nonlinear Systems," Proceedings of 22nd International Federation of Automatic Control World Congress, 56, 2, 2840-2845, Yokohama, Japan, 2023.

8. Xiao, M., C. Hu, and **Z. Wu***, "Transfer Learning-Based Modeling and Predictive Control of Nonlinear Processes," Proceedings of the American Control Conference, 92-99, San Diego, California, 2023.
9. Hu, C. and **Z. Wu***, "Online Learning-Based Predictive Control of Switched Nonlinear Systems With Disturbances," Proceedings of the American Control Conference, 106-112, San Diego, California, 2023.
10. Parker, S., **Z. Wu** and P. D. Christofides, "Cybersecurity in Process Control, Operations, and Supply Chain," Proceedings of Foundations of Computer Aided Process Operations / Chemical Process Control, 20 pages, San Antonio, Texas, 2023.
11. Zheng, Y. and **Z. Wu***, "Physics-Informed Machine Learning Modeling for Model Predictive Control of Nonlinear Processes,," Proceedings of Foundations of Computer Aided Process Operations / Chemical Process Control, 6 pages, San Antonio, Texas, 2023.
12. Hu, C. and **Z. Wu***, "Online Machine Learning Modeling and Predictive Control of Switched Nonlinear Systems," Proceedings of Foundations of Computer Aided Process Operations / Chemical Process Control, 20 pages, San Antonio, Texas, 2023.
13. Zheng, Y. and **Z. Wu***, "Online Learning for Machine Learning-based Modeling and Predictive Control of Crystallization Processes under Batch-to-Batch Parametric Drift," Proceedings of the 7th International Symposium on Advanced Control of Industrial Processes, 216-221, Vancouver, BC, Canada, 2022.
14. Pravin P S , J. Tan and **Z. Wu***, "Performance evaluation of various hyperparameter tuning strategies for uncertain parameter forecast using LSTM," Proceedings of the 7th International Symposium on Advanced Control of Industrial Processes, 301-306, Vancouver, BC, Canada, 2022.
15. Zheng, Y. and **Z. Wu***, "Predictive Control of Batch Crystallization Process Using Machine Learning," Proceedings of the 13th IFAC Symposium on Dynamics and Control of Process Systems, 798-803, Busan, Republic of Korea, 2022.
16. **Wu, Z.**,* A. Alnajdi, Q. Gu and P. D. Christofides, "Machine-Learning-based Predictive Control of Nonlinear Processes with Uncertainty," Proceedings of the American Control Conference, 2810-2816, Atlanta, Georgia, 2022.

Before NUS:

17. **Wu, Z.**,* J. Luo, D. Rincon, and P. D. Christofides, "Co-Teaching Approach to Machine Learning-based Predictive Control of Nonlinear Processes," Proceedings of 11th IFAC International Symposium on Advanced Control of Chemical Processes, 8 pages, Venice, Italy, 2021. **(Keynote Presentation)**
18. Alhajeri, M., **Z. Wu***, D. Rincon, F. Albalawi, and P. D. Christofides, "Estimation-Based Predictive Control of Nonlinear Processes Using Recurrent Neural Networks," Proceedings of 11th IFAC International Symposium on Advanced Control of Chemical Processes, 6 pages, Venice, Italy, 2021.
19. Chen, S.*, **Z. Wu**, P. D. Christofides, "Cyber-Security of Decentralized and Distributed Control Architectures with Machine-Learning Detectors for Nonlinear Processes," Proceedings of the American Control Conference, 3264-3271, New Orleans, Louisiana, 2021.
20. **Wu, Z.**,* D. Rincon, and P. D. Christofides, "Handling Noisy Data in Machine Learning Modeling and Predictive Control of Nonlinear Processes," Proceedings of the American Control Conference, 3336-3342, New Orleans, Louisiana, 2021.
21. **Wu, Z.**,* D. Rincon, and P. D. Christofides, "Improving Machine Learning Modeling of Nonlinear Processes Under Noisy Data Via Co-teaching Method," Proceedings of the American Control Conference, 4650-4656, New Orleans, Louisiana, 2021.
22. Chen, S.*, **Z. Wu**, P. D. Christofides, "Machine Learning-Based Cyber-attack Detection and Resilient Operation via Economic Model Predictive Control for Nonlinear Processes," Proceedings of the 28th Mediterranean Conference on Control and Automation, 794-801, Saint-Raphael, France, 2020.
23. Ding, Y.*, Y. Zhang, **Z. Wu**, P. D. Christofides, "Run-to-Run Control of Thermal Atomic Layer Deposition," Proceedings of the 28th Mediterranean Conference on Control and Automation, 1080-1086, Saint-Raphael, France, 2020.

24. **Wu, Z.**,* D. Rincon, M. Park and P. D. Christofides, "Economic MPC of Nonlinear Processes via Recurrent Neural Networks Using Structural Process Knowledge," Proceedings of 21st International Federation of Automatic Control World Congress, Paper VI161-09.11, 7 pages, Berlin, Germany, 2020.
25. **Wu, Z.**,* D. Rincon and P. D. Christofides, "Real-time Machine Learning-Based CLBF-MPC of Nonlinear Systems," Proceedings of 21st International Federation of Automatic Control World Congress, Paper VI161-09.8, 6 pages, Berlin, Germany, 2020.
26. **Wu, Z.**,* D. Rincon and P. D. Christofides, "Incorporating Structural Process Knowledge in Recurrent Neural Network Modeling of Nonlinear Processes," Proceedings of the American Control Conference, 2413-2418, Denver, Colorado, 2020.
27. **Wu, Z.*** and P. D. Christofides, "Control Lyapunov-Barrier Function-Based Predictive Control of Nonlinear Systems Using Machine Learning Models," Proceedings of the American Control Conference, 2754-2759, Denver, Colorado, 2020.
28. **Wu, Z.**,* A. Tran, Y. M. Ren, C. S. Barnes, S. Chen and P. D. Christofides, "Computational Fluid Dynamics Modeling and Control of Phthalic Anhydride Synthesis in a Fixed-Bed Catalytic Reactor," Proceedings of the American Control Conference, 2151-2157, Philadelphia, Pennsylvania, 2019.
29. **Wu, Z.**,* and P. D. Christofides, "On Impact of Unsafe Set Structure in Control Lyapunov-Barrier Function-Based Model Predictive Control," Proceedings of the American Control Conference, 989-994, Philadelphia, Pennsylvania, 2019.
30. Zhang, Z., **Z. Wu**,* D. Rincon and P. D. Christofides, "Integrating Safeness-Index Based MPC and Safety Relief Valve Activation for Operational Safety of Chemical Processes," Proceedings of the American Control Conference, 995-1001, Philadelphia, Pennsylvania, 2019.
31. Aiello, E. M.,* **Z. Wu**, P. D. Christofides, C. Toffanin and L. Magni, "Improving Diabetes Conventional Therapy via Machine Learning Modeling," Proceedings of the American Control Conference, 4136-4143, Philadelphia, Pennsylvania, 2019.
32. **Wu, Z.**,* A. Tran, Y. M. Ren, C. S. Barnes, S. Chen and P. D. Christofides, "Machine Learning-Based Model Predictive Control of Distributed Chemical Processes," Proceedings of IFAC CPDE/ CDPS-2019, 8 pages, Oaxaca, Mexico, 2019.
33. **Wu, Z.**,* H. Durand, and P. D. Christofides, "Control Lyapunov-Barrier Function-Based Economic Model Predictive Control of Nonlinear Systems," Proceedings of IFAC NMPC-2018, 48-53, Madison, Wisconsin, 2018.
34. **Wu, Z.**,* H. Durand, and P. D. Christofides, "Handling Process Safety and Stochastic Uncertainty in Economic Model Predictive Control," Proceedings of IFAC NMPC-2018, 424-429, Madison, Wisconsin, 2018.
35. **Wu, Z.**, F. Albalawi, Z. Zhang, J. Zhang, H. Durand and P. D. Christofides,* "Model Predictive Control for Process Operational Safety: Utilizing Safeness Index-Based Constraints and Control Lyapunov-Barrier Functions," Proceedings of 13th International Symposium on Process Systems Engineering - PSE 2018, Computer-Aided Chemical Engineering, 44, 2017-2022, San Diego, California, 2018. **(Keynote Presentation)**.
36. Zhang, Z.,* **Z. Wu**, H. Durand, F. Albalawi and P. D. Christofides, "On Integration of Model Predictive Control with Safety System: Preventing Thermal Runaway," Proceedings of 13th International Symposium on Process Systems Engineering - PSE 2018, Computer-Aided Chemical Engineering, 44, 2011-2016, San Diego, California, 2018.
37. **Wu, Z.**,* F. Albalawi, Z. Zhang, J. Zhang, H. Durand and P. D. Christofides, "Control Lyapunov-Barrier Function-Based Model Predictive Control of Nonlinear Systems," Proceedings of the American Control Conference, 5920-5926, Milwaukee, Wisconsin, 2018.
38. **Wu, Z.**,* J. Zhang, Z. Zhang, F. Albalawi, H. Durand, M. Mahmood, P. Mhaskar and P. D. Christofides, "Lyapunov-Based Economic Model Predictive Control of Stochastic Nonlinear Systems," Proceedings of the American Control Conference, 3900-3907, Milwaukee, Wisconsin, 2018.

(* denotes presenting author)

Selected Presentations with Published Abstracts

1. Tan, G. Y.*, M., Xiao, G. Wu, and **Z. Wu**, "Lyapunov-Stable Neural Network for Model-Based Control of Nonlinear Systems," AIChE Annual Meeting, San Diego, California, 2024.
2. Xiao, M., K. Vellayappan, P. S. Pravin, K. Gudena, and **Z. Wu***, "Multi-Source Transfer Learning for Accelerating Modeling of Chemical Processes," AIChE Annual Meeting, San Diego, California, 2024.
3. Xu, Z., and **Z. Wu***, "Cyber-Secure Machine Learning Modeling and Predictive Control of Nonlinear Chemical Process Network Using Federated Learning," AIChE Annual Meeting, Orlando, Florida, 2023. **(Keynote Presentation)**
4. Tan, G. Y.*, and **Z. Wu**, "Improving Robustness of Machine Learning Modeling of Nonlinear Processes Using Lipschitz-Constrained Neural Networks," AIChE Annual Meeting, Orlando, Florida, 2023.
5. Xiao, M*. C. Hu, and **Z. Wu**, "Transfer Learning-Based Modeling and Predictive Control of Nonlinear Process Network," AIChE Annual Meeting, Orlando, Florida, 2023.
6. Zhao, T., Y. Zheng, and **Z. Wu***, "Reduced-Order Modeling and Predictive Control of Nonlinear Processes Using Machine Learning," AIChE Annual Meeting, Phoenix, Arizona, 2022.
7. Hu, C., Y. Zheng, and **Z. Wu***, "On-Line Learning in Model Predictive Control of Nonlinear Processes: Generalization Guarantees and Stability Analysis," AIChE Annual Meeting, Phoenix, Arizona, 2022.
8. **Wu, Z.**,* D. Rincon, Q. Gu and P. D. Christofides "Statistical Machine Learning in Model Predictive Control of Nonlinear Processes," paper 176f, Boston, Massachusetts, 2021.
9. **Wu, Z.**,* D. Rincon, and P. D. Christofides, "Control Lyapunov-Barrier Function-Based Predictive Control of Nonlinear Processes Using Real-Time Machine Learning Modeling," AIChE Annual Meeting, San Francisco, CA, 2020.
10. **Wu, Z.**,* Z. Zhang, D. Rincon, and P. D. Christofides, "Machine Learning Methods in Process Control," AIChE Annual Meeting, Orlando, FL, 2019.
11. **Wu, Z.**,* J. Zhang, Y. Li, H. Durand, and P. D. Christofides, "Cyber Security of Model Predictive Control Systems for Chemical Processes," AIChE Annual Meeting, Pittsburgh, PA, 2018.
12. **Wu, Z.**,* J. Zhang, Z. Zhang, F. Albalawi, H. Durand, M. Mahmood, P. Mhaskar, and P. D. Christofides, "Economic Performance Improvement for Lyapunov-Based Economic Model Predictive Control Using Disturbance Probability Distributions," AIChE Annual Meeting, Minneapolis, MN, 2017.

(* denotes presenting author)

Invited Presentations

1. **Wu, Z.**, "Advanced Machine Learning in Process Modeling and Control," 11th Asian Symposium on Process Systems Engineering (PSE Asia), Penang, Malaysia, August 2024. (**Keynote Presentation**)
2. **Wu, Z.**, "AI for process intelligence and control," NRF workshop on AI for chemical and biological manufacturing, Singapore, April 2024.
3. **Wu, Z.**, ""Input Convex LSTM: A Convex Approach for Fast Lyapunov-Based Model Predictive Control," Institute for Machine Learning (Head: Professor Sepp Hochreiter), Johannes Kepler University, December 2023.
4. **Wu, Z.**, "Machine Learning in Process Operational Safety and Cybersecurity," Plant AIM Summit 2023, Singapore, October 2023. (**Keynote Presentation**)
5. **Wu, Z.**, "Machine Learning in Model Predictive Control," 15th Global Chinese Chemical Engineers Symposium (GCCES-2023), HKUST, Hong Kong, August 2023.
6. **Wu, Z.**, "Machine Learning in Model Predictive Control," AI Thrust, Information Hub, Hong Kong University of Science and Technology (Guangzhou), April 2023.
7. **Wu, Z.**, "Machine Learning in Model Predictive Control," School of Automation, Southeast University, China, February 2023.
8. **Wu, Z.**, "Machine Learning in Model Predictive Control," Institute of Internet of Things Engineering, Jiangnan University, China, February 2023.
9. **Wu, Z.**, "Machine Learning in Model Predictive Control," College of Control Science and Engineering, Zhejiang University, China, February 2023.

10. **Wu, Z.**, "Machine Learning in Model Predictive Control," 10th Asian Symposium on Process Systems Engineering (PSE Asia), Chennai, India, December 2022. (**Keynote Presentation**)
11. **Wu, Z.**, "Machine Learning in Model Predictive Control," International Conference on Emerging Electronics & Automation (E2A) 2022, NIT Silchar, India, December 2022. (**Keynote Presentation**)
12. **Wu, Z.**, "Machine Learning in Model Predictive Control, Operational Safety and Cybersecurity," 31th Chinese Process Control Conference (CPCC), Xuzhou, Jiangsu, China, July 2020. (**Keynote Presentation**)
13. **Wu, Z.**, "Machine Learning in Model Predictive Control, Operational Safety and Cybersecurity," Department of Chemical Engineering, University of Michigan-Anh Arbor, February 2020.
14. **Wu, Z.**, "Machine Learning in Model Predictive Control, Operational Safety and Cybersecurity," Department of Chemical Engineering, Louisiana State University, February 2020.
15. **Wu, Z.**, "Machine Learning in Model Predictive Control, Operational Safety and Cybersecurity," Department of Chemical Engineering, Texas Tech University, January 2020.

Technical Reviewer

AIChE Journal, Industrial & Engineering Chemistry Research, Chemical Engineering Science, Computers & Chemical Engineering, Chemical Engineering Research and Design, Automatica, IEEE Transactions on Automatic Control, Control Engineering Practice, Journal of Process Control, International Journal of Robust and Nonlinear Control, IEEE Transactions on Control Systems Technology, American Control Conference, Conference on Decision and Control

Research Grants

1. Accelerate Pharmaceutical Manufacturing Through Systems Engineering and Machine Learning, **Lead PI**, A*STAR Pharma Innovation Programme Singapore, Total award amount: SGD $1,147,900, Duration: 2023 – 2026, My share 50%
2. Online Machine Learning Modeling and Advanced Control of Chemical Processes, **Lead PI**, MOE AcRF Tier 1, Total award amount: SGD $212,380, Duration: 2023 – 2026
3. Physics-Informed Machine Learning Modeling and Predictive Control of Nonlinear Chemical Processes, **Lead PI**, A*STAR MTC Young Individual Research Grants, Total award amount: SGD $286,000, Duration: 2023 – 2026
4. Traversing Geodesics in Discovery-Development Space – from Novel Electrophoto Catalysis to Sustainable and Scalable Manufacturing Processes, **Co-PI**, NRF Competitive Research Programme, Total award amount: SGD $5,874,220, Duration: 2023 – 2028, My share 10%
5. Machine-Learning-Based Predictive Control and Optimization of Large-Scale Chemical Processes, **Lead PI**, NUS Start-up Grant, Total award amount: SGD $500,000, Duration: 2021 – 2025
6. Data-Driven Knowledge Discovery in Pharmaceutical Manufacturing Through Batch Process Optimization, **Lead PI**, Pfizer Asia Manufacturing Pte. Ltd., Total award amount: SGD $380,000, Duration: 2021 – 2023
7. Cyber-Physical Production System - Towards Contextual and Intelligent Response, **Co-PI**, A*STAR IAF-PP, Total award amount: SGD $18,473,400, Duration: 2019 – 2022, My share 5%

Research Group

1. Postdoctoral researchers: WANG, Yujia; XU, Zeyuan
2. PhD students: ZHAO, Tianyi; XIAO, Ming; WU, Guoquan; WANG, Wenlong; WU, Wanlu
3. Research engineers: Keerthana Vellayappan; YU, Donghan
4. Master students: Oo, Yue Yang; Tsoi, Wai Mun; Lee, Max
5. Alumni: Zhiyuan Wang (PhD, 2023, Co-advised by Prof. G. P. Rangaiah; Lecturer, DigiPen Institute of Technology Singapore); Pravin P S (Research Fellow, 2021 – 2022; Assistant Professor at Electronics & Instrumentation Engineering Department, National Institute of Technology Silchar, India); Cheng Hu (Research Fellow, 2022 – 2023; Assistant Professor at Shanghai University, China); Tan Zhi Ming, Jaswin (M.Eng, 2021 – 2022; process engineer in Micron Semiconductor Asia Pte Ltd); Yingzhe Zheng (Research Engineer, 2021 – 2022; Machine learning engineer, ByteDance, Singapore, 2024); Tan Gian Yion, Wallace (Research Engineer, 2022 – 2023; PhD student in Chemical Engineering, MIT, 2023); Zihao Wang (Research Engineer, 2023 – 2024; PhD student in School of Medicine, NTU, 2024)