Qin Lin

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Research interests

The mission of my research is to answer the question: *how can we provide people with cyber-physical systems they can bet their lives on?* [Jeannette Wing]. My research interests are in the intersection of machine learning, control theory, and formal verification towards the goal to enhance security and safety of safety-critical cyber-physical systems whilst deployed in dynamic, uncertain, and adversarial environments. I develop explainable and verifiable machine learning-based intrusion detection algorithms to protect industrial control systems, such as water treatment plants, from cyber attacks. I also rigorously verify safety properties of learning-enabled components and develop safety-guaranteed planning and control algorithms for autonomous driving systems.

Education

Delft University of Technology — Delft the Netherlands
Ph.D. in Computer Science, Advisors: Prof. Sicco Verwer, Prof. Jan van den Berg — 2015–2019

- Thesis: "Intelligent Control Systems: Learning, Interpreting, Verification"
- Funded by Dutch Government Projects: VENI project MANTA & NWO project LEMMA

Tongji University — Shanghai, China
M.Eng. in Control Theory and Control Engineering, Advisor: Prof. Jun Wang — 2011–2014

- Thesis: "Research on Methods for Processing Wind Speed Data of Wind Farms"

Hefei University of Technology — Hefei, China
B.Eng. in Automation — 2007–2011

Appointments

Department of Computer Science, Cleveland State University — Cleveland, USA
Tenure-track Assistant Professor — from Jan 2022

Robotics Institute, Carnegie Mellon University — Pittsburgh, USA
Postdoc Research Fellow, Advisor: Prof. John M. Dolan — May 2019–Jan 2022

- Funded by DARPA Assured Autonomy project
- Topic: Safety verification for learning-enabled components of autonomous vehicles

Publications

Google scholar link

Journal papers

1. **Qin Lin**, Stefan Mitsch, André Platzer, and John M. Dolan, "Practically Safe and Recoverable Waypoint-following for Autonomous Vehicles", *IEEE Control Systems Letters, 6, pp.1574-1579*
2. Shivesh Khaitan[*], **Qin Lin**[+], Dolan M. Dolan, "Safe planning and control under uncertainty for self-driving", *IEEE Transactions on Vehicular Technology, 70(10), pp. 9826-9837.*

[*] supervised students
[+] corresponding author

3. **Qin Lin**, Yihuan Zhang, Sicco Verwer, and Jun Wang, 2019. "MOHA: a multi-mode hybrid automaton model for learning car-following behaviors", *IEEE Transactions on Intelligent Transportation Systems, 20(2), pp.790-796.*

4. Yihuan Zhang, **Qin Lin**, Jun Wang, Sicco Verwer, and John M. Dolan, 2018. "Lane-change intention estimation for car-following control in autonomous driving", *IEEE Transactions on Intelligent Vehicles, 3(3), pp.276-286.*

5. Huajie Gu, Jun Wang, **Qin Lin** and Qi Gong, 2015. "Automatic contour-based road network design for optimized wind farm micrositing", *IEEE Transactions on Sustainable Energy, 6(1), pp.281-289.*

6. **Qin Lin** and Jun Wang, 2014. "Vertically correlated echelon model for the interpolation of missing wind speed data", *IEEE Transactions on Sustainable Energy, 5(3), pp. 804-812.*

Conference papers

1. Emanuel Munoz Panduro[*], Dvij Kalaria, **Qin Lin**[+], and John M. Dolan. "Online Adaptive Compensation for Model Uncertainty Using Extreme Learning Machine-based Control Barrier Functions." In *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 10959-10966. IEEE.

2. Jialun Li[*], Xiaojia Xie, **Qin Lin**, Jianping He, and John M. Dolan. "Motion Planning by Search in Derivative Space and Convex Optimization with Enlarged Solution Space." In *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 13500-13507. IEEE, 2022.

3. Dvij Kalaria[*], **Qin Lin**[+], and John M. Dolan. "Delay-aware Robust Control for Safe Autonomous Driving." In *2022 IEEE Intelligent Vehicles Symposium (IV)*, pp. 1565-1571. IEEE, 2022. (selected for oral presentation, top %10)

4. Omid Jahanmahin[*], **Qin Lin**, Yanjun Pan, and John M. Dolan. "Jerk-Minimized CILQR for Human-Like Driving on Two-Lane Roadway." In *2021 IEEE Intelligent Vehicles Symposium (IV)*, pp. 1282-1289. IEEE, 2021.

5. **Qin Lin**, Sicco Verwer, and John M. Dolan, "Safety Verification of a Data-driven Adaptive Cruise Controller", *in 31st IEEE Intelligent Vehicle Symposium (IV), 2020 (pp. 1875-1880). IEEE*

6. Yanjun Pan[*], **Qin Lin**, Het Shah, John M. Dolan, "Safe Planning for Self-Driving Via Adaptive Constrained ILQR". *2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), (pp. 2377-2383). IEEE.*

7. **Qin Lin**, Xin Chen, Aman Khurana, John M. Dolan, "ReachFlow: An Online Safety Assurance Framework for Waypoint-Following of Self-driving Cars". *in 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), (pp. 6627-6632). IEEE.*

8. **Qin Lin**, Wenshuo Wang, Yihuan Zhang, and John M. Dolan, "Measuring Similarity of Interactive Driving Behaviors Using Matrix Profile". *In 2020 American Control Conference (ACC) (pp. 3965-3970). IEEE.*

9. **Qin Lin**, Sicco Verwer, Robert Kooij and Aditya Mathur, "Using Datasets from Industrial Control Systems for Cyber Security Research and Education". *In International Conference on Critical Information Infrastructures Security (pp. 122-133). Springer, 2019.*

10. **Qin Lin**, Sridha Adepu, Sicco Verwer, and Aditya Mathur, "TABOR: A Graphical Model-based Approach for Anomaly Detection in Industrial Control Systems". *In Proceedings of the 2018 on Asia Conference on Computer and Communications Security (pp. 525-536). ACM.* (acceptance rate: 62/320=20%)

11. Gaetano Pellegrino, Christian Hammerschmidt, **Qin Lin**, and Sicco Verwer, "Learning Deterministic Finite Automata from Infinite Alphabets". *In 2017 International Conference on Grammatical Inference (pp. 120-131).*

12. Gaetano Pellegrino, **Qin Lin**, Christian Hammerschmidt, and Sicco Verwer, "Learning Behavioral Fingerprints from Netflows Using Timed Automata". *In Integrated Network and Service Management (IM), 2017 IFIP/IEEE Symposium on (pp. 308-316). IEEE.* (acceptance rate: 44/154=28.6%)

13. Xiaoran Liu[*], **Qin Lin**, Sicco Verwer, and Dmitri Jarnikov, "Anomaly Detection in a Digital Video Broadcasting System Using Timed Automata", *Thirty-Second Annual ACM/IEEE Symposium on Logic in Computer Science (LICS) Workshop on Learning and Automata (LearnAut), 2017*

14. Yihuan Zhang, Jun Wang, **Qin Lin**, Sicco Verwer, and John M. Dolan, "A Data-driven Behavior Generation Algorithm in Car-following Scenarios". *In Dynamics of Vehicles on Roads and Tracks Vol 1: Proceedings of the 25th International Symposium on Dynamics of Vehicles on Roads and Tracks (IAVSD 2017), (pp. 227-232). CRC Press.*

15. Yihuan Zhang, **Qin Lin**, Jun Wang, and Sicco Verwer, "Car-following Behavior Model Learning Using Timed Automata". *IFAC-PapersOnLine, 50(1), 2017 (pp.2353-2358)*

16. **Qin Lin**, Christian Hammerschmidt, Gaetano Pellegrino, and Sicco Verwer, "Short-term Time Series Forecasting with Regression Automata", *ACM SIGKDD 2016 Workshop on Mining and Learning from Time Series (MiLeTS)*

17. Christian Hammerschmidt, Sicco Verwer, and **Qin Lin**, "Interpreting Finite Automata for Sequential Data", Interpretable Machine Learning for Complex Systems: NIPS 2016 workshop proceedings

18. **Qin Lin**, Jun Wang, and Weiting Qiao, "Denoising of Wind Speed Data by Wavelet Thresholding". *In Chinese Automation Congress (CAC), 2013 (pp. 518-521). IEEE*

Manuscripts

1. Dvij Kalaria[*], **Qin Lin**[+], and John M. Dolan, "Delay-aware Robust Control for Safe Autonomous Driving and Racing", submitted to IEEE TVT

2. Jinfeng Chen[*], **Qin Lin**[+], Zhiqiang Gao, and Fan Zhang, "Extended State Observer with Control Lyapunov and Barrier Functions for Uncertain Safety-Critical Control", submitted to IEEE ACC

3. Srujan Deolasee[*], **Qin Lin**[+], Jialun Li, and John M. Dolan, "Spatio-temporal Motion Planning for Autonomous Vehicles with Trapezoidal Corridors and Bezier Curves", submitted to IEEE ACC

Honors and Awards

- Winner of the Competition for Motion Planning of Autonomous Vehicles (ITSC 2021), with Shivesh Khaitan and John M. Dolan

FUNDING

- U.S. Department of Education, Modeling and Simulation Program, $ 1M, 2023-2025, PI: Dr. Yongxin Tao, co-PIs: Dr. Qin Lin, Dr. Wenbing Zhao, Dr. Navid Goudarzi

Professional service

Editorial Board

- Guest editor, Transportation Safety and Environment, Special Issue on *Eco-Safe and Efficient Automated Driving in Mixed Traffic: Theory and Applications*
- Editorial Board of Young Scientists, Journal of Computer Science and Technology (JCST), 2022.7-2024.6

Program Committee Member

- AAAI Student Abstract and Poster Program (2022, 2023)
- AIoTS-2022, in conjunction with 20th International Conference on Applied Cryptography and Network Security (ACNS 2022)

Journal reviewing

- Machine Learning
- IEEE Transactions on Intelligent Transportation Systems (TITS)

- IEEE Transactions on Vehicular Technology (TVT)
- IEEE Transactions on Intelligent Vehicles (TIV)
- IEEE Transactions on Human-Machine Systems (THMS)
- IEEE Robotics and Automation Letters (RA-L)
- IEEE Transactions on Automation Science and Engineering (TASE)
- IEEE Transactions on Dependable and Secure Computing (TDSC)
- IEEE Transactions on Sustainable Energy (TSE)
- Renewable Energy
- IET Renewable Power Generation
- Journal of Computer Science and Technology

Conference reviewing

- ACM Symposium on Applied Computing (SAC) (2016, 2017)
- European Conference on Artificial Intelligence (ECAI) (2016)
- International Joint Conference on Artificial Intelligence (IJCAI) (2018)
- Association for the Advancement of Artificial Intelligence (AAAI) (2019)
- IEEE International Conference on Robotics and Automation (ICRA) (2020, 2021, 2022)
- IFIP/IEEE Symposium on Integrated Network and Service Management (IM) (2018)
- International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research (CPAIOR) (2018)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) (2020)
- IEEE Intelligent Vehicle Symposium (IV) (2020, 2021)

Teaching

- **Teaching Assistant**, Delft University of Technology Cyber Data Analytics (CS4035), 2015-2018
  - published **one pedagogy paper** (C6) discussing how to design a project-centric cyber security graduate course.
- Lecture, CIS390/550, Introduction to Algorithms, CSU, 2022 Spring
- Lecture, CIS492, Machine Learning, CSU, 2022 Fall

Advising

- Xiaoran Liu, Anomaly Detection in a Digital Video Broadcasting System Using Timed Automata, master student, TU Delft
- Kaixin Ding, Real-time Intrusion Detection of Cyber Physical Systems, master student, TU Delft
- Alvin Shek, undergraduate research assistant, CMU
- Jialun Li, graduate from Shanghai Jiaotong University, research assistant, CMU
- Shivesh Khaitan, Master of Science in Robotics (MSR), CMU
- Dvij Kalaria, undergraduate from IIT kanpur, India, 2021 RISS program intern, CMU
- Emanuel Munoz, undergraduate from UTEC, Peru, 2021 RISS program intern, CMU
- Fan Zhang, Ph.D. student, CSU
- Jinfeng Chen, Ph.D. student, cosupervised with Prof. Zhiqiang Gao, CSU
- Colman McGuan, MSc, co-supervised with Prof. Chansu Yu, CSU
- Kushagra Gupt, BSc, Remote Intern, IIT Delhi, CSU

Referees

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- **John M. Dolan**
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- **Aditya P. Mathur**
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