Curriculum Vitae of Dongsheng Ding

CONTACT INFORMATION

Department of Electrical and Systems Engineering
University of Pennsylvania
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RESEARCH INTERESTS

My research interests lie in the interface of Optimization and Control, Machine Learning and Game Theory, and Probability and Statistics. Particularly, I am interested in developing reinforcement learning approaches for optimally controlling constrained and multi-agent dynamical systems, with applications in autonomous decision-making systems, toward a vision of safe, reliable, and trustworthy artificial intelligence systems. Also, I am interested in understanding other practical optimization and control problems, and developing adaptive, robust, and resilient algorithms to tackle them.

APPOINTMENT

Postdoctoral Researcher — Fall 2022 – Now
University of Pennsylvania
Host: Alejandro Ribeiro

EDUCATION

PhD in Electrical Engineering, GPA: 4.0/4.0 — Summer 2022
University of Southern California
Thesis: Provable reinforcement learning for constrained and multi-agent control systems
Advisor: Mihailo R. Jovanović

MS in Electrical Engineering, GPA: 3.9/4.0 — Summer 2017
University of Minnesota, Twin Cities

ME in Control Theory & Engineering, GPA: 3.7/4.0 — Spring 2015
BE in Automation, GPA: 3.8/4.0 — Summer 2011
Zhejiang University, Hangzhou, China
Master Thesis: Fractional-order nonlinear system control
Undergraduate Thesis: Central force optimization

SUBMITTED PAPERS

1. D. Ding, Z. Huan, and A. Ribeiro. "Resilient constrained reinforcement learning." arXiv:2312.17194 (under review)

REFEREED PUBLICATIONS

Journals

1. D. Ding, K. Zhang, J. Duan, T. Başar, and M. R. Jovanović. "Convergence and sample complexity of natural policy gradient primal-dual methods for constrained MDPs," *J. Mach. Learn. Res.*; also arXiv: 2206.02346, 2022. (under review)
2. D. Ding, X. Wei, Z. Yang, Z. Wang, and M. R. Jovanović. "Fast multi-agent temporal-difference learning via homotopy stochastic primal-dual optimization," arXiv:1908.02805, 2020. (under revision)

3. Q. Wang, J. Zhang, D. Ding, and D. Qi, "Adaptive Mittag-Leffler stabilization of a class of fractional order uncertain nonlinear systems," *Asian J. Control*, 18(6) 2343–2351, 2016.
4. D. Ding, D. Qi, and Q. Wang, "Asymptotic pseudo-state stabilization of uncertain fractional-order nonlinear systems with additive disturbance," *Nonlinear Dyn.*, 81(1) 667–677, 2015.
5. Q. Wang, D. Ding, and D. Qi, "Mittag-Leffler synchronization of uncertain fractional order chaotic systems," *Chinese Physics B*, 24(6), 2015.
6. D. Ding, D. Qi, and Q. Wang, "Nonlinear Mittag-Leffler stabilization of commensurate fractional-order nonlinear systems," *IET Control Theory Appl.*, 9(5) 681–690, 2014.
7. D. Ding, D. Qi, X. Luo, J. Chen, X. Wang, and P. Du, "Convergence analysis and performance of an extended central force optimization algorithm," *Appl. Math. Comput.*, 219(4), 2246–2259, 2012.
8. D. Ding, X. Luo, J. Chen, X. Wang, P. Du, and Y. Guo, "A convergence proof and parameter analysis of central force optimization algorithm," *J. Convergence Inf. Technol.*, 6(10), 16–23, 2011.

Machine Learning Conferences (Long Papers)

1. D. Ding, C.-Y. Wei, K. Zhang, and A. Ribeiro. "Last-iterate convergent policy gradient primal-dual methods for constrained MDPs," in *Proceedings of the Advances in Neural Information Processing Systems*, New Orleans, Louisiana, 2023. (acceptance rate 26.1%)
2. D. Ding, X. Wei, Z. Yang, Z. Wang, and M. R. Jovanović. "Sample efficient genearalized Lagrangian policy optimization for safe multi-agent reinforcement learning," in *Proceedings of the Learning for Dynamics and Control Conference*, Philadelphia, Pennsylvania, 2023.
3. D. Ding, C.-Y. Wei, K. Zhang, and M. R. Jovanović. "Independent policy gradient for large-scale Markov potential games: sharper rates, function approximation, and game-agnostic convergence," in *Proceedings of the 39th International Conference on Machine Learning*, Baltimore, Maryland, 2022. (acceptance rate 21.5%, 118/1117 long presentations)
4. D. Ding, X. Wei, Z. Yang, Z. Wang, and M. R. Jovanović. "Provably efficient safe exploration via primal-dual policy optimization," in *Proceedings of the 24th International Conference on Artificial Intelligence and Statistics*, Virtual, 2021. (acceptance rate 30%, 48/455 orals)
5. D. Ding, K. Zhang, T. Başar, and M. R. Jovanović. "Natural policy gradient primal-dual method for constrained Markov decision processes," in *Proceedings of the Advances in Neural Information Processing Systems*, Virtual, 2020. (acceptance rate 20%)

Control Conferences (Short Papers)

1. D. Ding and M. R. Jovanović. "Policy gradient primal-dual mirror descent for constrained MDPs with large state spaces," in *Proceedings of the 61st IEEE Conference on Decision and Control*, Cancún, Mexico, 2022.
2. D. Ding, K. Zhang, T. Basar and M. R. Jovanović, "Convergence and optimality of policy gradient primal-dual method for constrained Markov decision processes," in *Proceedings of the 2022 American Control Conference*, Atlanta, Georgia, 2022.
3. D. Ding, X. Wei, H. Yu, and M. R. Jovanović. "Byzantine-resilient distributed learning under constraints," in *Proceedings of the 2021 American Control Conference*, Virtual, 2021.
4. D. Ding, J. Yuan, and M. R. Jovanović. "Discounted online Newton method for time-varying time series prediction," in *Proceedings of the 2021 American Control Conference*, Virtual, 2021.
5. D. Ding and M. R. Jovanović. "Global exponential stability of primal-dual gradient flow dynamics based on the proximal augmented Lagrangian," in *Proceedings of the 59th IEEE Conference on Decision and Control*, Virtual, 2020.
6. D. Ding, X. Wei, Z. Yang, Z. Wang, and M. R. Jovanović. "Fast multi-agent temporal-difference learning via homotopy stochastic primal-dual method," in *the Optimization Foundations for Reinforcement Learning Workshop at NeurIPS*, Vancouver, Canada, 2019.
7. D. Ding, X. Wei, and M. R. Jovanović. "Distributed robust statistical learning: Byzantine mirror descent," in *Proceedings of the 58th IEEE Conference on Decision and Control*, Nice, France, 2019.
8. D. Ding and M. R. Jovanović. "Global exponential stability of primal-dual gradient flow dynamics based on the proximal augmented Lagrangian," in *Proceedings of the 2019 American Control Conference*, Philadelphia, Pennsylvania, 2019.
9. D. Ding, B. Hu, N. K. Dhingra, and M. R. Jovanović. "An exponentially convergent primal-dual algorithm for nonsmooth composite minimization," in *Proceedings of the 57th IEEE Conference on Decision and Control*, Miami Beach, Florida, 2018.
10. D. Ding and M. R. Jovanović. "A primal-dual Laplacian gradient flow dynamics for distributed resource allocation problems," in *Proceedings of the 2018 American Control Conference*, Milwaukee, Wisconsin, 2018.
11. D. Ding, D. Qi, and Q. Wang, "Adaptive Mittag-Leffler stabilization of commensurate fractional-order nonlinear systems," in *Proceedings of the 53rd IEEE Conference on Decision and Control*, Los Angeles, California, 2014.
12. D. Ding, G. Zhang, D. Qi, and H. Zhang, "Strategy analysis of an evolutionary spectrum sensing game," in *the Intelligent Computing and Applications (LSMS & ICSEE)*, Shanghai, China, 2014. (nominate paper award)

13. D. Ding, D. Qi, and Q. Wang, "Alternative LMI characterizations for fractional-order linear systems," in *Proceedings of the 33rd Chinese Control Conference*, Nanjing, China, 2014.
14. D. Ding, D. Qi, and Q. Wang, "Fractional-order integral state space modeling and quasi state analysis via block operational matrix scheme," in *Proceedings of the 26th Chinese Control and Decision Conference*, Changsha, China, 2014.

TALKS & POSTERS

1. **Invited talk** of "Constrained policy optimization: a tale of regularization and optimism," in *the ESE PhD colloquium*, UPenn, 2023.
2. Contributed talk & poster of "Last-iterate convergent policy gradient primal-dual methods for constrained MDPs" in *the 37th Conference on Neural Information Processing Systems*, New Orleans, Louisiana, 2023.
3. **Invited talk** of "Provable constrained policy optimization in reinforcement learning," in *the Safe Reinforcement Learning Online Seminar*, Virtual, 2023.
4. Contributed poster of "Sample efficient genearalized Lagrangian policy optimization for safe MARL" in *the 5th Annual Learning for Dynamics and Control Conference*, Philadelphia, Pennsylvania, 2023.
5. Contributed talk of "Policy gradient primal-dual mirror descent for constrained MDPs with large state spaces," in *the 61st IEEE Conference on Decision and Control*, Cancún, Mexico, 2022.
6. **Invited talk** of "Finite-time performance of policy optimization methods for constrained reinforcement learning," in *the INFORMS 2022 Annual Meeting*, Indianapolis, Indiana, 2022.
7. Contributed talk of "Policy gradient primal-dual method for constrained MDPs," in *the 2022 American Control Conference*, Atlanta, Georgia, 2022.
8. Contributed talk & poster of "Independent policy gradient for large-scale Markov potential games: sharper rates, function approximation, and game-agnostic convergence" in *the 39th International Conference on Machine Learning*, Baltimore, Maryland, 2022. (118/1117 long presentations)
9. **Invited poster** of "Independent policy gradient for large-scale Markov potential games" in *the REAL@USC-Meta center workshop*, ECE, USC, 2022.
10. **Invited poster** of "Provably efficient safe exploration via primal-dual policy optimization" in *the 11th Annual Research Festival*, ECE, USC, 2021.
11. **Invited talk** of "Provable constrained policy optimization for reinforcement learning" in *the 38th Southern California Control Workshop*, University of California, Irvine, California, Virtual, 2021.
12. Contributed talk & poster of "Provably efficient safe exploration via primal-dual policy optimization" in *the 24th International Conference on Artificial Intelligence and Statistics*, Virtual, 2021. (48/455 orals)

13. Contributed talk & poster of "Natural Policy Gradient Primal-Dual Method for Constrained Markov Decision Processes" in *the 34th Conference on Neural Information Processing Systems*, Virtual, 2020.
14. Contributed talk of "Global exponential stability of primal-dual gradient flow dynamics based on the proximal augmented Lagrangian" in *the 59th IEEE Conference on Decision and Control*, Virtual, 2020.
15. Contributed poster of "Fast multi-agent temporal-difference learning via homotopy stochastic primal-dual method," in *the Optimization Foundations for Reinforcement Learning Workshop at NeurIPS*, Vancouver, Canada, 2019; *the Southern California Machine Learning Symposium*, UCSD, 2020.
16. **Invited poster** of "Distributed robust statistical learning: Byzantine mirror descent" in *the 10th Annual Research Festival*, ECE, USC, 2019.
17. Contributed talk of "Exponential stability of primal-dual gradient flow dynamics based on proximal augmented Lagrangian," in *the 2019 American Control Conference*, Philadelphia, Pennsylvania, 2019.
18. Contributed talk of "Nonsmooth composite minimization: an exponentially convergent primal-dual algorithm," in *the 57th IEEE Conference on Decision and Control*, Miami Beach, Florida, 2018.
19. **Invited poster** of "An exponentially stable primal-dual algorithm for nonsmooth optimization" in *the 9th Annual Research Festival*, ECE, USC, 2018.
20. Contributed talk of "A primal-dual Laplacian gradient flow dynamics for distributed resource allocation problems," in *the 2018 American Control Conference*, Milwaukee, Wisconsin, 2018.
21. **Invited talk** of "A primal-dual algorithm for distributed resource allocation" in *the 34th Southern California Control Workshop*, University of California, Riverside, California, 2018.
22. Contributed talk of "Adaptive Mittag-Leffler stabilization of commensurate fractional-order nonlinear systems" in *the 53rd IEEE Conference on Decision and Control*, Los Angeles, California, 2014.
23. Contributed talk of "Alternative LMI characterizations for fractional-order linear systems" in *the 33rd Chinese Control Conference*, Nanjing, China, 2014.
24. Contributed talk of "Fractional-order integral state space modeling" in *the 26th Chinese Control and Decision Conference*, Changsha, China, 2014.

HONORS & AWARDS

Scholar Award, Conference on Neural Information Processing Systems	2023
Expert Reviewers, International Conference on Machine Learning	2021
Travel Award, Conference on Neural Information Processing Systems	2020
Top Reviewers, International Conference on Machine Learning	2020
Travel Award, IEEE Conference on Decision and Control	2020
Travel Award, American Control Conference	2018, 2019, 2022

MHI PhD Scholar Finalist, ECE, University of Southern California	2018, 2021
ECE Department Fellowship, University of Minnesota	2015
Honor for Outstanding Graduate Student, Zhejiang University	2015
Nominate Paper Award, LSMS & ICSEE, 2014, Shanghai	2014
Bosch Scholarship, Bosch in China	2013
The First-Class of Graduate Scholarship, Zhejiang University	2012–2015
National Scholarship, Ministry of Education of P.R. China	2011
Wei Shaoxiang Engineering Talent, Wei Shaoxiang Foundation, HongKong	2010
The Second-Class of Physics and Technology Innovation Contest, Zhejiang Physical Society, Zhejiang, China	2009
The First-Class of Advanced Mathematics Contest, Zhejiang Mathematical Society, Zhejiang, China	2008

ACADEMIC SERVICE

Journal Referee

IEEE Transactions on Control of Network Systems
IEEE Transactions on Automatic Control
IEEE Robotics and Automation Letters
IEEE Control Systems Letters
Systems & Control Letters
Optimization Letters
Automatica
IEEE Access
Nonlinear Dynamics
IET Control Theory & Applications
International Journal of Robust and Nonlinear Control
Frontiers of Information Technology & Electronic Engineering
International Journal of Systems Science
The Journal of the Franklin Institute
Journal of Applied Mathematics and Computing
IEEE Transactions on Pattern Analysis and Machine Intelligence
APSIPA Transactions on Signal and Information Processing
Transactions on Machine Learning Research
Journal of Machine Learning Research
Machine Learning

Conference Referee

IEEE Conference on Decision and Control	2018–2023
Conference on Neural Information Processing Systems	2020–2023
International Conference on Learning Representations	2021–2024
International Conference on Artificial Intelligence and Statistics	2021
International Conference on Machine Learning	2020–2024
AAAI Conference on Artificial Intelligence	2023, 2024
American Control Conference	2018–2024

IFAC World Congress 2020
Chinese Control Conference 2014
Chinese Control and Decision Conference 2014

Conference Volunteer
38th International Conference on Machine Learning, Virtual 2021, 2022
24th International Conference on Artificial Intelligence and Statistics, Virtual 2021
35th Conference on Neural Information Processing Systems, Virtual 2021

Co-chair of Nonlinear System and Control Section
26th Chinese Control and Decision Conference, Changsha, China 2014

Admissions Committee, University of Pennsylvania
PhD Admission in the Department of Electrical and Systems Engineering Fall 2023

TEACHING EXPERIENCE

Guest Lecturer, University of Pennsylvania
ESE 5140 Graph Neural Networks Fall 2023

Teaching Assistant, University of Southern California
EE 587 Nonlinear Systems Spring 2018

Guest Lecturer, University of Minnesota Twin Cities
EE 3015 Statistical Methods in Electrical and Computer Engineering Spring 2017

Teaching Assistant, University of Minnesota Twin Cities
EE 4231 Automatic Control Systems Fall 2016
EE 3015 Statistical Methods in Electrical and Computer Engineering Spring 2017
EE 8231 Optimization Theory Spring 2017

MENTORING EXPERIENCE

Mentor for PhD Students, University of Pennsylvania
Berkay Uslu (2nd year) Fall 2023 – Now
Topic: Constrained diffusion models
Shervin Khalafi (2nd year) Fall 2023 – Now
Topic: Constrained diffusion models

Mentor for Master Students, University of Pennsylvania
Zhengyan Huan (2nd year) Summer 2023 – Now
Topic: Resilient constrained reinforcement learning
Yi Zhao (1st year) Summer 2023 – Now
Topic: Risk-constrained reinforcement learning

Mentor for Undergraduate Students, University of Southern California
Directed Research 490 Spring 2022

Mentor for Master Students, University of Southern California

Viterbi Graduate Mentorship Program Fall 2018 – Summer 2021

SKILLS Python, LaTeX, C/C++, Matlab, SQL

MEMBERSHIPS The Institute of Electrical and Electronics Engineers (IEEE)
IEEE Control Systems Society Membership
The Institute for Operations Research and the Management Sciences (INFORMS)
Stanford Encyclopedia of Philosophy

GRADUATE COURSE HIGHLIGHTS **Control Systems:** EE 5231 Linear System and Optimal Control, EE 8215 Nonlinear Systems, AEM 8421 Robust Multi-Variable Control Systems, AEM 8423 Convex Optimization Methods in Control; **Optimization and Computation:** EE 5239 Introduction to Nonlinear Optimization, EE 8231 Optimization Theory, ISE 633 Large-Scale Optimization for Machine Learning, CSCI 5304 Computational Aspects of Matrix Theory, CSCI 8314 Sparse Matrix Computations; **Probability and Machine Learning:** MATH 507A/B Theory of Probability, EE 556 Stochastic Systems & Reinforcement Learning, CSCI 5525 Machine Learning, EE 546 Mathematics of High-Dimensional Data, DSO 699 Statistical Learning Theory, CSCI 699 Theoretical Machine Learning, EE 5581 Information Theory and Coding.