Dongsheng Ding

CONTACT INFORMATION	Department of Electrical and Systems Engineering University of Pennsylvania 3401 Walnut Street, Philadelphia, PA 19104	Office: Warren Center 454C Phone: (213) 574–9471 E-mail: dongshed@seas.upenn.edu

APPOINTMENT

Postdoctoral Researcher   Fall 2022 – Now
University of Pennsylvania
Advisor: Professor 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: Professor 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

RESEARCH INTERESTS

My research interests lie in the interface of Optimization, Control Theory, and Reinforcement Learning. My current research focuses on the analysis and design of control and decision-making methods for dealing with real-world environments, e.g., safety/risk constraints, multi-agent interactions, and unknown/time-varying dynamics. Applications include autonomous robotics, smart grid, and transportation systems.

PREPRINTS

1. D. Ding, X. Wei, Z. Yang, Z. Wang, and M. R. Jovanović. "Sample efficient genearalized Lagrangian policy optimization for safe multi-agent reinforcement learning," submitted.

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," *IEEE Trans. Autom. Control*; also arXiv:1908.02805, 2020. (under review)

3. Q. Wang, J. Zhang, <u>D. Ding</u>, 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. <u>D. Ding</u>, 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, <u>D. Ding</u>, and D. Qi, "Mittag-Leffler synchronization of uncertain fractional order chaotic systems," *Chinese Physics B*, 24(6), 2015.

6. <u>D. Ding</u>, 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. <u>D. Ding</u>, 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. <u>D. Ding</u>, 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.

Conferences

1. <u>D. Ding</u> 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. (to appear)

2. <u>D. Ding</u>, 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 MD, 2022. (acceptance rate 21.5%, long presentation)

3. <u>D. Ding</u>, 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.

4. <u>D. Ding</u>, X. Wei, H. Yu, and M. R. Jovanović. "Byzantine-resilient distributed learning under constraints," in *Proceedings of the 2021 American Control Conference*, New Orleans, Louisiana, 2021.

5. <u>D. Ding</u>, J. Yuan, and M. R. Jovanović. "Discounted online Newton method for time-varying time series prediction," in *Proceedings of the 2021 American Control Conference*, New Orleans, Louisiana, 2021.

6. <u>D. Ding</u>, 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)

7. 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%)

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 59th IEEE Conference on Decision and Control*, Virtual, 2020.

9. 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.

10. 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.

11. 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.

12. 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.

13. 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.

14. 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.

15. 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)

16. 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.

17. 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 "Finite-time performance of policy optimization methods for constrained reinforcement learning," in *the INFORMS 2022 Annual Meeting*, Indianapolis, Indiana, 2022.

2. Contributed talk of "Policy gradient primal-dual method for constrained MDPs," in *the 2022 American Control Conference*, Atlanta, Georgia, 2022.

3. 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 MD, 2022.

4. Invited poster of "Independent policy gradient for large-scale Markov potential games" in *the REAL@USC-Meta center workshop*, ECE, USC, 2022.

5. Invited poster of "Provably efficient safe exploration via primal-dual policy optimization" in *the 11th Annual Research Festival*, ECE, USC, 2021.

6. Invited talk of "Provable constrained policy optimization for reinforcement learning" in *the 38th Southern California Control Workshop*, University of California, Irvine, California, Virtual, 2021.

7. 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)

8. 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.

9. 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.

10. 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.

11. Invited poster of "Distributed robust statistical learning: Byzantine mirror descent" in *the 10th Annual Research Festival*, ECE, USC, 2019.

12. 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.

13. 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.

14. Invited poster of "An exponentially stable primal-dual algorithm for nonsmooth optimization" in *the 9th Annual Research Festival*, ECE, USC, 2018.

15. Contributed talk of "A primal-dual Laplacian gradient flow dynamics for distributed resource allocation problems," in *the 2018 American Control Conference*, Milwaukee, Wisconsin, 2018.

16. Invited talk of "A primal-dual algorithm for distributed resource allocation" in *the 34th Southern California Control Workshop*, University of California, Riverside, California, 2018.

17. 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.

18. Contributed talk of "Alternative LMI characterizations for fractional-order linear systems" in *the 33rd Chinese Control Conference*, Nanjing, China, 2014.

19. Contributed talk of "Fractional-order integral state space modeling" in *the 26th Chinese Control and Decision Conference*, Changsha, China, 2014.

HONORS & AWARDS	

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 & TEACHING ACTIVITIES

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

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
Nonlinear Dynamics
Journal of Applied Mathematics and Computing
IEEE Transactions on Pattern Analysis and Machine Intelligence
Transactions on Machine Learning Research
Journal of Machine Learning Research
Machine Learning
IEEE Conference on Decision and Control, 2018, 2019, 2020, 2021, 2022
Conference on Neural Information Processing Systems, 2020, 2021, 2022
International Conference on Learning Representations, 2021, 2022, 2023
International Conference on Artificial Intelligence and Statistics, 2021
International Conference on Machine Learning, 2020, 2021, 2022
AAAI Conference on Artificial Intelligence, 2023
American Control Conference, 2018, 2019, 2020, 2021, 2022, 2023
IFAC World Congress, 2020
Chinese Control Conference, 2014
Chinese Control and Decision Conference, 2014

Volunteer for Conference
38th International Conference on Machine Learning, Virtual, 2021, 2022
24th International Conference on Artificial Intelligence and Statistics, Virtual, 2021
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

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

Mentor for Graduate Students, University of Southern California
Viterbi Graduate Mentorship Program, Fall 2018 – Summer 2021

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

MEMBERSHIPS   The Institute of Electrical and Electronics Engineers (IEEE)
                IEEE Control Systems Society Membership
                Stanford Encyclopedia of Philosophy

GRADUATE COURSE **Control Systems:** EE 5231 Linear System and Optimal Control, EE 8215 Nonlin-
HIGHLIGHTS   ear Systems, AEM 8421 Robust Multi-Variable Control Systems, AEM 8423 Convex
                 Optimization Methods in Control; **Optimization and Computation:** EE 5239 Intro-
                 duction 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.