

Dongsheng Ding

CONTACT INFORMATION	Department of Electrical and Computer Engineering	Office: EEB 320
	University of Southern California	Phone: (213) 574-9471
	3740 McClintock Avenue, Los Angeles, CA 90007	E-mail: dongshed@usc.edu
EDUCATION	PhD Candidate , Electrical Engineering, GPA: 4.0/4.0 Summer 2022 (expected) University of Southern California 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	
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, personalized medicine, and intelligent transportation systems.	
RESEARCH EXPERIENCE	Multi-Agent Reinforcement Learning Fall 2018 – Now Design fast multi-agent temporal-difference learning algorithms Develop independent policy gradient methods for Markov potential games	
	Constrained Reinforcement Learning Fall 2018 – Now Analyze policy gradient methods for constrained reinforcement learning Develop provably efficient constrained policy optimization algorithms	
	Distributed Statistical Learning Fall 2018 – Now Analyze distributed computational model with Byzantine failures Propose Byzantine dual averaging algorithm for unconstrained optimization Propose Byzantine primal-dual algorithm for constrained optimization	
	Optimization from Control Theory Perspective Summer 2017 – Now Analyze augmented Lagrangian method for non-smooth composite optimization Establish exponential stability for proximal primal-dual gradient flow dynamics Propose primal-dual gradient flow dynamics for distributed resource allocation	
	Nonlinear Control in Fractional Calculus Fall 2012 – Spring 2015	

Construct fractional Lyapunov functions in Mittag-Leffler stability
Generalize back-stepping design to fractional nonlinear systems

Physically-Inspired Heuristic Algorithms

Fall 2010 – Fall 2011

Investigate optimization mechanism in multi-body system
Propose and analyze central force optimization algorithms

PREPRINTS

1. D. Ding, X. Wei, Z. Yang, Z. Wang, and M. R. Jovanović. “Sample efficient generalized Lagrangian policy optimization for safe multi-agent reinforcement learning,” submitted.
2. D. Ding and M. R. Jovanović. “Policy gradient primal-dual mirror descent for constrained MDPs with large state spaces,” submitted.

REFEREED

Journals

PUBLICATIONS

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, 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.

Conferences

1. 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 MD, 2022. (acceptance rate 21.5%, long presentation)
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. (to appear)
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*, New Orleans, Louisiana, 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*, New Orleans, Louisiana, 2021.
5. 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)
6. 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%)
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.

12. 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.
13. 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.
14. 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)
15. 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.
16. 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. Poster of “Independent policy gradient for large-scale Markov potential games” in *the REAL@USC-Meta center workshop*, ECE, USC, 2022.
2. Poster of “Provably efficient safe exploration via primal-dual policy optimization” in *the 11th Annual Research Festival*, ECE, USC, 2021.
3. Talk of “Provable constrained policy optimization for reinforcement learning” in *the 38th Southern California Control Workshop*, University of California, Irvine, California, Virtual, 2021.
4. 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)
5. 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.
6. 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.
7. 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.
8. Poster of “Distributed robust statistical learning: Byzantine mirror descent” in *the 10th Annual Research Festival*, ECE, USC, 2019.

9. Talk of “Exponential stability of primal-dual gradient flow dynamics based on proximal augmented Lagrangian,” in *the 2019 American Control Conference*, Philadelphia, Pennsylvania, 2019.
10. Talk of “Nonsmooth composite minimization: an exponentially convergent primal-dual algorithm,” in *the 57th IEEE Conference on Decision and Control*, Miami Beach, Florida, 2018.
11. Poster of “An exponentially stable primal-dual algorithm for nonsmooth optimization” in *the 9th Annual Research Festival*, ECE, USC, 2018.
12. Talk of “A primal-dual Laplacian gradient flow dynamics for distributed resource allocation problems,” in *the 2018 American Control Conference*, Milwaukee, Wisconsin, 2018.
13. Talk of “A primal-dual algorithm for distributed resource allocation” in *the 34th Southern California Control Workshop*, University of California, Riverside, California, 2018.
14. 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.
15. Talk of “Alternative LMI characterizations for fractional-order linear systems” in *the 33rd Chinese Control Conference*, Nanjing, China, 2014.
16. 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
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
International Conference on Artificial Intelligence and Statistics, 2021
International Conference on Machine Learning, 2020, 2021, 2022
American Control Conference, 2018, 2019, 2020, 2021, 2022
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
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 – Now

SKILLS	Matlab, C/C++, Python, L ^A T _E X, SQL
MEMBERSHIPS	The Institute of Electrical and Electronics Engineers (IEEE) IEEE Control Systems Society Membership 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.