

Yongxin Chen

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RESEARCH INTERESTS I am interested in the intersection between control, machine learning, optimization, and robotics. My current research topics include theoretical foundations of machine learning and general purpose robots. I also work on optimal transport theory, algorithms and applications.

PROFESSIONAL APPOINTMENTS **Assistant Professor**
School of Aerospace Engineering, Institute for Robotics and Intelligent Machines, Machine Learning Center, Georgia Institute of Technology, 2018 - Present.

Assistant Professor
Department of Electrical and Computer Engineering, Iowa State University, 2017 - 2018.

Research Fellow
Memorial Sloan Kettering Cancer Center (MSKCC), New York, 2016 - 2017.

EDUCATION **PhD in Mechanical Engineering**
University of Minnesota, Minneapolis, 2011 - 2016.
Thesis: *Modeling and control of collective dynamics: from Schrödinger bridges to optimal mass transport*

Advisor: Prof. **Tryphon T. Georgiou**.

Minor: Mathematics

BS in Mechanical Engineering
Shanghai Jiao Tong University, Shanghai, China, 2007 - 2011.

HONORS AND AWARDS 1. NSF CAREER Award, 2020.
2. *George S. Axelby Best Paper Award*, IEEE Transaction on Automatic Control, 2017, “Optimal steering of a linear stochastic system to a final probability distribution, Part I”.
3. Doctoral Dissertation Fellowship (DDF), University of Minnesota, 2015-2016.
4. National Scholarship, Shanghai Jiao Tong University, China, 2008.

JOURNAL PAPERS (ACCEPTED) 1. Y. Chen, T. T. Georgiou, and M. Pavon. “Fast cooling for a system of stochastic oscillators”, *Journal of Mathematical Physics*, **56** (11), p. 113302, 2015.
2. Y. Chen, T. T. Georgiou. “Stochastic bridges of linear systems”, *IEEE Trans. Automat. Control*, **61** (2), pp. 526-531, 2016.

3. Y. Chen, T. T. Georgiou, and M. Pavon. “Optimal steering of a linear stochastic system to a final probability distribution, part I”, *IEEE Trans. Automat. Control*, **61** (5), pp. 1158-1169, 2016. **George S. Axelby Best Paper Award, IEEE Transaction on Automatic Control, 2016**
4. Y. Chen, T. T. Georgiou, and M. Pavon. “Optimal steering of a linear stochastic system to a final probability distribution, part II”, *IEEE Trans. Automat. Control*, **61** (5), pp. 1170-1180, 2016.
5. Y. Chen, T. T. Georgiou, and M. Pavon. “On the relation between optimal transport and Schrödinger bridges: A stochastic control viewpoint”, *Journal of Optimization Theory and Applications*, **169** (2), pp. 671-691, 2016.
6. Y. Chen, T. T. Georgiou, and M. Pavon. “Entropic and displacement interpolation: a computational approach using the Hilbert metric”, *SIAM Journal on Applied. Math.*, **76** (6), pp. 2375-2396, 2016.
7. A. Zare, Y. Chen, M. R. Jovanović and T. T. Georgiou. “Low-complexity modeling of partially available second-order statistics via matrix completion”, *IEEE Trans. Automat. Control*, **62** (2), pp. 1368 - 1383, 2017.
8. Y. Chen, T. T. Georgiou, and M. Pavon. “Optimal transport over a linear dynamical system”, *IEEE Trans. Automat. Control*, **62** (5), pp. 2137 - 2152, 2017.
9. Y. Chen, T. T. Georgiou, M. Pavon, and A. Tannenbaum. “Robust transport over networks”, *IEEE Trans. Automat. Control*, **62** (9), pp. 4675 - 4682, 2017.
10. Y. Chen, T. T. Georgiou, L. Ning, and A. Tannenbaum. “Matricial Wasserstein-1 Distance”, *IEEE Control Systems Letters*, **1** (1), pp. 14 - 19, 2017.
11. Y. Chen, F. D. Cruz, R. Sandhu, A. Kung, P. Mundi, J. Deasy, and A. Tannenbaum “Pediatric Sarcoma Data Forms a Unique Cluster Measured via the Earth Mover’s Distance”, *Scientific Reports* **7**, article number: 7035, 2017.
12. Y. Chen, J. Karlsson, and T. T. Georgiou. “The role of the time-arrow in mean-square estimation of stochastic processes”, *IEEE Control Systems Letters*, **2** (1), pp. 85 - 90, 2018.
13. K. Yamamoto, Y. Chen, L. Ning, T. T. Georgiou and A. Tannenbaum “Regularization and Interpolation of Positive Matrices”, *IEEE Trans. Automat. Control*, **63** (4), pp. 1208 -1212, 2018.
14. Y. Chen, T. T. Georgiou, and A. Tannenbaum. “Matrix Optimal Mass Transport: a Quantum Mechanical Approach”, *IEEE Trans. Automat. Control*, **63** (8), pp. 2612 - 2619, 2018.
15. Y. Chen, T. T. Georgiou, M. Pavon, and A. Tannenbaum “Efficient-Robust Routing for Single Commodity Network Flows”, *IEEE Trans. Automat. Control*, **63** (7), pp. 2287 - 2294, 2018.
16. Y. Chen, T. T. Georgiou, and M. Pavon. “Optimal steering of a linear stochastic system to a final probability distribution, part III”, *IEEE Trans. Automat. Control*, **63** (9), pp. 3112 - 3118, 2018.
17. Y. Chen, and J. Karlsson. “State tracking of linear ensembles via optimal mass transport”, *IEEE Control Systems Letters*, **2** (2), pp. 260 - 265, 2018.

18. E. K. Ryu, Y. Chen, W. Li, and S. Osher. “Vector and Matrix Optimal Mass Transport: Theory, Algorithm, and Applications”, *SIAM Journal of Scientific Computing*, **40** (5), A3675-A3698, 2018.
19. Y. Chen, G. Conforti, and T.T. Georgiou. “Measure-valued spline curves: an optimal transport viewpoint”, *SIAM Journal of Mathematical Analysis*, **50** (6), pp. 5947 - 5968, 2018
20. Y. Chen, T. T. Georgiou, and A. Tannenbaum. “Vector-valued Optimal Mass Transport”, *SIAM Journal on Applied. Math*, **78** (3), pp. 1682 -1696, 2018.
21. Y. Chen, T.T. Georgiou, and M. Pavon. “Steering the Distribution of Agents in Mean-Field Games System”, *Journal of Optimization Theory and Applications*, **179** (1), pp. 332 - 357, 2018.
22. Y. Chen, T.T. Georgiou, and A. Tannenbaum. “Optimal transport for Gaussian mixture models”, *IEEE Access*, **7**, pp. 6269 - 6278, 2018.
23. Y. Chen, E. Haber, K. Yamamoto, T. T. Georgiou, and A. Tannenbaum. “An efficient algorithm for matrix-valued and vector-valued optimal mass transport”, *Journal of Scientific Computing*, **77** (1), pp. 79 - 100, 2018.
24. Y. Chen, T. T. Georgiou, and A. Tannenbaum. “Interpolation of Matrices and Matrix-Valued Measures: The Unbalanced Case”, *European Journal of Applied Mathematics*, **30** (3), pp. 458 - 480, 2019.
25. H. Farooq, Y. Chen, T.T. Georgiou, A. Tannenbaum, and C. Lenglet. “Network Curvature as a Hallmark of Brain Structural Connectivity”, *Nature Communications*, **10** (1), pp. 1 - 11, 2019.
26. Z. Askarzadeh, R. Fu, A. Halder, Y. Chen, and T.T. Georgiou. “Stability theory of stochastic models in opinion dynamics”, *IEEE Trans. Automat. Control*, **65** (2), pp. 522 - 533, 2019.
27. Y. Chen, T. T. Georgiou, M. Pavon, and A. Tannenbaum. “Relaxed Schrödinger bridges and robust network routing”, *IEEE Transactions on Control of Network Systems*, **7** (2), pp. 923 - 931, 2020.
28. Y. Chen, W. Gangbo, T. T. Georgiou, and A. Tannenbaum. “On the matrix Monge-Kantorovich problem”, *European Journal of Applied Mathematics*, **31** (4), pp. 574 - 600, 2020.
29. Y. Chen, T.T. Georgiou, and A. Tannenbaum. “Stochastic control and non-equilibrium thermodynamics: fundamental limits”, *IEEE Trans. Automat. Control*, **65** (7), pp. 2979 - 2991, 2020.
30. S. Lu, I. Tsaknakis, M. Hong and Y. Chen. “Hybrid Block Successive Approximation for One-Sided Non-Convex Min-Max Problems: Algorithms and Applications”, *IEEE Trans. Signal Processing*, **68**, pp. 3676 - 3691, 2020.
31. V. Ciccone, Y. Chen, T. T. Georgiou, and M. Pavon. “Regularized transport between singular covariance matrices”, *IEEE Trans. Automat. Control*, to appear.
32. W. Chen, D. Wang, J. Liu, Y. Chen, SZ. Khong, T. Basar, KH. Johansson, and L. Qiu. “On Spectral Properties of Signed Laplacians with Connections to Eventual Positivity”, *IEEE Trans. Automat. Control*, to appear.

33. I. Haasler, Y. Chen, and J. Karlsson. “Optimal Steering of Ensembles with Origin-Destination Constraints”, *IEEE Control Systems Letters*, to appear.
34. R. Singh, I. Haasler, Q. Zhang, J. Karlsson, and Y. Chen. “Incremental inference of collective graphical models”, *IEEE Control Systems Letters*, to appear.
35. Y. Chen, T. T. Georgiou, and M. Pavon. “Stochastic control liaisons: Richard Sinkhorn meets Gaspard Monge on a Schrödinger bridge”, *SIAM Review*, to appear.
36. I. Haasler, R. Singh, Q. Zhang, J. Karlsson, and Y. Chen. “Multi-marginal Optimal Transport and Probabilistic Graphical Models,” *IEEE Transactions on Information Theory*, to appear.
37. I. Haasler, A. Ringh, Y. Chen, and J. Karlsson. “Multi-marginal optimal transport with a tree-structured cost and the Schrödinger bridge problem,” *SIAM Journal on Control and Optimization*, to appear.
38. A. Taghvaei, O. M. Miangolarra, R. Fu, Y. Chen, and T. T. Georgiou. “On the relation between information and power in stochastic thermodynamic engine,” *IEEE Control Systems Letters*, to appear.
39. W. Haddad, Y. Chen, and M. Lanchares. “Mixed Norm H_2/H_∞ and Entropy Covariance Control: A Convex Optimization Approach”, in *International Journal of Control*, to appear.
40. R. Fu, A. Taghvaei, Y. Chen, and T. T. Georgiou. “Maximal Power Output of a Stochastic Thermodynamic Engine,” *Automatica*, to appear.
41. Y. Chen, T. T. Georgiou, and M. Pavon. “Optimal Transport in Systems and Control,” *Annual Review of Control, Robotics, and Autonomous Systems*, to appear.

JOURNAL PAPERS
(UNDER REVIEW)

1. R. Singh, Q. Zhang, and Y. Chen. “Learning Hidden Markov Models from Aggregate Observations”, 2020.
2. R. Singh, I. Haasler, Q. Zhang, J. Karlsson, and Y. Chen. “Inference with Aggregate Data: An Optimal Transport Approach”, 2020.

CONFERENCE
PAPERS
(SELECTED)

1. Y. Zhang, Q. Cai, Z. Yang, Y. Chen, and Z. Wang “Can Temporal-Difference and Q-Learning Learn Representation? A Mean-Field Theory”, in *2020 Conference on Neural Information Processing Systems*, **Oral**, Vancouver, Canada, 2020.
2. R. Singh, Q. Zhang, and Y. Chen. “Improving Robustness via Risk Averse Distributional Reinforcement Learning”, in *2nd Learning for dynamics & control conference*, Berkeley, 2020.
3. Z. Yi, Z. Cao, E. Theodorou, and Y. Chen. “Nonlinear Covariance Control via Differential Dynamic Programming”, in *2020 American Control Conference*, Denver, CO, 2020.
4. W. Haddad, Y. Chen, and M. Lanchares. “Mixed Norm H_2/H_∞ and Entropy Covariance Control: A Convex Optimization Approach”, in *2020 American Control Conference*, Denver, CO, 2020.
5. Z. Fu, Z. Yang, Y. Chen, and Z. Wang. “Actor-Critic Provably Finds Nash Equilibria of Linear-Quadratic Mean-Field Games” in *International Conference on Learning Representations 2020*, Addis Ababa, Ethiopia, 2020.

6. Z. Yang, Y. Chen, M. Hong, and Z. Wang. “Provably Global Convergence of Actor-Critic: A Case for Linear Quadratic Regulator with Ergodic Cost” in *2019 Conference on Neural Information Processing Systems*, Vancouver, Canada, 2019.
7. S. Lu, R. Singh, X. Chen, Y. Chen, and M. Hong. “Alternating Gradient Descent Ascent for Nonconvex-strongly-concave Min-Max Optimization” in *53rd Asilomar Conference on Signals, Systems and Computers*, Asilomar, USA, 2019.
8. Y. Chen, T. T. Georgiou, and M. Pavon. “Covariance Steering in Zero-Sum Linear-Quadratic Two-Player Differential Games” in *58th IEEE Conference on Decision and Control*, Nice, France, 2019.
9. I. Haasler, A. Ringh, Y. Chen, and J. Karlsson. “Estimating Ensemble Flows on a Hidden Markov Chain” in *58th IEEE Conference on Decision and Control*, Nice, France, 2019.
10. D. Alpayo, Y. Chen, T. T. Georgiou, and M. Pavon. “On optimal steering of a non-Markovian Gaussian process” in *58th IEEE Conference on Decision and Control*, Nice, France, 2019.
11. Y. Chen, G. Conforti, T.T. Georgiou, and L. Ripani. “Multi-marginal Schrödinger bridges” in *4th conference on Geometric Science of Information*, Toulouse, France, 2019.
12. Y. Chen, and U. Vaidya. “Sample Complexity for Nonlinear Stochastic Dynamics” in *2019 American Control Conference*, Philadelphia, PA, 2019.
13. Z. Askarzadeh, R. Fu, A. Halder, Y. Chen, and T.T. Georgiou. “Stability Analysis of Opinion Dynamics Over Influence Networks” in *2019 American Control Conference*, Philadelphia, PA, 2019.
14. Y. Chen, T. T. Georgiou, and M. Pavon. “Steering the Distribution of Agents in Mean-Field Games” in *57th IEEE Conference on Decision and Control*, Miami Beach, FL, USA, 2018.
15. Y. Chen, T. T. Georgiou, and A. Tannenbaum. “Wasserstein Geometry of Quantum States and Optimal Transport of Matrix-Valued Measures ” in *Workshop of Emerging Applications of Control and System Theory (EACST), 2017 (Dedicated to Professor Mathukumalli Vidyasagar on his 70th birthday.)*
16. J. Lerner, R. Sandhu, Y. Chen, and A. Tannenbaum “Machine Learning for Joint Classification and Segmentation” in *Workshop of Emerging Applications of Control and System Theory (EACST), 2017 (Dedicated to Professor Mathukumalli Vidyasagar on his 70th birthday.)*
17. H. Farooq, Y. Chen, T.T. Georgiou, and C. Lenglet. “Brain Parcellation and Connectivity Mapping using Wasserstein Geometry” in *20th International Conference on Medical Image Computing and Computer Assisted Intervention*, 2017.
18. Y. Chen, J. H. Oh, R. Sandhu, S. Lee, J.O. Deasy, and A. Tannenbaum. “Transcriptional responses to ultraviolet and ionizing radiation: An approach based on graph curvature” in *IEEE International Conference on Bioinformatics and Biomedicine*, 2016.
19. Y. Chen, T. T. Georgiou, M. Pavon, and A. Tannenbaum. “A new approach to robust transportation over networks” in *Proceedings of the 55th IEEE Conference on Decision and Control*, Las Vegas, NV, USA, 2016.

20. H. Farooq, Y. Chen, T.T. Georgiou, and C. Lenglet. “Some geometric ideas for feature enhancement of diffusion tensor fields” in *Proceedings of the 55th IEEE Conference on Decision and Control*, Las Vegas, NV, USA, 2016.
21. W. Chen, J. Liu, Y. Chen, S.Z. Khong, D. Wang, T. Basar, L. Qiu, and K. H. Johansson. “Characterizing the Positive Semidefiniteness of Weighted Laplacians via Generalized Effective Resistances” in *Proceedings of the 55th IEEE Conference on Decision and Control*, Las Vegas, NV, USA, 2016.
22. Y. Chen, S. Z. Khong, and T. T. Georgiou. “On the definiteness of graph Laplacians with negative weights: Geometrical and passivity-based approaches” in *2016 American Control Conference*, Boston, MA, USA, 2016.
23. Y. Chen, T. T. Georgiou, and M. Pavon. “Steering state statistics with output feedback” in *Proceedings of the 54th IEEE Conference on Decision and Control*, Osaka, Japan, 2015.
24. Y. Chen, T. T. Georgiou, and M. Pavon. “Optimal control of the state statistics for a linear stochastic system” in *Proceedings of the 54th IEEE Conference on Decision and Control*, Osaka, Japan, 2015.
25. Y. Chen, T. T. Georgiou, and M. Pavon. “Optimal mass transport over bridges” in *Proceedings of the 2nd Conference on Geometric Science of Information*, Paris, France, 2015.
26. Y. Chen, T. T. Georgiou, and M. Pavon. “Optimal steering of inertial particles diffusing anisotropically with losses” in *Proceedings of the 2015 American Control Conference*, Chicago, IL, USA, 2015.
27. Y. Chen and T. T. Georgiou. “The flatness of power spectral zeros and their significance in quadratic estimation” in *Proceedings of the 53rd IEEE Conference on Decision and Control*, Los Angeles, CA, USA, 2014.
28. Y. Chen, M. R. Jovanović, and T. T. Georgiou. “State covariances and the matrix completion problem” in *Proceedings of the 52nd IEEE Conference on Decision and Control*, Florence, Italy, 2013.

INVITED TALKS

1. “Graphical Optimal Transport and its Applications”, *Department of Mathematics, University of Georgia*, Athens, GA, 2021.
2. “Graphical Optimal Transport”, Workshop on Optimal Control, Optimal Transport, and Data Science, Institute for Mathematics and Its Applications, Minneapolis, 2020.
3. “Beyond Wasserstein geodesic: spline interpolation for probability distributions” *Department of Mathematics, Stanford University*, Stanford, CA, 2019.
4. “Measure-valued splines and matrix optimal transport” *Department of Mathematics, Georgia Institute of Technology*, Atlanta, GA, 2019.
5. “Optimization over probability measures” *University of Illinois at Urbana-Champaign*, Champaign, IL, 2019.
6. “Controlling Uncertainty” *Courant Institute of Mathematical Sciences*, New York, NY, 2018.
7. “Steering the distribution of agents in mean field games” *Michigan State University*, East Lansing, MI, 2018.

8. “Optimal mass transport: theory, algorithm and applications” *University of Wisconsin-Madison*, Madison, WI, 2018.
9. “Vector and matrix optimal mass transport: theory and algorithm” *Department of Mathematics, Iowa State University*, Ames, IA, 2018.
10. “Matrix optimal mass transport, a Quantum mechanical approach” *University of California, Los Angeles*, Los Angeles, CA, 2017.
11. “Matrix optimal mass transport, a Quantum mechanical approach”, *Princeton University*, Princeton, NJ, 2017.
12. “Densities and flows with applications in signal/image processing and control”, *New York University*, New York, NY, 2017.
13. “Modeling and control of collective dynamics”, *Keio University*, Tokyo, Japan, 2015.
14. “Modeling and control of collective dynamics”, *University of Michigan*, Ann Arbor, MI, USA, 2015.
15. “Modeling and control of collective dynamics”, *Institute for Mathematics and its Applications (IMA)*, Minneapolis, MN, USA, 2015.
16. “Schrödinger bridges and the steering of stochastic and deterministic systems”, *Lund University*, Lund, Sweden, 2015.
17. “Schrödinger bridges and the steering of stochastic and deterministic systems”, *KTH Royal Institute of Technology*, Stockholm, Sweden, 2015.
18. “Schrödinger bridges and the steering of stochastic and deterministic systems”, *University of Athens*, Athens, Greece, 2015.

CONFERENCE
TALKS

1. “Nonlinear Covariance Control via Differential Dynamic Programming”, 2020 American Control Conference, Denver, CO, 2020.
2. “State Tracking of Linear Ensembles Via Optimal Mass Transport” in *57th IEEE Conference on Decision and Control*, Miami Beach, FL, USA, 2018.
3. “Steering the Distribution of Agents in Mean-Field Games” in *57th IEEE Conference on Decision and Control*, Miami Beach, FL, USA, 2018.
4. “Modeling and Control of collective dynamics” in *2017 American Control Conference*, Seattle, WA, USA, 2017.
5. “A new approach to robust transportation over networks” in *the 55th IEEE Conference on Decision and Control*, Las Vegas, NV, USA, 2016.
6. “An alternating minimization algorithm for structured covariance completion problems” in *the 22nd International Symposium on Mathematical Theory of Networks and Systems*, Minneapolis, MN, USA, 2016.
7. “Stochastic control, entropic interpolation and gradient flows on Wasserstein product spaces” in *the 22nd International Symposium on Mathematical Theory of Networks and Systems*, Minneapolis, MN, USA, 2016.
8. “Noncommutative Sinkhorn theorem and generalizations” in *the 22nd International Symposium on Mathematical Theory of Networks and Systems*, Minneapolis, MN, USA, 2016.

9. “Optimal steering of ensembles” in *the 22nd International Symposium on Mathematical Theory of Networks and Systems*, Minneapolis, MN, USA, 2016.
10. “On the definiteness of graph Laplacians with negative weights: Geometrical and passivity-based approaches”, *2016 American Control Conference*, Boston, MA, USA, 2016.
11. “Optimal Control of the State Statistics for a Linear Stochastic System”, *54th IEEE Conference on Decision and Control*, Osaka, Japan, 2015.
12. “Steering State Statistics with Output Feedback”, *54th IEEE Conference on Decision and Control*, Osaka, Japan, 2015.
13. “Optimal steering of inertial particles diffusing anisotropically with losses”, *2015 American Control Conference*, Chicago, IL, USA, 2015.
14. “Schrödinger bridges and the steering of stochastic and deterministic systems”, *Workshop “New challenges in reciprocal processes, Schrödinger bridges, optimal transport with application to control engineering problems for classical and quantum systems”*, Padova, Italy, 2015.
15. “The flatness of power spectral zeros and their significance in quadratic estimation”, *53rd IEEE Conference on Decision and Control*, Los Angeles, CA, USA, 2014.
16. “State covariances and the matrix completion problem”, *52nd IEEE Conference on Decision and Control*, Florence, Italy, 2013.

REFEREE

IEEE Transactions on Automatic Control (TAC)
 IEEE Transactions on Control of Network Systems (TCNS)
 IEEE Transactions on Control Systems Technology (TCST)
 IEEE Control Systems Letters (L-CSS)
 SIAM Journal on Mathematical Analysis (SIMA)
 Journal of Scientific Computing (JOMP)
 Optimal Control Applications and Methods
 IET Cyber-Physical Systems: Theory & Applications
 Systems & Control Letters
 IEEE Conference on Decision and Control
 International Symposium on Mathematical Theory of Networks and Systems
 American Control Conference
 European Control Conference
 International Conference on Learning Representations

WORKSHOP ORGANIZER

1. “Uncertainty Synthesis”, *58th Conference on Decision and Control*, Nice, France, 2019.
2. “Computational optimal transport for applications in control and estimation”, *58th Conference on Decision and Control*, Nice, France, 2019.
3. “Control of Distributions: Theory and Applications”, *2021 American Control Conference*, 2021.

ASSOCIATE
EDITOR

1. *24th International Symposium on Mathematical Theory of Networks and Systems*,
Cambridge, UK, 2020.

MEMBERSHIP

Institute of Electrical and Electronics Engineers (IEEE)
Society for Industrial and Applied Mathematics (SIAM)