Amirhossein Taghvaei

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Webpage: amirtag.github.io   University of Washington, Seattle, WA, 98195

PROFESSIONAL EXPERIENCE

Assistant Professor
William Boeing Department of Aeronautics & Astronautics
University of Washington, Seattle   September 2021-now

Postdoctoral Scholar
Department of Mechanical and Aerospace Engineering
University of California, Irvine   2019-2021

EDUCATION

Ph.D. in Mechanical Engineering
M.S. in Mathematics
University of Illinois at Urbana-Champaign   2013-2019

B.Sc. in Mechanical Engineering
B.Sc. in Physics (Dual Major)
Sharif University of Technology, Tehran, Iran   2008-2013

PUBLICATIONS

Refereed archival journal publications:

[J13] O. Movilla Miangolarra, A. Taghvaei, R. Fu, Y. Chen, and T. T. Georgiou. "Energy harvesting from anisotropic fluctuations," *Phys. Rev. E* 104, 044101, Oct 2021, doi: 10.1103/PhysRevE.104.044101

[J12] A. Taghvaei and P. G. Mehta, "Optimal Transportation Methods in Nonlinear Filtering" in IEEE Control Systems Magazine, vol. 41, no. 4, pp. 34-49, Aug. 2021, doi: 10.1109/MCS.2021.3076391.

[J11] A. Taghvaei and P. G. Mehta, "On the Lyapunov Foster criterion and Poincare inequality for Reversible Markov Chains," in IEEE Transactions on Automatic Control, (Early Access), doi: 10.1109/TAC.2021.3089643.

[J10] O. Movilla Miangolarra, A. Taghvaei, R. Fu, Y. Chen, and T. T. Georgiou,"Underdamped stochastic thermodynamic engines in contact with a heat bath with arbitrary temperature profile," Phys. Rev. E 103, 062103, Jun 2021, doi: 10.1103/PhysRevE.103.062103

[J9] A. Taghvaei, O. Movilla Miangolarra, R. Fu, Y. Chen and T. T. Georgiou, "On the Relation Between Information and Power in Stochastic Thermodynamic Engines," in IEEE Control Systems Letters, vol. 6, pp. 434-439, 2022, doi: 10.1109/LCSYS.2021.3078716.

[J8] J. Kim, A. Taghvaei, Y. Chen, P. G. Mehta, "Feedback particle filter for collective inference," Foundations of Data Science, 3(3), 543:561, 2021, doi: 10.3934/fods.2021018

[J7] R. Fu, A. Taghvaei, Y. Chen, T. T. Georgiou, "Maximal power output of a stochastic thermodynamic engine," Automatica, 123, 109366, 2021, doi: 10.1016/j.automatica.2020.109366.

[J6] A. Taghvaei and P. G. Mehta, "An Optimal Transport Formulation of the Ensemble Kalman Filter," in IEEE Transactions on Automatic Control, vol. 66, no. 7, pp. 3052-3067, July 2021, doi: 10.1109/TAC.2020.3015410.

[J5] A. Taghvaei, T. T. Georgiou, L. Norton, and A. Tannenbaum, "Fractional SIR epidemiological models", Scientific reports 10, 1, 1-15, 2020, doi: 10.1038/s41598-020-77849-7

[J4] A. Taghvaei, P. G. Mehta, and S. P. Meyn, "Diffusion Map-based Algorithm for Gain Function Approximation in the Feedback Particle Filter", SIAM/ASA Journal on Uncertainty Quantification,

8(3), 1090-1117, 2020, doi: 10.1137/19M124513X.

[J3] C. Zhang, A. Taghvaei and P. G. Mehta, "A Mean-Field Optimal Control Formulation for Global Optimization," in IEEE Transactions on Automatic Control, vol. 64, no. 1, pp. 282-289, Jan. 2019, doi: 10.1109/TAC.2018.2833060.

[J2] C. Zhang, A. Taghvaei and P. G. Mehta, "Feedback Particle Filter on Riemannian Manifolds and Matrix Lie Groups," in IEEE Transactions on Automatic Control, vol. 63, no. 8, pp. 2465-2480, Aug. 2018, doi: 10.1109/TAC.2017.2771336.

[J1] A. Taghvaei, J. de Wiljes, P. G. Mehta, and S. Reich, "Kalman Filter and Its Modern Extensions for the Continuous-Time Nonlinear Filtering Problem." ASME. J. Dyn. Sys., Meas., Control. March 2018; 140(3): 030904. doi: 10.1115/1.4037780.

Conference proceedings (Machine learning)

[ML5] J. Fan, Q. Zhang, A. Taghvaei, and Y. Chen, "Variational Wasserstein gradient flow", International Conference on Machine Learning (ICML), 2022, Accepted.

[ML 4] J. Fan, A. Taghvaei, Y. Chen. Scalable computations of Wasserstein barycenter via input convex neural networks. Proceedings of the 38th International Conference on Machine Learning (ICML), PMLR 139:1571-1581, 2021.

[ML3] A. Taghvaei, A Makkuva, S. Oh, J. Lee. Optimal transport mapping via input-convex neural networks. Proceedings of the 37th International Conference on Machine Learning (ICML), PMLR 119:6672-6681, 2020.

[ML2] A. Taghvaei, P. G. Mehta, Accelerated flow for probability distributions. Proceedings of the 36th International Conference on Machine Learning (ICML), PMLR 97:6076-6085, 2019.

[ML1] A. Taghvaei, J. Kim, P. G. Mehta, How regularization effects the critical points in linear neural networks. Advances in Neural Information Processing Systems (NeurIPS), 30, 2017.

Conference proceedings (Control)

[C18] A. Taghvaei, O. Movilla Miangolarra, R. Fu, Y. Chen, T. T. Georgiou, "On the relation between information and power in stochastic thermodynamic engines", IEEE Conference on Decision and Control (CDC), Austin, December 2021

[C17] A. Dong, A. Taghvaei, T. T. Georgiou, "Lasso formulation of the shortest path problem", IEEE Conference on Decision and Control (CDC), 402-407, Jeju Island, Republic of Korea, December 2020 .

[C16] R. Fu, O. Movilla, A. Taghvaei, Y. Chen, T. T. Georgiou, "Harvesting energy from a periodic heat bath", IEEE Conference on Decision and Control (CDC), 3034-3039, Jeju Island, Republic of Korea, December 2020 .

[C15] S. Y. Olmez, A. Taghvaei, P. G. Mehta, "Deep FPF: Gain function approximation in high dimensions", IEEE Conference on Decision and Control (CDC), 4790-4795, Jeju Island, Republic of Korea, December 2020.

[C14] T. Wang, A. Taghvaei, P. G. Mehta, "Bio-inspired Learning of Sensorimotor Control for Locomotion", IEEE American Control Conference (ACC), 2188–2193, Denver, July 2020.

[C13] A. Taghvaei, P. G. Mehta, T. T. Georgiou, "Optimality vs Stability Trade-off in Ensemble Kalman Filters", 24th International Symposium on Mathematical Theory of Networks and Systems

(MTNS), 2020

[C12] T. Wang, A. Taghvaei, P. G. Mehta, "Q-learning for POMDP: An application to learning locomotion gaits", IEEE Conference on Decision and Control (CDC), 2758–2763, Nice, France, December 2019.

[C11] J. W. Kim, A. Taghvaei, P. G. Mehta, S. P. Meyn, "An approach to duality in nonlinear filtering", IEEE American Control Conference (ACC), 5360–5365, Philadelphia, July 2019.

[C10] A. Taghvaei, P. G. Mehta, "Error analysis of the stochastic linear feedback particle filter", IEEE Conference on Decision and Control (CDC), 7194–7199, Miami, December 2018.

[C9] J. Kim, A. Taghvaei, P. G. Mehta, "Derivation and Extensions of the Linear Feedback Particle Filter based on Duality Formalisms", IEEE Conference on Decision and Control (CDC), 7188–7193, Miami, December 2018.

[C8] A. Taghvaei, P. G. Mehta, "Error analysis of the linear feedback article filter", IEEE American Control Conference (ACC), 4261–4266, Milwaukee, June 2018.

[C7] A. Taghvaei, P. G. Mehta. S. P. Meyn, "Error Estimates for the Kernel Gain Function Approximation in the Feedback Particle Filter", IEEE American Control Conference (ACC), 4576–4582, Seattle, May 2017.

[C6] C. Zhang, A. Taghvaei, P. G. Mehta, "Attitude Estimation of a Wearable Motion Sensor", IEEE American Control Conference (ACC), 4570–4575, Seattle, May 2017.

[C5] A. Taghvaei, P. G. Mehta, "Gain Function Approximation in the Feedback Particle Filter". IEEE Conference on Decision and Control (CDC), 5446–5452 Las Vegas, December 2016.

[C4] C. Zhang, A. Taghvaei, P. G. Mehta. "Attitude Estimation with Feedback Particle Filter". IEEE Conference on Decision and Control (CDC), 5440–5445, Las Vegas, December 2016.

[C3] A. Taghvaei, P. G. Mehta. "An Optimal Transport Formulation of Linear Feedback Particle Filter". IEEE American Control Conference (ACC), 3614–3619, Boston, June 2016.

[C2] C. Zhang, A. Taghvaei, P. G. Mehta. "Feedback Particle Filter on Matrix Lie group", IEEE American Control Conference (ACC), 2723–2728, Boston, June 2016.

[C1] A. Taghvaei, S. A. Hutchinson, and P. G. Mehta. "A Coupled Oscillator-based Control Architecture for Locomotory Gaits". IEEE Conference on Decision and Control (CDC), 3487–3492, Los Angeles, December 2014.

Ph.D. Thesis:

A. Taghvaei. *Design and analysis of particle-based algorithms for nonlinear filtering and sampling.* Ph.D. Dissertation, University of Illinois at Urbana-Champaign, 2019

Teaching Experience

Nonlinear Systems and Control (AA/EE/ME 583), University of Washington, Seattle, Fall, 2021

Control Systems in Aerospace (AA 447), University of Washington, Seattle, Spring, 2022

Teaching Assistant (TA) in **Statistical Learning** with Prof. Bruce Hajek, Department of Electrical and Computer Enginerring, University of Illinois at Urbana-Champaign, Illinois, USA, Fall 2017

Teaching Assistant (TA) in *Mathematical Methods in Engineering II* with Prof. Prashant Mehta, Department of Mechanical Science and Enginerring, University of Illinois at Urbana-Champaign, Illinois, USA, Fall 2016

	CSE Fellow[1], Computational Science and Engineering, UIUC, 2016-2017, **Ranked 9th** in **National University Entrance Exam**, Iran, 2008
INVITED TALKS	Variational Wassserstein Gradient flow, Kantorovich Initiative Retreat, Univesity of Washington, Seattle, Mar, 2022 Optimal Transportation Methods in Nonlinear filtering, Nonlinear Dynamics and Controls Lab (NDCL), Univesity of Washington, Seattle, Feb, 2022 Controlled Interacting Particle Systems for Estimation and Sampling, University of Washington, Feb, 2021 Feedback Particle Filter: Design, Estimation, and Error Analysis. University of California Los Angeles, Nov, 2019 Feedback Particle Filter: Design, Estimation, Analysis. University of California Irvine, June, 2019 Poisson equation, its approximation, and error analysis. Mathematical Analysis Seminar Series. University of Illinois at Urbana-Champaign, Feb, 2019 Accelerated Gradient Flow for Probability Distributions, CSL Student Conference, University of Illinois at Urbana-Champaign, Feb, 2019 Efficient Implementation of the Feedback Particle Filter Algorithm in High Dimensions, CSE Annual Meeting: 2017 Fellows Symposium, University of Illinois at Urbana-Champaign, April, 2017. Bias-Variance Tradeoff in solution to the Poisson Equation, 5th Workshop on Cognition and Control, University of Florida, Gainesville, Jan, 2017 Gain Function Approximation in the Feedback Particle Filter, 5th Workshop on Control and Game Theory, Purdue University, Purdue, April, 2016 Poisson Equation in Learning and Classification, 4th Workshop on Cognition and Control, University of Florida, Gainesville, Jan, 2016
CONFERENCE PRESENTATIONS	A. Taghvaei, O. Movilla Miangolarra, R. Fu, Y. Chen, and T. T. Georgiou, "On the relation between information and power in stochastic thermodynamic engines", IEEE Conference on Decision and Control (CDC), December 2021(virtual) A. Taghvaei, A Makkuva, S. Oh, and J. Lee. "Optimal transport mapping via input-convex neural networks". International Conference on Machine Learning (ICML), Jun, 2020 (virtual). A. Taghvaei and P. G. Mehta, "Accelerated flow for probability distributions". International Conference on Machine Learning (ICML), Long Beach, June, 2019. A. Taghvaei and P. G. Mehta, "Error analysis of the stochastic linear feedback particle filter", IEEE Conference on Decision and Control (CDC), Miami, December 2018. A. Taghvaei and P. G. Mehta, "Error analysis of the linear feedback article filter", IEEE American Control Conference (ACC), Milwaukee, June 2018. A. Taghvaei, P. G. Mehta, and S. P. Meyn, "Numerical Methods to Solve the Weighted Poisson Equation", SIAM Conference on Uncertainty Quantification, Garden Grove, California, April, 2018 A. Taghvaei, J. Kim, and P. G. Mehta, "How regularization effects the critical points in linear neural networks", Advances in Neural Information Processing Systems (NurIPS), Long Beach, December, 2017 A. Taghvaei, P. G. Mehta, and S. P. Meyn, "Error Estimates for the Kernel Gain Function Approximation in the Feedback Particle Filter", IEEE American Control Conference (ACC), Seattle, May 2017.

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[1]Annual award to outstanding graduate students with interdisciplinary and computationally oriented research.

A. Taghvaei and P. G. Mehta, "Gain Function Approximation in the Feedback Particle Filter". IEEE Conference on Decision and Control (CDC), Las Vegas, December 2016.

A. Taghvaei and P. G. Mehta. "An Optimal Transport Formulation of Linear Feedback Particle Filter". IEEE American Control Conference (ACC), Boston, June 2016.

A. Taghvaei, S. A. Hutchinson, and P. G. Mehta. "A Coupled Oscillator-based Control Architecture for Locomotory Gaits". IEEE Conference on Decision and Control (CDC), Los Angeles, December 2014.

INTERNSHIP
EXPERIENCE

AI Researcher, with Dr. Amin Jalali, Technicolor AI Research Lab, Palo Alto, Summer, 2018

- Project: Restricted Convex Potentials for Approximating the Wasserstein Metric and the Optimal Transport Mapping

Algorithm developer, with university start-up company, Rithmio,   2014-2015

- Project: Development of algorithms and software for real time classification of physical activities, based on wearable inertial sensors

PROFESSIONAL
SERVICE

Mentorship of Ph.D. students Rui Fu, Olga Movilla, and Anqi Dong at UC Irvine

Mentorship of Master's students Tixian Wang and Yagiz Olmez at UIUC

Mentorship of undergraduate students Ayano Hiranaka, Kumar Gandhi, Peter Ivanov, and Ulzee An at UIUC

Invited Reviewer of TAC, CSM, JCOMP, ASME, NeurIPS, ICML, ICLR, CDC, ACC

Session chair for filtering at IEEE Conference on Decision and Control (CDC), Las Vegas, December 2016

Organizer of the of the Coordinated Science Laboratory Student Conference, 2015-2018

Organizer of the Coordinated Science Laboratory (CSL) Social Hour, 2015-2017

Organizer of the Machine Learning reading group, CSL, Fall, 2018

Participation in Engineering Volunteering In Stem Education (ENVISION), University of Illinois at Urbana-Champaign, Spring and Fall 2017

Participation in the Mentoring Undergraduates in Science and Engineering (MUSE) program, University of Illinois at Urbana-Champaign, 2015-2016