

Alex A. Gorodetsky

CONTACT INFORMATION	Department of Aerospace Engineering University of Michigan 3025 FXB 1320 Beal Avenue Ann Arbor, MI, 48109, USA	<i>email:</i> goroda@umich.edu <i>email:</i> alex@alexgorodetsky.com <i>web:</i> www.alexgorodetsky.com
RESEARCH INTERESTS	Computational algorithms for decision making under uncertainty: Uncertainty quantification; autonomous systems; multi-agent systems; Bayesian inference and statistics; machine learning; numerical analysis; path planning stochastic optimal control and optimization.	
EDUCATION	Massachusetts Institute of Technology , Cambridge, MA Ph.D., Computational Science and Engineering, Department of Aeronautics and Astronautics, February 2017 <ul style="list-style-type: none">• Thesis: <i>Continuous low-rank tensor decompositions, with applications to stochastic optimal control and data assimilation</i>• Advisers: Professor Sertac Karaman, Professor Youssef M. Marzouk• Areas of Study: Computational Science, Control, Autonomy S.M., Department of Aeronautics and Astronautics, June 2012 <ul style="list-style-type: none">• Thesis: <i>A learning method for the approximation of discontinuous functions for stochastic simulations</i>• Adviser: Professor Youssef M. Marzouk• Area of Study: Computational Science University of Michigan , Ann Arbor, MI B.S.E., Aerospace Engineering, June 2010 <ul style="list-style-type: none">• <i>Summa cum Laude</i>• Minor in Mathematics	
AWARDS	<ul style="list-style-type: none">• Air Force Office of Scientific Research Young Investigator Award (2018)• John von Neumann Postdoctoral Research Fellowship in Computational Science 2016• Department of Energy Office of Science Graduate Fellowship (DOE SCGF), Finalist, 2012	
PROFESSIONAL EXPERIENCE	University of Michigan , Ann Arbor, MI <i>Assistant Professor</i> January 2018 – Present <i>Department of Aerospace Engineering</i> Sandia National Laboratories , Albuquerque, NM <i>John von Neumann Postdoctoral Fellow</i> October 2016 – December 2017 <i>Optimization and Uncertainty Quantification Group</i> <i>Computer Science Research Institute</i> Massachusetts Institute of Technology , Cambridge, MA <i>Graduate Research Assistant</i> September 2010 – September 2016 <i>Aerospace Computational Design Laboratory</i>	

- [1] Kachar, K.G., Gorodetsky, A. A., Dynamic Multi-agent assignment via discrete optimal transport. *IEEE Journal on Control of Network Systems (Accepted)*, 2021
- [2] Aksoy, D., Alben, S., Deegan, R. D., and Gorodetsky, A. A. "Inverse Design of Self-Oscillatory Gels through Deep Learning.", *Neural Computing and Applications (Accepted)* 2021.
- [3] Gorodetsky, A. A., Jakeman, J. D., and Geraci, G. "MFNets: data efficient all-at-once learning of multifidelity surrogates as directed networks of information sources." *Computational Mechanics* 68:4 (2021): 741-758.
- [4] Gorodetsky, A. A., Jakeman, J.D., Geraci, G., Eldred, M.S., "MFNETS: multifidelity data-driven networks for Bayesian learning and prediction." *International Journal of Uncertainty Quantification* 10:6 (2020) : 595-622
- [5] Galimoto, N., Gorodetsky, A.A. "Bayesian system ID: optimal management of parameter, model, and measurement uncertainty." *Nonlinear Dyn* (2020). <https://doi.org/10.1007/s11071-020-05925-8>
- [6] Gorodetsky, A. A., Geraci, G., Eldred M. S., Jakeman, J. A generalized approximate control variate framework for multifidelity uncertainty quantification. *Journal of Computational Physics*, 408, (2020): 109257
- [7] Jakeman, J., Eldred, M. S., Geraci, G., Gorodetsky, A.A. Adaptive multi-index collocation for uncertainty quantification and sensitivity analysis. *International Journal for Numerical Methods in Engineering*, 121:6 (2020) : 1314 – 1343.
- [8] Alben, S., Gorodetsky, A. A., Kim, D., Deegan, R. D. Semi-implicit methods for the dynamics of elastic sheets. *Journal of Computational Physics*, 399 (2019): 108952
- [9] Wildey, T., Gorodetsky, A.A., Belme, A.C., Shadid, J. N., Robust Uncertainty Quantification using reponse surface approximations of discontinuous functions *International Journal of Uncertainty Quantification*, 9:5 (2019): 415-437
- [10] Gorodetsky A. A., Jakeman, J. D. Gradient-based Optimization for Regression in the Functional Tensor-Train Format. *Journal of Computational Physics*, 374 (2018): 1219-1238
- [11] Gorodetsky A. A., Karaman, S., and Marzouk Y. M. A continuous analogue of the tensor-train decomposition. *Computer Methods in Applied Mechanics and Engineering*, 347 (2018): 59-94
- [12] Kramer, B., and Gorodetsky, A. System identification via CUR-factored Hankel approximation. *SIAM Journal on Scientific Computing* 40.2 (2018): A848-A866
- [13] Gorodetsky A. A., Karaman, S., and Marzouk Y. M. High-dimensional stochastic optimal control using continuous tensor decompositions. *International Journal of Robotics Research*, 37.2-3 (2018): 340-377
- [14] Gorodetsky, A. A., and Marzouk, Y. M. Mercer kernels and integrated variance experimental design: connections between Gaussian process regression and polynomial approximation *SIAM/ASA Journal on Uncertainty Quantification*, 4:1 (2016): 796-828
- [15] Gorodetsky, A. A., and Marzouk, Y. M. Efficient localization of discontinuities in complex computational simulations. *SIAM Journal on Scientific Computing*, 36.6 (2014): A2584-A2610

PREPRINTS

- [16] Gorodetsky, A. A., Safta, C., and Jakeman J.D. "Reverse-mode differentiation in arbitrary tensor network format: with application to supervised learning", 2021.
- [17] Pham, T. and Gorodetsky, A. "Ensemble approximate control variate estimators: Applications to multi-fidelity importance sampling.", 2021, <http://arxiv.org/abs/2101.02786> (Undergoing first revision)
- [18] De, S., Salehi, H. and Gorodetsky, A., "Efficient MCMC Sampling for Bayesian Matrix Factorization by Breaking Posterior Symmetries." 2020, arXiv preprint <https://arxiv.org/abs/2006.04295>
- [19] Rai, P., Kolla, H, Cannada, L., Gorodetsky, A.A., Randomized functional sparse Tucker tensor for compression and fast visualization of scientific data. arXiv preprint arXiv:1907.05884 (2019).

CONFERENCE PUBLICATIONS

- [20] Gorodetsky, A. A., Whittaker, C.B., Szulman, A., Jorns, B. "Robust Design of Electro-spray Emitters." *AIAA Propulsion and Energy 2021 Forum*. Virtual, August 11-13, 2021.
- [21] Xunbi, J., Molnar, T. G., Gorodetsky, A. A., Orosz, G. "Bayesian Inference for Time Delay Systems with Application to Connected Automated Vehicles." *2021 IEEE International Intelligent Transportation Systems Conference (ITSC)*. 2021.
- [22] Chen, B., Tandon, S., Gorsich, D., Gorodetsky, A., Veerapaneni, S. "Behavioral Cloning in Atari Games Using a Combined Variational Autoencoder and Predictor Model." *IEEE Conference on Evolutionary Computation*, Virtual, June 28 - July 1, 2021.
- [23] Yang, H. , Gorodetsky, A. A., Fujii, Y., Wang, K-W. "Multifidelity Uncertainty Quantification for Online Simulations of Automotive Propulsion Systems.", *Proceedings of the ASME 2021 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference IDETC/CIE2021*. Virtual, August 17-20, 2021.
- [24] Galioto, N. Gorodetsky, A. A., "A new objective for identification of partially observed linear time-invariant dynamical systems from input-output data." *Learning for Dynamics and Control (LADC)*, Virtual, June 7-8, 2021.
- [25] Galioto, N. Gorodetsky, A. A., "Bayesian Identification of Hamiltonian Dynamics from Symplectic Data." *Conference on Decision and Control (CDC)*, Virtual, December 14-18, 2020.
- [26] Yang, H., Kidambi, N., Fujii, Y., Gorodetsky, A., Wang, K-W. "Uncertainty Quantification Using Generalized Polynomial Chaos for Online Simulations of Automotive Propulsion Systems." *American Control Conference (ACC) 2020*. pp. 295-300. IEEE, July 1-3, 2020. <https://doi.org/10.23919/ACC45564.2020.9147870>
- [27] Whittaker, C.B., Gorodetsky, A. Jorns B. "Quantifying uncertainty in the scaling laws of porous electro-spray emitters." *AIAA Propulsion and Energy 2020 Forum*, August 24-28, 2020.
- [28] Baskar, D., Gorodetsky., A. A Simulated Wind-field Dataset for Testing Energy Efficient Path-Planning Algorithms for UAVs in Urban Environment. *2020 AIAA Aviation Form*, 2020.
- [29] He, K. Wang, J. and Gorodetsky, A.. Uncertainty Analysis of Trajectory Tracking for Autonomous Dynamic Soaring. *AIAA Scitech 2020 Forum*. 2020.

- [30] Jorns, B., Gorodetsky, A., Lasky, I., Kimber, A., Dahl P., St. Peter, B., Dressler, R. Uncertainty Quantification of Electrospray Thruster Array Lifetime. *36th International Electric Propulsion Conference*, University of Vienna, Austria, September 15 – 20, 2019.
- [31] Eldred, M. S., Geraci, G., Gorodetsky, A., and Jakeman, J. Recent advancements in Multilevel-Multifidelity techniques for forward UQ in the DARPA SEQUOIA project. *AIAA Scitech Forum* January 2019.
- [32] Geraci, G., Eldred, M.S., Gorodetsky, A. A., Jakeman J. Leveraging Active Subspaces for Efficient Multifidelity Uncertainty Quantification. *ECCM-ECCFD 2018*, Glasgow, Scotland, UK 2018.
- [33] Tal, E., Gorodetsky, A. A, Karaman, S. Continuous Tensor Train-Based Dynamic Programming for High-Dimensional Zero-Sum Differential Games. *American Control Conference (ACC)*, Milwaukee, WI, USA, 2018.
- [34] Sayre-McCord, R. T., Guerra, W., Antonini, A., Arneberg, J., Brown, A., Cavalheiro, G., Fang, Y., Gorodetsky, A., McCoy, D., Quilter, S., Riether, F., Tal, E., Terzioglu, Y., Carlone, L., Karaman, S. Visual-inertial navigation algorithm development using photorealistic camera simulation in the loop. *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, Australia, 2018.
- [35] Eldred, M. S., Geraci, G., Gorodetsky, A., and Jakeman, J. Multilevel-Multifidelity Approaches for Forward UQ in the DARPA SEQUOIA project. *2018 AIAA Non-Deterministic Approaches Conference*. 2018.
- [36] Gorodetsky, A., Karaman S., and Marzouk, Y. M. Low-rank tensor integration for Gaussian filtering of continuous time nonlinear systems In: *56th IEEE Conference on Decision and Control*, Melbourne, Australia, December, 2017.
- [37] Alora, J., Gorodetsky, A., Karaman S., Lowry, N., and Marzouk, Y. M. Automated synthesis of low-rank control systems from sc-LTL specifications using tensor-train decompositions In: *55th IEEE Conference on Decision and Control*, Las Vegas, NV, USA, December, 2016.
- [38] Gorodetsky, A., Karaman S., and Marzouk, Y. M. Efficient high-dimensional stochastic optimal motion control using tensor-train decomposition. In: *Proceedings of Robotics: Science and Systems*, Rome, Italy, July, 2015.
- [39] Gorodetsky, A., Galioto, N. Bayesian system identification: accounting for model error for improved robustness to sparse and noisy data. In *Machine Learning in Science and Engineering*, Virtual, December 13-14, 2020.
- [40] Gorodetsky, A., Galioto, N. Bayesian approaches to data-driven learning of dynamical systems. In *3rd Physics Inspired Machine Learning Conference*, Santa Fe, NM, USA, January 12 – 17, 2020.
- [41] Safta, C., Sargsyan, K., Gorodetsky, A., Jakeman, J., Ricciuto, D. M, Uncertainty Quantification for E3SM Land Component using Low-Rank Surrogate Models. In *American Geophysical Union, Fall Meeting 2019*, December 2019.
- [42] Gorodetsky, A., Geraci, G., Eldred, M., Jakeman J. Multifidelity uncertainty quantification for fluid dynamics applications. In *Front UQ Workshop* Pisa, Italy, September 10 – 12, 2019.
- [43] Gorodetsky, A., Geraci, G., Eldred, M., Jakeman J. Unifying Multifidelity Sampling Approaches as Approximate Control Variates. In *US National Congress on Computational Mechanics*, Austin, TX, USA, July 28 – August 1, 2019.

SELECTED
CONFERENCE
TALKS

- [44] Gorodetsky, A. and Mathelin, L. New Approaches to Learn Low-rank Models of Dynamical Systems From Streaming Data. In *3rd International Conference on Uncertainty Quantification in Computational Sciences and Engineering (UNCECOMP 2019)* Crete, Greece, June 24 – 26, 2019
- [45] Gorodetsky, A., Jakeman, J., Mathlin, L., Pivot C. Learning Strategies for Generating Low-Rank Representations of Physical Systems. In *SIAM Conference on Computational Science and Engineering* Spokane, WA, USA, February 24 – March 1, 2019.
- [46] Gorodetsky, A., Geraci, G., Eldred, M., Jakeman J. Multifidelity Model Management using Latent Variable Bayesian Networks. In *World Congress on Computational Mechanics*, New York, NY, USA, July 22 – 27, 2018.
- [47] Gorodetsky, A., Geraci, G., Eldred, M., Jakeman J. Multifidelity Model Management using Latent Variable Bayesian Networks. In *SIAM Annual Conference*, Portland, OR, USA July 9 – 15, 2018.
- [48] Gorodetsky, A., Geraci, G., Eldred, M., Jakeman J. Latent Variable Networks for Multifidelity Uncertainty Quantification In *ECCM-ECFD*, Glasgow, Scotland, UK, June 11 – 15, 2018.
- [49] Gorodetsky, A., Geraci, G., Eldred, M., Jakeman J. Multifidelity Model Management using Latent Variable Bayesian Networks. In *SIAM Conference on Uncertainty Quantification*, Los Angeles, CA, USA, April 15 – 19, 2018.
- [50] Gorodetsky, A., Geraci, G., Eldred, M., Jakeman J. Multifidelity Model Management using Latent Variable Bayesian Networks. In *2nd Physics Inspired Machine Learning Conference*, Santa Fe, NM, USA, January 21 – 25, 2018.
- [51] Gorodetsky, A. Low rank functional decompositions, with application to stochastic optimal control. In: *2017 Meeting of the International Linear Algebra Society*, Ames, IA, USA, July 24 – July 28 2017.
- [52] Gorodetsky, A. Exploiting low-rank structure in stochastic optimal control and filtering problems. In: *SIAM Conference on Control and its Applications*, Pittsburgh, PA, USA, July 10 – July 12 2017.
- [53] Gorodetsky, A. and Jakeman J. D. Continuous alternating least squares for regression of low-rank functions. In: *SIAM Conference on Computational Science and Engineering*, Atlanta, GA, USA, February 27 – March 3 2017.
- INVITED TALKS [54] Bayesian System ID: optimal management of parameter, model, and measurement uncertainty. In *Department of Mathematics, University of Iowa*, November 2, 2021.
- [55] Bayesian System ID: optimal management of parameter, model, and measurement uncertainty. In *Mechanical and Aerospace Engineering, University of San Diego*, May 7, 2021.
- [56] Sampling algorithms for generalized model ensembles in multifidelity uncertainty quantification. In *Workshop on multilevel and multifidelity sampling methods in UQ for PDEs, Erwin Schrödinger Institute (Virtual)*, May 4-5, 2020.
- [57] Compression algorithms for enabling high-dimensional motion planning. In *University of Maryland, College Park, Mathematics Department seminar*, October 15, 2019.
- [58] Tensor decompositions and their UQ applications. In *USC Summer School on Uncertainty Quantification*, Los Angeles, CA, USA, August 14-16, 2019
- [59] Compression algorithms for enabling high-dimensional motion planning. In *LIMSI-CNRS*, Orsay, France, June 20, 2019.

- [60] Scalable learning of dynamical systems: low-rank approaches for increasing computational efficiency. In *Physics Informed Machine Learning Workshop*, University of Washington, Seattle, WA, USA June 6 – 7, 2019.
- [61] Compression algorithms for enabling high-dimensional motion planning. In *Sandia National Laboratories*, Albuquerque, NM, May 23, 2019.
- [62] Low-rank tensor compression algorithms for generating, managing, and analyzing large scale scientific data. In *17th International Conference on Numerical Combustion*, Aachen Germany, May 5 – May 8, 2019.
- [63] Exploiting and learning structure for multifidelity UQ. In *U2CanUQ conference*, University of Arizona, Tuscon, Arizona, USA, April 10, 2019. **Keynote.**
- [64] Multifidelity uncertainty quantification through approximate control variates and Bayesian networks. In *University of Notre Dame, Department of Applied Mathematics*, Notre Dame, Indiana, USA, November 15, 2018.
- [65] Low-rank tensor approaches for adaptive function approximation: algorithms and examples. In *University of Michigan Applied Mathematics Seminar*, Ann Arbor, MI, USA, September 7, 2018.
- [66] Modeling connections between multifidelity information sources for uncertainty quantification. In *UTRC*, Hartford, CT, USA, August 20 – 21, 2018.
- [67] Functional tensor-train approach and algorithms. In *Yale, Department of Chemistry*, New Haven, CT, USA, August 13-16, 2018.
- [68] Regression in low-rank functional formats. In *USC Workshop on Scientific Machine Learning*, Los Angeles, CA, USA, June 4–6, 2018.
- [69] Compression for stochastic optimal control. In *Los Alamos National Laboratory.*, Los Alamos, NM, USA, June 20, 2017.
- [70] Real-time control and uncertainty quantification of autonomous systems using low-rank multilinear compression. In *University of Michigan Aerospace Engineering Seminar*, Ann Arbor, MI, USA, April 12, 2017.
- [71] Low-rank computation for optimal stochastic control and function approximation. In *MIT Aerospace Computational Design Laboratory Seminar*, Cambridge, MA, USA, November 3, 2015.

OPEN SOURCE
SOFTWARE

GPEXP: Experimental design for Gaussian process regression

- Python package for performing experimental design for Gaussian process models
- Github source code: <https://github.com/goroda/GPEXP>

C³: Compressed Continuous Computation

- Library for computing with multidimensional functions in a compressed format
- Has utilities to aid computation in the context of control, optimization, probabilistic inference, multilinear algebra, and integration
- Github source code: <https://github.com/goroda/Compressed-Continuous-Computation>

C³SC: Compressed Continuous Computation for Stochastic Optimal Control

- Library for solving stochastic optimal control problem with nonlinear dynamics
- Github source code: <https://github.com/goroda/c3sc>

MFNetsSurrogate: Multifidelity networked Surrogates

- A set of routines to enable construction of completely unstructured multifidelity surrogate models for fusing multiple information sources.
- Github source code: <https://github.com/goroda/MFNetsSurrogates>

PROFESSIONAL
MEMBERSHIPS

Society for Industrial and Applied Mathematics (SIAM), Member, 2010–present
American Institute of Aeronautics and Astronautics (AIAA), Member, 2017–present
Institute for Electrical and Electronics Engineers (IEEE), Member, 2018–present

CURRENTLY
SUPERVISED
STUDENTS/POSTDOCS

PhD Students

- Doruk Aksoy, PhD Candidate, Department of Aerospace Engineering
- Brian Chen (co-advised), PhD Candidate, Department of Mathematics
- Thomas Dixon, PhD Pre-Candidate, Department of Aerospace Engineering
- Joshua Eckels, PhD Pre-Candidate, Department of Aerospace Engineering
- Nicholas Galioto, PhD Candidate, Department of Aerospace Engineering
- Carleen McKenna, PhD Candidate, Department of Aerospace Engineering
- Liliang Wang, PhD Candidate, Department of Aerospace Engineering
- Hang Yang (co-advised), PhD Candidate, Department of Mechanical Engineering

Postdoctoral Fellows

- Trung Bao Pham (2019-2021)

Thesis Committee (current and past)

- Ahmad Ansari, Aerospace Engineering (2018)
- Matthew Byrne, Applied Physics/Aerospace Engineering (TBD)
- Ankit Goel, Aerospace Engineering (2019)
- Xianan Huang, Mechanical Engineering (2019)
- Dominic Liao-McPherson, Aerospace Engineering (2020)
- Shaowu Pan, Aerospace Engineering (2020)
- David Miles cue, MIT Aeronautics and Astronautics Engineering (2020, (Reader))
- Siddhartha Srivastava, Aerospace Engineering (2020)
- Collin Whittaker, Aerospace Engineering (TBD)
- Songan Zhang, Mechanical Engineering (2021)
- Adam Bruce, Aerospace Engineering (2021)

PROFESSIONAL
SERVICE

Referee Service

- *Advances in Computational Mathematics (ACOM)*
- *ASME Turbine Technical Conference and Exposition*
- *American Control Conference (ACC)*
- *AIAA Scitech*
- *BIT Numerical Mathematics*
- *Computational Geosciences (COMG)*
- *Computer Methods in Applied Mechanics and Engineering (CMAME)*
- *Conference on Decision and Control (CDC)*
- *Entropy*
- *IEEE Transactions on Aerospace and Electronic Systems*
- *IEEE Transactions on Very Large Scale Integration Systems*
- *IEEE Transactions on Automatic Control (TAC)*
- *International Journal of Robotics Research (IJRR)*
- *International Journal of Uncertainty Quantification (IJUQ)*
- *Journal of Aerospace Information Systems*
- *Journal of Computational Physics (JCP)*
- *Journal of Intelligent and Robotic Systems*
- *Journal of Machine Learning for Modeling and Computing*
- *Journal of Propulsion and Power*
- *Mathematical Methods in the Applied Sciences*
- *Neural Computation*

- *Robotics: Science and Systems Conference (RSS)*
- *AIAA Journal on Aerospace Information Systems*
- *SIAM Journal of Scientific Computing*
- *SIAM Journal of Dynamical Systems*
- *SIAM Journal of Data Science*
- *SIAM/ASA Journal on Uncertainty Quantification*

Reviewing

- Review DOE ASCR Career Award 2019,2020,2021
- Reviewer for ANR (France)

Society and Conference Service

- *Student paper competition chair, NDA TC: AIAA Scitech 2022*
- *Minisymposium organizer: SIAM Annual Meeting 2019*
- *Minisymposium organizer: SIAM CSE 2019, 2021*
- *Minisymposium organizer: ICIAM 2019*
- *Minisymposium organizer: USNCCM 2019, 2020, 2021*
- *Minisymposium organizer : SIAM UQ 2020, SIAM UQ2022 (cancelled due to Covid-19)*
- *Minisymposium organizer : SIAM MDS 2020 (cancelled due to Covid-19)*
- *Minisymposium organizer: WCCM 2020 (cancelled due to Covid-19)*

CITIZENSHIP

USA