

IOANNIS EXARCHOS

PERSONAL INFORMATION

Mountain View, CA, United States

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RESEARCH INTERESTS

Stochastic optimal control, reinforcement learning, optimization, robotics, machine/deep learning applications in control and neuroscience, differential game theory.

EARNED DEGREES

Georgia Institute of Technology

Atlanta, GA

1. Ph.D. Aerospace Engineering

Dec. 2017

Focus: Stochastic Optimal Control, Machine Learning Applications in Control

Advisors: Profs. Panagiotis Tsiotras, Evangelos A. Theodorou

Dissertation title: *Stochastic Optimal Control – A Forward and Backward Sampling Approach*

2. M.S. Mathematics

Dec. 2015

Focus: Probability, Stochastic Processes

3. M.S. Aerospace Engineering

Dec. 2013

Focus: Dynamical Systems and Control, Differential Game Theory

University of Patras

Patras, Greece

4. Eng.Dipl. Mechanical Engineering and Aeronautics

Nov. 2010

GPA: 9.12/10, *Valedictorian* (top of graduating class)

Advisor: prof. Spilios Fassois

Thesis title: *Uncertainty Analysis in Structures using Time Series Data: System Identification via Random Coefficient Pooled ARX Models*

RESEARCH EXPERIENCE

Microsoft

Senior Applied Scientist

Dec. 2023 – Present

Applied Scientist

Jun. 2021 – Oct. 2023

As a Senior Applied Scientist at Microsoft, most of my work is focused on developing and optimizing bidding algorithms for online ad auctions. This involves optimization and control on very large-scale systems. Keywords: auto-bidding controllers, pricing/revenue optimization, online advertising auctions, KPI forecasting, monetization.

Stanford University

Post-doctoral Fellow

Oct. 2019 – Feb. 2021

Department of Computer Science

Project: Applications of deep reinforcement learning and stochastic optimal control in robotics. Investigation of control policy transferability between source (training) and target (testing) environments in simulation using techniques such as domain randomization and adaptation (transfer learning, sim-to-real gap).

PI: Prof. C. Karen Liu

Emory University

Post-doctoral Fellow

Feb. 2018 – Sep. 2019

Department of Biomedical Informatics

Project: Machine Learning Algorithms for Closed-Loop Neuromodulation

PIs: Dr. Robert E. Gross, MD, PhD and Dr. Jon T. Willie, MD, PhD

Development of deep learning algorithms to aid in the design of closed-loop stimulation paradigms for the treatment of various neurological disorders such as epilepsy and narcolepsy through deep brain stimulation.

Georgia Institute of Technology

Research Assistant, School of Aerospace Engineering

Dynamics and Control Systems Lab

Aug. 2011 – Dec. 2017

TEACHING
EXPERIENCE

Georgia Institute of Technology

Teaching Assistant, AE 6511: Optimal Guidance and Control
Assignment grading, lectures, office hours.

Jan. - May 2014,
Aug. - Dec. 2016

Teaching Assistant, AE 8803: Stoch. Optimal Control and Reinf. Learning
Lecture on Stochastic Optimal Control via FBSDEs

Jan. - May 2017

GRADUATE LEVEL
COURSES

Control Theory: Linear Systems, Nonlinear Control, Advanced Nonlinear Control, Robust Control, Optimal Guidance and Control, Stochastic Optimal Control and Reinforcement Learning

Mathematics: Real Analysis, Operator Theory, Ordinary Differential Equations, Probability II, Stochastic Calculus, Numerical Methods for PDEs

Optimization and Machine Learning: Linear Optimization, Nonlinear Optimization, Machine Learning for Control, Deep Learning for Perception (audit)

Neuroscience: Computational Neuroscience, Neuroanatomy and Systems Neuroscience (Emory University, audit)

Dynamics: Advanced Dynamics, Advanced Flight Dynamics

COMPUTER
SKILLS

Languages : Python, MATLAB.

Software : PyTorch, TensorFlow, PyBullet, DART, GPOPS, MATLAB, Mathematica.

Platforms : Linux, Windows.

LANGUAGE
SKILLS

English (fluent), Greek (native), German (advanced), Spanish (beginner)

PUBLICATIONS

[2024]

1. M. Pereira, C. Duarte, **I. Exarchos**, and E. Theodorou, “Deep \mathcal{L}^1 Stochastic Optimal Control Policies for Planetary Soft-landing”, *Journal of Guidance, Control, and Dynamics*, Vol. 47, No.4, April 2024 [paper]

[2022]

2. **I. Exarchos**, K. Wang, B. Do, F. Stroppa, M. M. Coad, A. M. Okamura, and C. K. Liu, “Task-specific Design Optimization and Manufacturing for Inflated-Beam Soft Robots with Growable Discrete Joints”, *2022 International Conference on Robotics and Automation (ICRA)* [paper]

[2021]

3. **I. Exarchos**, M. Pereira, Z. Wang, and E. Theodorou, “NOVAS: Non-convex Optimization via Adaptive Stochastic Search for End-to-End Learning and Control”, *2021 International Conference on Learning Representations (ICLR)* [paper]
4. **I. Exarchos**, Y. Jiang, W. Yu, and C. K. Liu, “Policy Transfer via Kinematic Domain Randomization and Adaptation”, *2021 International Conference on Robotics and Automation (ICRA)*, [paper]
5. T. Chen, Z. Wang, **I. Exarchos**, and E. Theodorou, “Large-Scale Multi-Agent Deep FBSDEs”, *2021 International Conference on Machine Learning (ICML)* [paper]
6. K. Werling, D. Omens, J. Lee, **I. Exarchos** and C. K. Liu, “Fast and Feature-Complete Differentiable Physics for Articulated Rigid Bodies with Contact”, *Robotics: Science and Systems 2021* [paper]
7. Y. Jiang, M. Guo, J. Li, **I. Exarchos**, J. Wu, and C. K. Liu, “DASH: Modularized Human Manipulation Simulation with Vision and Language for Embodied AI”, *The 20th Annual Symposium on Computer Animation (SCA)* [paper]

[2020]

8. M. Pereira, Z. Wang, **I. Exarchos**, and E. Theodorou, “Safe Optimal Control Using Stochastic Barrier Functions and Deep Forward-Backward SDEs”, *2020 Conference on Robot Learning (CoRL)*, selected for plenary presentation, November 16 - 18, 2020, [paper]

9. S. Park, M. J. Connolly, **I. Exarchos**, A. Fernandez, M. Ghetiya, C. Gutekunst, and R. E. Gross, “Optimizing Neuromodulation based on Surrogate Neural States for Seizure Suppression in a Rat Temporal Lobe Epilepsy Model”, *Journal of Neural Engineering*, Vol. 17, No. 4, July 2020, doi: [10.1088/1741-2552/ab9909](https://doi.org/10.1088/1741-2552/ab9909)
 10. **I. Exarchos**, A. A. Rogers, L. M. Aiani, R. E. Gross, G. D. Clifford, N. P. Pedersen, and J. T. Willie, “Supervised and Unsupervised Machine Learning for Automated Scoring of Sleep-Wake and Cataplexy in a Mouse Model of Narcolepsy”, *SLEEP*, Vol. 43, No. 5, May 2020, doi: [10.1093/sleep/zsz272](https://doi.org/10.1093/sleep/zsz272)
- [2019]
11. Z. Wang, K. Lee, M. Pereira, **I. Exarchos**, and E. Theodorou, “Deep Forward-Backward SDEs for Min-Max Control”, *58th IEEE Conference on Decision and Control (CDC)*, Nice, France, December 11-13, 2019, pp. 6807-6814, doi: [10.1109/CDC40024.2019.9028871](https://doi.org/10.1109/CDC40024.2019.9028871)
 12. M. Pereira, Z. Wang, **I. Exarchos**, and E. Theodorou, “Learning Deep Stochastic Optimal Control Policies using Forward-Backward SDEs”, *Proceedings of Robotics: Science and Systems XV*, Freiburg im Breisgau, Germany, June 22-26, 2019, doi: [10.15607/RSS.2019.XV.070](https://doi.org/10.15607/RSS.2019.XV.070)
 13. **I. Exarchos**, E. Theodorou, and P. Tsotras, “Stochastic Differential Games – A Sampling Approach via FBSDEs”, *Dynamic Games and Applications*, Vol. 9, No. 2, June 2019, pp. 486-505, doi: [10.1007/s13235-018-0268-4](https://doi.org/10.1007/s13235-018-0268-4)
 14. **I. Exarchos**, E. Theodorou, and P. Tsotras, “Optimal Thrust Profile for Planetary Soft Landing under Stochastic Disturbances”, *Journal of Guidance, Control, and Dynamics*, Vol. 42, No. 1, 2019, pp.209-216, doi: [10.2514/1.G003598](https://doi.org/10.2514/1.G003598)
- [2018]
15. **I. Exarchos**, E. Theodorou, and P. Tsotras, “Stochastic L^1 -Optimal Control via Forward and Backward Sampling”, *Systems & Control Letters*, Vol. 118, July 2018, pp. 101-108, doi: [10.1016/j.sysconle.2018.06.005](https://doi.org/10.1016/j.sysconle.2018.06.005)
 16. **I. Exarchos** and E. Theodorou, “Stochastic Optimal Control via Forward and Backward Stochastic Differential Equations and Importance Sampling”, *Automatica*, Vol. 87, January 2018, pp. 159-165, doi: [10.1016/j.automatica.2017.09.004](https://doi.org/10.1016/j.automatica.2017.09.004)
 17. H. Brar, **I. Exarchos**, Y. Pan, E. Theodorou, and B. Mahmoudi, “Seizure Reduction using Model Predictive Control”, *40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Honolulu HI, July 17-21, 2018, pp. 3152-3155, doi: [10.1109/EMBC.2018.8512911](https://doi.org/10.1109/EMBC.2018.8512911)
- [2016 and prior]
18. **I. Exarchos**, E. Theodorou, and P. Tsotras, “Game-Theoretic and Risk-Sensitive Stochastic Optimal Control via Forward and Backward Stochastic Differential Equations”, *55th IEEE Conference on Decision and Control (CDC)*, Las Vegas NV, December 12-14, 2016, pp. 6154-6160, doi: [10.1109/CDC.2016.7799215](https://doi.org/10.1109/CDC.2016.7799215)
 19. **I. Exarchos** and E. Theodorou, “Learning Optimal Control via Forward and Backward Stochastic Differential Equations”, *The American Control Conference (ACC)*, Boston MA, July 6-8, 2016, pp. 2155-2161, doi: [10.1109/ACC.2016.7525237](https://doi.org/10.1109/ACC.2016.7525237)
 20. **I. Exarchos**, P. Tsotras, and M. Pachter, “UAV Collision Avoidance based on the Solution of the Suicidal Pedestrian Differential Game”, *AIAA Guidance, Navigation, and Control Conference (SciTech)*, San Diego CA, January 4-8, 2016, pp. 1-16, doi: [10.2514/6.2016-2100](https://doi.org/10.2514/6.2016-2100)
 21. **I. Exarchos**, P. Tsotras, and M. Pachter, “On the Suicidal Pedestrian Differential Game”, *Dynamic Games and Applications*, Vol. 5, No. 3, September 2015, pp. 297-317, doi: [10.1007/s13235-014-0130-2](https://doi.org/10.1007/s13235-014-0130-2)
 22. **I. Exarchos** and P. Tsotras, “An Asymmetric Version of the Two Car Game”, *53rd IEEE Conference on Decision and Control (CDC)*, Los Angeles CA, December 15-17, 2014, pp. 4272-4277, doi:[10.1109/CDC.2014.7040055](https://doi.org/10.1109/CDC.2014.7040055)

1. *Sampling-based Methods in Optimal Control*, Lecture for CS 348E – Character Animation: Modeling, Simulation, and Control of Human Motion, Department of Computer Science, Stanford University, May 2020.

2. *Stochastic Optimal Control– Overview and Recent Advances*, Invited talk at the Center for Cyber-Physical Systems and Internet of Things, Ming Hsieh Department of Electrical and Computer Engineering, University of Southern California, January 2019.

HONORS AND AWARDS

- Gerondelis Foundation Fellowship 2016-2017
- Excellent Reviewer for AIAA Journal of Guidance, Control, and Dynamics 2017-2018
- Onassis Foundation Scholar – Doctoral Fellowship 2011-2015
The A. S. Onassis Foundation
- Academic Distinction 2012
Technical Chamber of Greece
- Highest Honors (Valedictorian, top of graduating class) 2010
University of Patras
- G. and A. Skouras Foundation Fellowship 2010
- Annual National Fellowship (3 consecutive years) 2006-2009
Greek State Scholarship Foundation (IKY)
- Annual Award for Academic Excellence (4 consecutive years) 2006-2010
Greek State Scholarship Foundation (IKY)

SERVICE

Reviewer for: 1) AAAI Conference on Artificial Intelligence, 2) Automatica, 3) IEEE Trans. Automatic Control, 4) Systems & Control Letters, 5) Journal of Guidance, Control, and Dynamics, 6) Dynamic Games and Applications, 7) IEEE Robotics and Automation Letters, 8) Optimal Control - Applications and Methods, 9) Entropy, 10) Int. Journal of Robust and Nonlinear Control, 11) Engineering Reports, 12) Numerical Mathematics: Theory, Methods and Applications, 13) East Asian Journal on Applied Mathematics, 14) Journal of Physics: Complexity, 15) SLEEP, 16) IEEE Conference on Decision and Control, 17) American Control Conference, 18) IFAC World Congress, 19) Mathematical Problems in Engineering.

REFERENCES

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