



Mykel Kochenderfer

Assistant Professor of Aeronautics and Astronautics and, by courtesy, of Computer Science

CONTACT INFORMATION

- **Administrator**

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Bio

BIO

Mykel Kochenderfer is Assistant Professor of Aeronautics and Astronautics at Stanford University. Prior to joining the faculty, he was at MIT Lincoln Laboratory where he worked on airspace modeling and aircraft collision avoidance, with his early work leading to the establishment of the ACAS X program. He received a Ph.D. from the University of Edinburgh and B.S. and M.S. degrees in computer science from Stanford University. Prof. Kochenderfer is the director of the Stanford Intelligent Systems Laboratory (SISL), conducting research on advanced algorithms and analytical methods for the design of robust decision making systems. Of particular interest are systems for air traffic control, unmanned aircraft, and other aerospace applications where decisions must be made in uncertain, dynamic environments while maintaining safety and efficiency. Research at SISL focuses on efficient computational methods for deriving optimal decision strategies from high-dimensional, probabilistic problem representations. He is the author of "Decision Making under Uncertainty: Theory and Application" and "Algorithms for Optimization", both from MIT Press. He is a third generation pilot.

ACADEMIC APPOINTMENTS

- Assistant Professor, Aeronautics and Astronautics
- Assistant Professor (By courtesy), Computer Science
- Member, Bio-X
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Co-Director, Center for AI Safety, (2018- present)
- Director, SAIL-Toyota Center for AI Research, (2018- present)

PROGRAM AFFILIATIONS

- Symbolic Systems Program

PROFESSIONAL EDUCATION

- Ph.D., University of Edinburgh , Informatics (2006)
- M.S., Stanford University , Computer Science (2003)

- B.S., Stanford University , Computer Science (2003)

LINKS

- Personal site: <http://www.stanford.edu/people/mykel>

Teaching

COURSES

2019-20

- Advanced Topics in Sequential Decision Making: AA 229, CS 239 (Win)
- Decision Making under Uncertainty: AA 228, CS 238 (Aut)
- Engineering Design Optimization: AA 222, CS 361 (Spr)
- SETS: Engineering and Technology in Morocco: OSPGEN 57 (Sum)

2018-19

- Building Trust in Autonomy: AA 120Q (Win)
- Decision Making under Uncertainty: AA 228, CS 238 (Aut)
- Engineering Design Optimization: AA 222, CS 361 (Spr)
- SETS: Engineering and Technology in Morocco: OSPGEN 57 (Sum)

2017-18

- Advanced Topics in Sequential Decision Making: AA 229, CS 239 (Win)
- Building Trust in Autonomy: AA 93 (Spr)
- Building Trust in Autonomy: Research Experiences in Edinburgh: OSPGEN 17 (Sum)
- Decision Making under Uncertainty: AA 228, CS 238 (Aut)
- Engineering Design Optimization: AA 222, CS 361 (Spr)
- Why Go To Space?: AA 47SI (Spr)

2016-17

- Building Trust in Autonomy: AA 120Q (Win)
- Decision Making under Uncertainty: AA 228, CS 238 (Aut)
- Introduction to Multidisciplinary Design Optimization: AA 222, CS 361 (Spr)
- Middle East Technology and Engineering: OSPGEN 134 (Sum)
- Middle East Technology and Engineering: OSPGEN 34 (Sum)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

John Alsterda, Shane Barratt, Matthew Brown, Ravi Haksar, De-An Huang, Tim MacDonald, Aditya Mahajan, Jayant Mukhopadhyaya, Brian Munguía, Haruki Nishimura, Vivian Patterson, Adrien Perkins, Aman Sinha, Ana Tarano, Julie Walker, Patrick Washington, Adam Wiktor, Junzi Zhang

Postdoctoral Faculty Sponsor

Amir Maleki, Ayan Mukhopadhyay, Ransalu Senanayake, Aolin Xu

Doctoral Dissertation Advisor (AC)

Edward Balaban, Raunak Bhattacharyya, Maxime Bouton, Kyle Brown, Anthony Corso, Duncan Eddy, Masha Itkina, Kyle Julian, Mark Koren, Christopher Lazarus Garcia, Xiaobai Ma, Kunal Menda, John Mern, Chelsea Sidrane, Patrick Slade, Andrea Zanette

Orals Evaluator

Adrien Perkins

Master's Program Advisor

Ross Alexander, Tomer Arnon, Toby Bell, Jared Blanchard, William Brannon, Harper Carroll, Anthony Galczak, Ella Hofmann-Coyle, Jihee Hwang, Arec Jamgochian, Cindy Jiang, Nolan Johnson, Soyeon Jung, Sydney Katz, Aubrey Kingston, Derek Knowles, Mark Koren, Christina Lin, Rongfei Lu, Kunal Menda, Robert Moss, Rohan Punnoose, Jacob Reiter, Stelios Rousoglou, Peggy Wang, Anil Yildiz, Lauren Zhu

Doctoral (Program)

Jean-Raymond Betterton, Shushman Choudhury, Jayesh Gupta

Publications

PUBLICATIONS

- **Algorithms for Optimization**

Kochenderfer, M. J., Wheeler, T. A.
MIT Press.2019

- **People as sensors: Imputing maps from human actions** *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*

Afolabi, O., Driggs-Campbell, K. R., Dong, R., Kochenderfer, M. J., Sastry, S.
2018

- **A comparison of Monte Carlo tree search and rolling horizon optimization for large-scale dynamic resource allocation problems** *European Journal of Operational Research*

Bertsimas, D., Griffith, J., Gupta, V., Kochenderfer, M. J., Mistic, V. V.
2017; 263 (2): 664-678

- **Weighted double Q-learning** *International Joint Conference on Artificial Intelligence (IJCAI)*

Zhang, Z., Pan, Z., Kochenderfer, M. J.
2017

- **Deep stochastic radar models** *IEEE Intelligent Vehicles Symposium (IV)*

Wheeler, T. A., Holder, M. F., Winner, H., Kochenderfer, M. J.
2017

- **The value of inferring the internal state of traffic participants for autonomous freeway driving** *American Control Conference (ACC)*

Sunberg, Z. N., Ho, C., Kochenderfer, M. J.
2017

- **Simultaneous active parameter estimation and control using sampling-based Bayesian reinforcement learning** *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*

Slade, P., Culbertson, P., Sunberg, Z. N., Kochenderfer, M. J.
2017

- **Generalizable intention prediction of human drivers at intersections** *IEEE Intelligent Vehicles Symposium (IV)*

Phillips, D. J., Wheeler, T. A., Kochenderfer, M. J.
2017

- **Markov decision process-based distributed conflict resolution for drone air traffic management** *Journal of Guidance, Control, and Dynamics*

Ong, H., Kochenderfer, M. J.
2017; 40 (1): 69-80

- **Analysis of recurrent neural networks for probabilistic modeling of driver behavior** *IEEE Transactions on Intelligent Transportation Systems*

Morton, J., Wheeler, T. A., Kochenderfer, M. J.
2017; 18 (5): 1289-1298

- **Simultaneous policy learning and latent state inference for imitating driver behavior** *IEEE International Conference on Intelligent Transportation Systems (ITSC)*
Morton, J., Kochenderfer, M. J.
2017
- **Learning traffic patterns at small airports from flight tracks** *IEEE Transactions on Intelligent Transportation Systems*
Mahboubi, Z., Kochenderfer, M. J.
2017; 18 (4): 917-926
- **Layer-wise synapse optimization for implementing neural networks on general neuromorphic architectures** *IEEE Symposium Series on Computational Intelligence*
Mern, J., Gupta, J. K., Kochenderfer, M. J.
2017
- **Imitating driver behavior with generative adversarial networks** *IEEE Intelligent Vehicles Symposium (IV)*
Kuefler, A., Morton, J., Wheeler, T. A., Kochenderfer, M. J.
2017
- **Geometric concept acquisition in a dueling deep Q-network** *Annual Meeting of the Cognitive Science Society*
Kuefler, A., Kochenderfer, M. J., McClelland, J. L.
2017
- **Burn-in demonstrations for multi-modal imitation learning** *Conference on Robotic Learning*
Kuefler, A., Kochenderfer, M. J.
2017
- **Heuristics for planning with rare catastrophic events** *Winter Simulation Conference*
Kim, Y., Gur, Y., Kochenderfer, M. J.
2017
- **Reluplex: An efficient SMT solver for verifying deep neural networks** *International Conference on Computer-Aided Verification*
Katz, G., Barrett, C., Dill, D. L., Julian, K. D., Kochenderfer, M. J.
2017
- **Neural network guidance for UAVs** *AIAA Guidance, Navigation, and Control Conference (GNC)*
Julian, K. D., Kochenderfer, M. J.
2017
- **Belief State Planning for Autonomously Navigating Urban Intersections** *IEEE Intelligent Vehicles Symposium (IV)*
Bouton, M., Cosgun, A., Kochenderfer, M. J.
2017
- **Automated Dynamic Resource Allocation for Wildfire Suppression** *Lincoln Laboratory Journal*
Griffith, J., Kochenderfer, M. J., Moss, R. J., Mistic, V. V., Gupta, V., Bertsimas, D.
2017; 22 (2): 38-59
- **POMDPs.jl: A Framework for Sequential Decision Making under Uncertainty** *Journal of Machine Learning Research*
Egorov, M., Sunberg, Z. N., Balaban, E., Wheeler, T. A., Gupta, J. K., Kochenderfer, M. J.
2017; 18 (26): 1-5
- **Efficient Decision-Theoretic Target Localization** *International Conference on Automated Planning and Scheduling (ICAPS)*
Dressel, L., Kochenderfer, M. J.
2017
- **Learning Discrete Bayesian Networks from Continuous Data** *Journal of Artificial Intelligence Research*
Chen, Y., Wheeler, T. A., Kochenderfer, M. J.
2017; 59: 103-132
- **Probabilistic Airport Acceptance Rate Prediction** *AIAA Modeling and Simulation Conference*
Cox, J., Kochenderfer, M. J.

2016

- **Stochastic Video Prediction with Conditional Density Estimation** *Workshop on Action and Anticipation for Visual Learning*
Shu, R., Brofos, J., Zhang, F., Bui, H., Ghavamzadeh, M., Kochenderfer, M.
2016
- **Detection of hypervelocity impact radio frequency pulses through prior constrained source separation** *Radio Science*
Nuttall, A., Kochenderfer, M., Close, S.
2016; 51
- **Multi-Rotor Aircraft Collision Avoidance using Partially Observable Markov Decision Processes** *AIAA Modeling and Simulation Conference*
Mueller, E., Kochenderfer, M. J.
AIAA.2016
- **Simulation Comparison of Collision Avoidance Algorithms for Small Multi-Rotor Aircraft** *AIAA Modeling and Simulation Conference*
Mueller, E., Kochenderfer, M. J.
AIAA.2016
- **Policy Compression for Aircraft Collision Avoidance Systems** *Digital Avionics Systems Conference*
Julian, K., Lopez, J., Brush, J. S., Owen, M., Kochenderfer, M. J.
IEEE.2016
- **Analysis of Microscopic Behavior Models for Probabilistic Modeling of Driver Behavior** *IEEE International Conference on Intelligent Transportation Systems*
Wheeler, T. A., Robbel, P., Kochenderfer, M. J.
IEEE.2016
- **Factor Graph Scene Distributions for Automotive Safety Analysis** *IEEE International Conference on Intelligent Transportation Systems*
Wheeler, T. A., Kochenderfer, M. J.
IEEE.2016
- **Collision Avoidance for Unmanned Aircraft using Coordination Tables** *Digital Avionics Systems Conference*
Tompa, R. E., Wulfe, B., Owen, M., Kochenderfer, M. J.
IEEE.2016
- **Customer Simulation for Direct Marketing Experiments** *IEEE International Conference on Data Science and Advanced Analytics*
Tkachenko, Y., Kochenderfer, M. J., Kluza, K.
2016
- **Optimized and Trusted Collision Avoidance for Unmanned Aerial Vehicles using Approximate Dynamic Programming** *IEEE International Conference on Robotics and Automation*
Sunberg, Z., Kochenderfer, M., Pavone, M.
2016
- **Dynamic Logic Selection for Unmanned Aircraft Separation** *Digital Avionics Systems Conference*
Owen, M. P., Kochenderfer, M. J.
IEEE.2016
- **Markov Decision Process-Based Distributed Conflict Resolution for Drone Air Traffic Management** *Journal of Guidance, Control, and Dynamics*
Ong, H., Kochenderfer, M. J.
2016
- **Analysis of Recurrent Neural Networks for Probabilistic Modeling of Driver Behavior** *IEEE Transactions on Intelligent Transportation Systems*
Morton, J., Wheeler, T. A., Kochenderfer, M. J.
2016
- **Decision-Theoretic Approach to Designing Cyber Resilient Systems** *IEEE International Symposium on Network Computing and Applications*
Mehta, V., Rowe, P., Lewis, G., Magalhaes, A., Kochenderfer, M.
IEEE.2016
- **Learning Traffic Patterns at Small Airports from Flight Tracks** *IEEE Transactions on Intelligent Transportation Systems*
Mahboubi, Z., Kochenderfer, M. J.

2016

- **Improving Aircraft Collision Risk Estimation Using the Cross-Entropy Method** *Journal of Air Transportation*
Kim, Y., Kochenderfer, M. J.
2016; 24 (2): 55-61
- **Ground Delay Program Planning using Markov Decision Processes** *Journal of Aerospace Information Systems*
Cox, J., Kochenderfer, M. J.
2016; 13 (3): 134-142
- **Target Surveillance in Adversarial Environments using POMDPs** *AAAI Conference on Artificial Intelligence*
Egorov, M., Kochenderfer, M. J., Uudmae, J. J.
2016
- **Exploiting Anonymity in Approximate Linear Programming: Scaling to Large Multiagent MDPs** *AAAI Conference on Artificial Intelligence*
Robbel, P., Oliehoek, F. A., Kochenderfer, M. J.
2016
- **Signal Source Localization using Partially Observable Markov Decision Processes** *AIAA Infotech@Aerospace Conference*,
Dressel, L., Kochenderfer, M. J.
2015
- **Initial Scene Configurations for Highway Traffic Propagation** *IEEE International Conference on Intelligent Transportation Systems*
Wheeler, T. A., Robbel, P., Kochenderfer, M. J.
IEEE.2015
- **Optimal Aircraft Rerouting During Commercial Space Launches** *Digital Avionics Systems Conference*
Tomba, R. E., Kochenderfer, M. J., Cole, R., Kuchar, J. K.
IEEE.2015
- **Optimizing a Collision-Avoidance System for Closely Spaced Parallel Operations** *Journal of Aerospace Information Systems*
Smith, K. A., Vela, A. E., Kochenderfer, M. J., Olson, W. A.
2015; 12 (10): 618-633
- **Continuous Time Autonomous Air Traffic Control for Non-Towered Airports** *IEEE Conference on Decision and Control*
Mahboubi, Z., Kochenderfer, M. J.
IEEE.2015
- **Autonomous Air Traffic Control for Non-Towered Airports** *Air Traffic Management Research and Development Seminar*
Mahboubi, Z., Kochenderfer, M. J.
2015
- **Bayesian Preference Elicitation for Multiobjective Engineering Design Optimization** *Journal of Aerospace Information Systems*
Lepird, J. R., Owen, M. P., Kochenderfer, M. J.
2015; 12 (10): 634-645
- **Stress Testing Collision Avoidance Systems using Monte Carlo Tree Search** *Digital Avionics Systems Conference*
Lee, R., Kochenderfer, M. J., Mengshoel, O. J., Brat, G. P., Owen, M. P.
IEEE.2015
- **Optimization Approaches to the Single Airport Ground Holding Problem** *Journal of Guidance, Control, and Dynamics*
Cox, J., Kochenderfer, M. J.
2015; 38 (12): 2399-2406
- **A Probabilistic Framework for Microscopic Traffic Propagation** *IEEE International Conference on Intelligent Transportation Systems*
Wheeler, T. A., Robbel, P., Kochenderfer, M. J.
IEEE.2015
- **Decision Making Under Uncertainty: Theory and Application**
Kochenderfer, M. J.

MIT Press.2015

- **Optimal Lost-Link Policies for Unmanned Aircraft** *Digital Avionics Systems Conference*
Kim, Y., Kochenderfer, M. J.
IEEE.2015
- **Control of Epidemics on Graphs** *IEEE Conference on Decision and Control*
Ho, C., Kochenderfer, M. J., Mehta, V., Caceres, R. S.
IEEE.2015
- **Error Model Estimation for Airborne Beacon-Based Surveillance** *IET Radar, Sonar and Navigation*
Panken, A., Kochenderfer, M. J.
2014; 8 (6): 667-675
- **Vertical State Estimation for Aircraft Collision Avoidance with Quantized Measurements** *Journal of Guidance, Control, and Dynamics*
Asmar, D. M., Kochenderfer, M. J., Chryssanthacopoulos, J. P.
2013; 35 (6): 1797-1802
- **Collision Avoidance System Optimization for Closely Spaced Parallel Operations through Surrogate Modeling** *AIAA Guidance, Navigation, and Control Conference*
Smith, K., Kochenderfer, M. J., Olson, W., Vela, A.
2013
- **Decentralized Control of Partially Observable Markov Decision Processes** *IEEE Conference on Decision and Control*
Amato, C., Chowdhary, G., Geramifard, A., Ure, N. K., Kochenderfer, M. J.
2013
- **Fielding a Sense and Avoid Capability for Unmanned Aircraft Systems: Policy, Standards, Technology, and Safety Modeling** *Air Traffic Control Quarterly*
Cole, R., Kochenderfer, M. J., Weibel, R., Edwards, M., Griffith, J. D.
2013; 21 (1): 5-27
- **Traffic Alert Optimization for Airborne Collision Avoidance Systems** *AIAA Guidance, Navigation, and Control Conference*
Puntin, B., Kochenderfer, M. J.
2013
- **Compression of Optimal Value Functions for Markov Decision Processes** *Data Compression Conference*
Kochenderfer, M. J., Monath, N.
2013
- **Optimizing the Next Generation Collision Avoidance System for Safe, Suitable, and Acceptable Operational Performance** *Air Traffic Management Research and Development Seminar*
Holland, J. E., Kochenderfer, M. J., Olson, W. A.
2013
- **Decomposition Methods for Optimized Collision Avoidance with Multiple Threats** *Journal of Guidance, Control, and Dynamics*
Chryssanthacopoulos, J. P., Kochenderfer, M. J.
2012; 35 (2): 398-405
- **Predicting the Behavior of Interacting Humans by Fusing Data from Multiple Sources** *Conference on Uncertainty in Artificial Intelligence*
Schlicht, E. J., Lee, R., Wolpert, D. H., Kochenderfer, M. J., Tracey, B.
2012
- **Next Generation Airborne Collision Avoidance System** *Lincoln Laboratory Journal*
Kochenderfer, M. J., Holland, J. E., Chryssanthacopoulos, J. P.
2012; 19 (1): 17-33
- **Hazard Alerting Based on Probabilistic Models** *Journal of Guidance, Control, and Dynamics*
Chryssanthacopoulos, J. P., Kochenderfer, M. J.
2012; 35 (2): 442-450
- **Collision Avoidance for General Aviation** *IEEE Aerospace and Electronic Systems Magazine*

- Billingsley, T. B., Kochenderfer, M. J., Chryssanthacopoulos, J. P.
2012; 27 (7): 4-12
- **A New Approach for Designing Safer Collision Avoidance Systems** *Air Traffic Control Quarterly*
Kochenderfer, M. J., Chryssanthacopoulos, J. P., Weibel, R. E.
2012; 20 (1): 27-45
 - **Partially-Controlled Markov Decision Processes for Collision Avoidance Systems** *International Conference on Agents and Artificial Intelligence*
Kochenderfer, M. J., Chryssanthacopoulos, J. P.
2011
 - **Position Validation Strategies using Partially Observable Markov Decision Processes** *IEEE/AIAA Digital Avionics Systems Conference*
Kochenderfer, M. J., Shih, K. J., Chryssanthacopoulos, J. P., Rose, C. E., Elder, T. R.
2011
 - **Unmanned Aircraft Collision Avoidance using Continuous-State POMDPs** *Robotics: Science and Systems*
Bai, H., Hsu, D., Kochenderfer, M. J., Lee, W. S.
2011
 - **Analysis of Open-loop and Closed-loop Planning for Aircraft Collision Avoidance** *IEEE International Conference on Intelligent Transportation Systems*
Chryssanthacopoulos, J. P., Kochenderfer, M. J.
2011
 - **Accounting for State Uncertainty in Collision Avoidance** *Journal of Guidance, Control, and Dynamics*
Chryssanthacopoulos, J. P., Kochenderfer, M. J.
2011; 34 (4): 951-960
 - **Collision Avoidance System Optimization with Probabilistic Pilot Response Models** *American Control Conference*
Chryssanthacopoulos, J. P., Kochenderfer, M. J.
2011
 - **Aircraft Collision Avoidance using Monte Carlo Real-Time Belief Space Search** *Journal of Intelligent and Robotic Systems*
Wolf, T. B., Kochenderfer, M. J.
2011; 64 (2): 277-298
 - **Efficiently Estimating Ambient Near Mid-Air Collision Risk for Unmanned Aircraft** *AIAA Aviation Technology, Integration, and Operations Conference*
Maki, E., Weinert, A., Kochenderfer, M. J.
2010
 - **On Estimating Mid-Air Collision Risk** *AIAA Aviation Technology, Integration, and Operations Conference*
Kochenderfer, M. J., Griffith, J. D., Olszta, J. E.
2010
 - **A Decision-Theoretic Approach to Developing Robust Collision Avoidance Logic** *IEEE International Conference on Intelligent Transportation Systems*
Kochenderfer, M. J., Chryssanthacopoulos, J. P.
2010
 - **Collision Avoidance for Unmanned Aircraft using Markov Decision Processes** *AIAA Guidance, Navigation, and Control Conference*
Temizer, S., Kochenderfer, M. J., Kaelbling, L. P., Lozano-Perez, T.
2010
 - **Improved Monte Carlo Sampling for Conflict Probability Estimation** *AIAA Non-Deterministic Approaches Conference*
Chryssanthacopoulos, J. P., Kochenderfer, M. J., Williams, R. E.
2010
 - **Airspace Encounter Models for Estimating Collision Risk** *Journal of Guidance, Control, and Dynamics*
Kochenderfer, M. J., Edwards, M., Espindle, L. P., Kuchar, J. K., Griffith, J. D.
2010; 33 (2): 487-499
 - **Robustness of Optimized Collision Avoidance Logic to Modeling Errors** *IEEE/AIAA Digital Avionics Systems Conference*
Kochenderfer, M. J., Chryssanthacopoulos, J. P., Radecki, P.

2010

- **Classification of Primary Radar Tracks using Gaussian Mixture Models** *IET Radar, Sonar and Navigation*
Espindle, L. P., Kochenderfer, M. J.
2009; 3 (6): 559-568
- **Hazard Alerting using Line-of-Sight Rate** *AIAA Guidance, Navigation, and Control Conference*
Kochenderfer, M. J., Griffith, J. D., Kuchar, J. K.
2008
- **A Comprehensive Aircraft Encounter Model of the National Airspace System** *Lincoln Laboratory Journal*
Kochenderfer, M. J., Espindle, L. P., Kuchar, J. K., Griffith, J. D.
2008; 17 (2): 41-53
- **Electro-Optical System Analysis for Sense and Avoid** *AIAA Guidance, Navigation, and Control Conference*
Griffith, J. D., Kochenderfer, M. J., Kuchar, J. K.
2008
- **Adaptive Modeling and Planning for Reactive Agents** *AAAI National Conference on Artificial Intelligence*
Kochenderfer, M. J.
2005
- **Common Sense Data Acquisition for Indoor Mobile Robots** *AAAI National Conference on Artificial Intelligence*
Gupta, R., Kochenderfer, M. J.
2004
- **Evolving Hierarchical and Recursive Teleo-Reactive Programs through Genetic Programming** *European Conference on Genetic Programming*
Kochenderfer, M. J.
Springer.2003