

# David Fridovich-Keil

## Curriculum Vitae

Phone: (609) 580-9164

Email: dfk@eecs.berkeley.edu

Website: <https://people.eecs.berkeley.edu/~dfk/>



## ..... Education

PhD      **University of California, Berkeley**, *Electrical Engineering & Computer Sciences*

Advisor: Claire J. Tomlin

Expected graduation: May 2020

BSE      **Princeton University**, *Electrical Engineering*, 2015

*Summa Cum Laude*

Advisor: Paul R. Prucnal

## ..... Research Overview

My primary research interests lie in robust optimal control, motion planning, differential game theory, and safe autonomy. While I have also worked on a number of other projects related to distributed control, reinforcement learning, adaptive control, and active search, most of my work falls into the following categories:

- Efficient motion planning with strong, modular safety guarantees derived from Hamilton-Jacobi reachability analysis of nonlinear systems
- Confidence-aware prediction of other agents' motion for robust human-facing automation
- Posing interactive motion planning problems as multi-player, general-sum differential games and designing efficient algorithms to solve these games

## ..... Awards

1. **RSS Pioneer**, Workshop for top early-career robotics researchers., *Robotics: Science & Systems Pioneers Workshop*, 2019.
2. **Top Reviewer**, Rated one of the top 400 reviewers for NeurIPS 2019., *NeurIPS*, 2019.
3. **Outstanding Graduate Student Instructor**, Awarded to up to 9% of current GSIs throughout the university., *University of California Berkeley*, 2018.
4. **Charles Ira Young Memorial Prize**, Awarded each year to the student who excels in research in Electrical Engineering., *Princeton University*, 2015.

5. **G. David Forney Jr. Prize**, Awarded annually to a senior in Electrical Engineering Department. having an outstanding record in the communication science, systems & signals., *Princeton University*, 2015.
6. **James Hayes-Edger Palmer Prize**, Awarded annually to an engineering senior who has manifested excellent scholarship, a marked capacity for leadership and promise of creative achievement in engineering., *Princeton University*, 2015.
7. **NSF Graduate Research Fellowship**, *National Science Foundation*, 2015.

## ..... Teaching Experience

- 2019      **Graduate Student Instructor**, *Dept. of Electrical Engineering and Computer Sciences*, University of California, Berkeley  
 CS70: Discrete Mathematics and Probability Theory (Undergraduate)  
 Led discussion sections, held office hours, and ran “homework parties” for introductory CS course with approximately 300 students.
- 2017      **Graduate Student Instructor**, *Dept. of Electrical Engineering and Computer Sciences*, University of California, Berkeley  
 EE106A: Introduction to Robotics (Undergraduate and Masters)  
 Head lab instructor, managed two undergraduate teaching assistants and created and tested content for new hardware for course of approximately 100 students. Received 2018 Outstanding Graduate Student Instructor Award.
- 2015      **Teaching Assistant**, *Dept. of Electrical Engineering*, Princeton University  
 ELE302: Building Real Systems (Undergraduate)
- 2013-2015      **Tutor**, *McGraw Center for Teaching & Learning*, Princeton University  
 MAT201/3: Vector Calculus (Undergraduate)  
 MAT202/4: Linear Algebra (Undergraduate)  
 PHY103: General Physics I (Undergraduate)
- 2013      **Tutor**, *Freshman Scholars Institute*, Princeton University  
 POL245: Visualizing Data (Undergraduate)

## ..... Work Experience

- 2018      **Software Engineering Intern**, *Nuro Inc.*, Mountain View, CA  
 Planning, Prediction, and Control Team  
 Developed, tested, and deployed core safety features for autonomous vehicle motion planning and prediction.
- 2014      **Software Engineering Intern**, *Applied Science & Tech. Research Inst.*, Hong Kong  
 Integrated Circuit Design Group  
 Designed, implemented, and tested algorithms for depth estimation and video depth sense enhancement.

- 2013      **Embedded Systems Intern**, *Sentinel Photonics*, Monmouth Junction, NJ  
Built, aligned, and tested hydrogen cyanide gas sensor prototype. Designed and implemented signal processing backend for spectral analysis.

## ..... Professional Activities

### PROFESSIONAL SERVICE – LEADERSHIP ROLES

1. Coordinator, Workshop on Robust Autonomy: Tools for Safety in Real-World Uncertain Environments, Robotics: Science & Systems, 2019.
2. Coordinator, CPAR/DREAM Robotics Seminar Series, UC Berkeley, 2019–*pres.*
3. Senator, Graduate Assembly, UC Berkeley, 2017–*pres.*
4. Coordinator, Semiautonomous Control Theory Seminar Series, UC Berkeley, 2018–2019.
5. President, Electrical Engineering Graduate Student Association, UC Berkeley, Surveyed students and found that a significant fraction suffered anxiety related to finding a research advisor. Initiated the Rotations Committee to interface between students and faculty and explore the possibility of a rotations program for incoming first year PhD students., 2016–2017.

### PROFESSIONAL SERVICE – COMMITTEE ROLES

1. Qualifying Exam Ombudsman, Electrical Engineering Graduate Student Association, UC Berkeley, 2018–*pres.*
2. Rotations Committee, Electrical Engineering Graduate Student Association, UC Berkeley, Working with faculty committee for graduate matters to design a rotations program for first year graduate students., 2017–*pres.*
3. Student Representative, Graduate Student Matters Committee, UC Berkeley Electrical Engineering and Computer Sciences, 2016–2017.
4. Social Committee, Electrical Engineering Graduate Student Association, UC Berkeley, 2015–2016.

### REVIEW ACTIVITIES

1. Advances in Neural Information Systems.
2. American Control Conference.
3. IEEE International Conference on Robotics and Automation.
4. IEEE Robotics and Automation Letters.
5. IEEE/RSJ International Conference on Intelligent Robots and Systems.

### MENTORSHIP ACTIVITIES

1. High School Summer Research Mentor, Hybrid Systems Lab, 2019.
2. Session Leader, Girls in Engineering Summer Camp, 2019.
3. Graduate Research Mentor, Hybrid Systems Lab, 2018–*pres.*

4. Volunteer, Bay Area Scientists in Schools, 2018–*pres.*
5. Undergraduate Research Mentor, Hybrid Systems Lab, 2017–*pres.*
6. Session Leader, Get Science, Engineering, and Technology SWE Summer Camp, 2018–2019.

## ..... Academic Publications and Presentations

\* indicates equal contribution

### JOURNAL ARTICLES

1. **D. Fridovich-Keil\***, A. Bajcsy\*, J. F. Fisac, S. L. Herbert, S. Wang, A. D. Dragan, and C. J. Tomlin, “Confidence-aware motion prediction for real-time collision avoidance,” *International Journal of Robotics Research*, 2019.
2. R. Dobbe, O. Sondermeijer, **D. Fridovich-Keil**, D. Arnold, D. Callaway, and C. J. Tomlin, “Towards distributed energy services: Decentralizing optimal power flow with machine learning,” *IEEE Transactions on Smart Grid*, 2019.

### CONFERENCE PAPERS

1. **D. Fridovich-Keil**, E. Ratner, L. Peters, A. D. Dragan, and C. J. Tomlin, “Efficient iterative linear-quadratic approximations for nonlinear multi-player general-sum differential games,” in *International Conference on Robotics and Automation (ICRA)*, 2020.
2. **D. Fridovich-Keil\***, V. Rubies-Royo\*, and C. J. Tomlin, “An iterative quadratic method for general-sum differential games with feedback linearizable dynamics,” in *International Conference on Robotics and Automation (ICRA)*, 2020.
3. L. Peters, **D. Fridovich-Keil**, C. J. Tomlin, and Z. Sunberg, “Inference-based strategy alignment for general-sum differential games,” in *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2020.
4. T. Westenbroek\*, **D. Fridovich-Keil\***, E. Mazumdar\*, S. Arora, V. Prabhu, S. S. Sastry, and C. J. Tomlin, “Feedback linearization for unknown systems via reinforcement learning,” in *International Conference on Robotics and Automation (ICRA)*, 2020.
5. **D. Fridovich-Keil\***, J. F. Fisac\*, and C. J. Tomlin, “Safely probabilistically complete real-time planning and exploration in unknown environments,” in *International Conference on Robotics and Automation (ICRA)*, 2019.
6. S. L. Herbert\*, A. Bajcsy\*, **D. Fridovich-Keil**, J. F. Fisac, S. Deglurkar, A. D. Dragan, and C. J. Tomlin, “A scalable framework for real-time multi-robot, multi-human collision avoidance,” in *International Conference on Robotics and Automation (ICRA)*, 2019.
7. V. Rubies-Royo, **D. Fridovich-Keil**, S. L. Herbert, and C. J. Tomlin, “A classification-based approach for approximate reachability,” in *International Conference on Robotics and Automation (ICRA)*, 2019.
8. **D. Fridovich-Keil\***, S. L. Herbert\*, J. F. Fisac, S. Deglurkar, and C. J. Tomlin, “Planning, fast and slow: A framework for adaptive real-time safe trajectory planning,” in *International Conference on Robotics and Automation (ICRA)*, 2018.

9. J. F. Fisac\*, A. Bajcsy\*, S. L. Herbert, **D. Fridovich-Keil**, S. Wang, C. J. Tomlin, and A. D. Dragan, “Probabilistically safe robot planning with confidence-based human predictions,” in *Robotics: Science and Systems (RSS)*, 2018.
10. **D. Fridovich-Keil**, N. Hanford, M. P. Chapman, C. J. Tomlin, M. K. Farrens, and D. Ghosal, “A model predictive control approach to flow pacing for TCP,” in *55th Annual Allerton Conference on Communication, Control, and Computing*, 2017.
11. **D. Fridovich-Keil**, E. Nelson, and A. Zakhor, “AtomMap: A probabilistic amorphous 3D map representation for robotics and surface reconstruction,” in *International Conference on Robotics and Automation (ICRA)*, 2017.
12. R. Dobbe\*, **D. Fridovich-Keil\***, and C. J. Tomlin, “Fully decentralized policies for multi-agent systems: An information theoretic approach,” in *Advances in Neural Information Processing Systems*, 2017.

#### MANUSCRIPTS UNDER REVIEW

1. T. Westenbroek, E. Mazumdar, **D. Fridovich-Keil**, V. Prabhu, C. J. Tomlin, and S. S. Sastry, “Adaptive control for linearizable systems using on-policy reinforcement learning,” *Conference on Decision and Control (CDC)*, 2020.
2. E. Rolf\*, **D. Fridovich-Keil\***, M. Simchowitz, B. Recht, and C. J. Tomlin, “A successive-elimination approach to adaptive robotic sensing,” *IEEE Transactions on Robotics*, 2019.

#### MANUSCRIPTS IN PREPARATION

1. S. L. Herbert\*, **D. Fridovich-Keil\***, V. Rubies-Royo, and C. J. Tomlin, “Metareasoning for computationally adaptive planning in robotics,” *IEEE Transactions on Automatic Control*, 2020.

#### WORKSHOPS AND INVITED PRESENTATIONS

1. University of Michigan, Connected and Automated Vehicles (CAV), *A Scalable Framework for Real-Time Multi-Robot, Multi-Human Collision Avoidance*, 2019.
2. University of California, Berkeley, CITRIS/CPAR Control Theory and Automation Symposium, *A Scalable Framework for Real-Time Multi-Robot, Multi-Human Collision Avoidance*, 2019.
3. Robotic Manipulation and Interaction (EE 106B), University of California, Berkeley, *Iterative Linear Quadratic Approximations for Nonlinear Differential Games*, 2019.
4. Berkeley Artificial Intelligence Research (BAIR) Retreat, University of California, Berkeley, *Iterative Linear Quadratic Approximations for Nonlinear Multi-Player General-Sum Differential Games*, 2019.
5. DARPA Assured Autonomy Program, *Toward Robust Autonomy in Multi-Agent Safety-Critical Systems*, 2019.
6. Postmates X, *Toward Robust Autonomy in Multi-Agent Safety-Critical Systems*, 2019.
7. Department of Aeronautics & Astronautics, Stanford University, Multi-Agent Systems Lab, *Toward Robust Autonomy in Uncertain Safety-Critical Systems*, 2019.

8. Department of Aeronautics & Astronautics, Stanford University, Autonomous Systems Lab, *Toward Robust Autonomy in Uncertain Safety-Critical Systems*, 2019.
9. Nuro Inc., *Toward Robust Autonomy in Uncertain Safety-Critical Systems*, 2019.
10. Robotics: Science & Systems, Pioneers Workshop, *Toward Robust Autonomy in Uncertain Safety-Critical Systems*, 2019.
11. VeHiCal Annual Workshop, University of California, Berkeley, *A Scalable Framework for Real-Time Multi-Robot, Multi-Human Collision Avoidance*, 2018.
12. University of California, Santa Cruz, CITRIS/CPAR Control Theory and Automation Symposium, *Probabilistically Safe Robot Planning with Confidence-Based Human Predictions*, 2018.
13. Berkeley Artificial Intelligence Research (BAIR) Seminar Series, University of California, Berkeley, *Probabilistically Safe Robot Planning with Confidence-Based Human Predictions*, 2018.
14. Bay Area Robotics Symposium (BARS), Stanford University, *Probabilistically Safe Robot Planning with Confidence-Based Human Predictions*, 2018.
15. Bay Area Robotics Symposium (BARS), University of California, Berkeley, *Planning, Fast and Slow: A Framework for Adaptive Real-Time Safe Trajectory Planning*, 2017.
16. VeHiCal Annual Workshop, University of California, Berkeley, *Planning, Fast and Slow: A Framework for Adaptive Real-Time Safe Trajectory Planning*, 2017.
17. Berkeley Artificial Intelligence Research (BAIR) Seminar Series, University of California, Berkeley, *Planning, Fast and Slow with FaSTrack*, 2017.

## ..... References

1. Claire J. Tomlin  
**Position:** Professor, Electrical Engineering and Computer Sciences, UC Berkeley  
**Relationship:** PhD Advisor  
**Email:** tomlin at eecs.berkeley.edu  
**Phone:** (510) 643-6610
2. Ruzena Bajcsy  
**Position:** Professor, Electrical Engineering and Computer Sciences, UC Berkeley  
**Relationship:** Qualifying Exam Committee Chair  
**Email:** bajcsy at eecs.berkeley.edu  
**Phone:** (510) 642-9423
3. S. Shankar Sastry  
**Position:** Professor, Electrical Engineering and Computer Sciences, UC Berkeley  
**Relationship:** Qualifying Exam Committee Member  
**Email:** sastry at eecs.berkeley.edu  
**Phone:** (510) 642-1857
4. Anca Dragan  
**Position:** Assistant Professor, Electrical Engineering and Computer Sciences, UC Berkeley  
**Relationship:** Coauthor  
**Email:** anca at berkeley.edu
5. Chris Dellin  
**Position:** Planning and Control Team Lead, Nuro Inc.  
**Relationship:** Summer Internship Mentor  
**Email:** cdellin at nuro.ai
6. George J. Pappas  
**Position:** Chair, Electrical and Systems Engineering, University of Pennsylvania  
**Email:** pappasg at seas.upenn.edu  
**Phone:** (215) 898-9780
7. Mac Schwager  
**Position:** Assistant Professor, Aeronautics and Astronautics, Stanford University  
**Email:** schwager at stanford.edu