David D. Fan

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Robotics, Motion Planning, Traversability, Learning-based Controls, Safe RL

Education

Ph.D. in Robotics, Georgia Institute of Technology
Graduated Aug 2021, GPA 4.0
President's Fellowship Recipient, SMART Fellowship Recipient
Thesis: Safe Robot Planning and Control Using Uncertainty-Aware Deep Learning

Master of Science in Electrical Engineering, Texas A&M University
Graduated Spring 2015, GPA: 3.9
Leroy Fouraker Department Fellowship Recipient
Thesis: Backpropagation for Continuous Theta Neuron Networks

Bachelor of Science in Biomedical Engineering, Duke University
Pratt School of Engineering Class of 2009, GPA: 3.7
Dean's List with Distinction

Research Experience

NASA Jet Propulsion Laboratory Internship (Sept 2018-)
Full GNC stack development for hybrid quadrotor ground/aerial UAVs, differential drive, ackermann steered, tracked, and legged robots, for autonomous exploration of challenging subterranean environments. Traversability/GNC subteam lead, 1st place in DARPA Subterranean Challenge Urban Circuit, 2nd place in DARPA Subterranean Challenge Tunnel Circuit. (https://costar.jpl.nasa.gov/)

Doctoral Work (Fall 2016-)
Autonomous Control and Decision Laboratory (https://sites.gatech.edu/acds/)
Advisor: Dr. Evangelos Theodorou
Data-efficient reinforcement learning for robotic systems, learning-based estimation and control in perceptually degraded environments for UAVs, Guarantees for real-time safety-critical learning-based control and trajectory optimization, Uncertainty-aware traversability analyses for high-speed driving in unstructured environments.

Master's Thesis (Spring 2015)
Computer Engineering and Systems Group, Texas A&M University
Advisor: Dr. Peng Li
Large-scale simulation of spiking neural networks, investigation of learning rules for theta neural networks

Associate in Research (May 2009 – August 2011)
Center for Cognitive Neuroscience, Duke University
Advisor: Dr. Henry Yin
Computational analysis of neuronal data in mammalian basal ganglia circuits, In vivo multi-electrode neuronal recordings in behaving mice and rats

Work Experience

Space and Naval Warfare Systems Command (Summer intern, 2016-2018)
NIWC, San Diego, CA
RL-based swarm control algorithms for teams of heterogeneous UAVs with dogfighting capabilities.

Academic Program Coordinator (August 2011 – June 2012)
The Harvest Center, Bronx, NY
Coordinating and facilitating afterschool program, Adult G.E.D. preparation, tutoring

Field Engineer (January 2010 – May 2011)
Triangle BioSystems International, Durham, NC
Design, assembly, testing, and development of state-of-the-art high-throughput wireless neurophysiology data transmitters, In-field setup, support, and marketing

Skills

C++, Python, Julia, Matlab, Simulink, Linux, ROS, PX4, Tensorflow, Pytorch
Experience with quadrotors, manipulators, tracked and wheeled vehicles, legged robots, field testing in extreme environments, circuit design, assembly, soldering, small animal surgery, electrophysiology techniques.

Selected Publications

Agha, Ali, Kyohei Otsu, Benjamin Morrell, David D. Fan, Rohan Thakker, Angel Santamaria-Navarro, Sung-Kyun Kim et al. "**NeBula: Quest for Robotic Autonomy in Challenging Environments; TEAM CoSTAR at the DARPA Subterranean Challenge**." Journal of Field Robotics (2021).

Fan, David D., Kyohei Otsu, Yuki Kubo, Anushri Dixit, Joel Burdick, and Ali-Akbar Agha-Mohammadi. "**STEP: Stochastic Traversability Evaluation and Planning for Safe Off-road Navigation.**" *Under review. arXiv preprint arXiv:2103.02828*, 2021.

Kim, Sung-Kyun, Amanda Bouman, Gautam Salhotra, David D. Fan, Kyohei Otsu, Joel Burdick, and Ali-akbar Agha-mohammadi. "**PLGRIM: Hierarchical value learning for large-scale exploration in unknown environments**." 31st International Conference on Automated Planning and Scheduling (ICAPS) 2021.

Amanda Bouman, Muhammad Fadhil Ginting, Nikhilesh Alatur, Matteo Palieri, David D. Fan, Kim Sung-Kyun, Thomas Touma, Torkom Pailevanian, Kyohei Otsu, Joel Burdick, Ali-akbar Agha-mohammadi. **Autonomous Spot: Long-Range Autonomous Exploration of Extreme Environments with Legged Locomotion**. International Conference on Intelligent Robots and Systems (IROS) 2020. (**Best Paper Award** on Safety, Security, and Rescue Robotics.)

Nikhilesh Alatur, David D Fan, Jesus Tordesillas Torres, Michael Paton, Kyohei Otsu, Rohan Thakker, Ali-akbar Agha-mohammadi. **Autonomous Off-road Terrain Navigation in GPS-denied and Perceptually Degraded Environments: An Experimental Perspective**. 17th International Symposium on Experimental Robotics (ISER) 2020.

Fan, David D., Ali-akbar Agha-mohammadi, and Evangelos A. Theodorou. "**Deep learning tubes for tube MPC**." Robotics: Science and Systems (RSS) 2020.

Fan, D. D., Nguyen, J., Thakker, R., Alatur, N., Agha-mohammadi, A. A., & Theodorou, E. A. **Bayesian learning-based adaptive control for safety critical systems**. IEEE International Conference on Robotics and Automation (ICRA) *2020*.

Fan, D. D., Thakker, R., Bartlett, T., Miled, M. B., Kim, L., Theodorou, E., & Agha-mohammadi, A. A. **Autonomous Hybrid Ground/Aerial Mobility in Unknown Environments**. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2019*

Lew, T., Emmei, T., Fan, D. D., Bartlett, T., Santamaria-Navarro, A., Thakker, R., & Agha-mohammadi, A. A. **Contact inertial odometry: Collisions are your friend.** The International Symposium on Robotics Research (ISRR) 2019.

Santamaria-Navarro, A., Thakker, R., Fan, D.D., Morrell, B., & Agha-mohammadi, A. A. **Towards Resilient Autonomous Navigation of Drones**. The International Symposium on Robotics Research (ISRR) 2019.

Fan, David D., Evangelos A. Theodorou, and John Reeder. "**Model-Based Stochastic Search for Large Scale Optimization of Multi-Agent UAV Swarms**." *IEEE Symposium Series on Computational Intelligence (SSCI)*, 2018.

Bakshi, Kaivalya, David Fan, and Evangelos A. Theodorou. "S**chrodinger Approach to Optimal Control of Large-Size Populations**." Transactions on Automatic Control 2021.

Pereira, M., Fan, D. D., An, G. N., & Theodorou, E. (2018). **MPC-Inspired Neural Network Policies for Sequential Decision Making**. *arXiv Preprint arXiv:1802.05803*.

Bakshi, K. S., Fan, D. D., & Theodorou, E. A. (2017). **Stochastic control of systems with control multiplicative noise using second order FBSDEs**. In *American Control Conference (ACC), 2017* (pp. 424–431).

Fan, D. D., Theodorou, E., & Reeder, J. (2017). **Evolving cost functions for model predictive control of multi-agent UAV combat swarms.** In *Proceedings of the Genetic and Evolutionary Computation Conference Companion* (pp. 55–56).

Fan, D. D., & Theodorou, E. A. (2017). **Differential Dynamic Programming for time-delayed systems**. *Decision and Control (CDC), 2016 IEEE 55th Conference on*, 573–579.

Fan, D., Rossi, M. A., & Yin, H. H. (2012). **Mechanisms of action selection and timing in substantia nigra neurons**. *Journal of Neuroscience*, *32*(16), 5534–5548.

Fan, D., Rich, D., Holtzman, T., Ruther, P., Dalley, J. W., Lopez, A., et al. (2011). **A wireless multi-channel recording system for freely behaving mice and rats**. *PloS One*, *6*(7), e22033.