

# Mark Cutler | markjcutler.com

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## Education

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### Massachusetts Institute of Technology

*PhD, GPA – 4.7/5.0*

Robotics and Autonomous Systems

Cambridge MA

2012–2015

### Massachusetts Institute of Technology

*MS, GPA – 4.7/5.0*

Aeronautical and Astronautical Engineering

Cambridge MA

2010–2012

### Brigham Young University

*BS, GPA – 3.99/4.0*

Mechanical Engineering

Provo UT

2004–2005, 2007–2010

## Dissertation

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**Title:** *Practical Robot Reinforcement Learning through Efficient Simulator Sampling*

**Committee:** Jonathan P. How (chair), Leslie Kaelbling, Andrea Censi

**Description:** Designing efficient algorithms for decision making under uncertainty for autonomous systems. Efficiency comes by properly incorporating possibly inaccurate simulations of the system to be controlled.

## Masters Thesis

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**Title:** *Design and Control of an Autonomous Variable-Pitch Quadrotor Helicopter*

**Advisor:** Jonathan P. How

**Description:** Designed, built, and programmed a novel autonomous multi-rotor helicopter capable of agile, aggressive, and aerobatic flight. Developed new flight control algorithms and autopilot hardware for the vehicle control.

## Experience

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Research.....

### Aerospace Controls Lab, MIT

*Research Assistant*

Cambridge MA

2010–2015

- Designed and wrote all of the lab infrastructure code used for autonomous vehicle communication, control, estimation, planning, and visualization
- Designed, built, and soldered custom autopilots that currently operate all the lab vehicles
- Implemented lightweight, vision-based estimation code for relative navigation of quadrotors
- Implemented a robust multi-vehicle path planning algorithm used for multi-vehicle missions

**MAGICC Lab, BYU****Provo UT***Undergraduate Research Assistant**2008–2010*

- Wrote wind estimation algorithms for small unmanned air-vehicles (UAVs)
- Developed atmospheric energy harvesting techniques for small UAVs to enhance their flight time, range, and mission capabilities
- Designed and built a three axis robot capable of mapping insect flapping patterns

**Industry.....****SpotterRF****Orem UT***Mechanical Design Engineer**2010–2010*

- Developed new heat management techniques for small radar devices resulting in a significant high-temperature performance improvement
- Designed a new carbon-fiber case for the radar encasement

**L-3 Communications****Salt Lake City UT***Mechanical Design Engineer**2009–2009*

- Designed demo platform for new modem integration into mobile communication ground station
- Performed thermal, structural, weight, and power analyses to optimize data link and modem case designs

**Corning Inc.****Corning NY***Advanced Machine Design Engineer**2008–2008*

- Researched and tested method that reduced tool run-out by 55% in contouring mills
- Designed mechanism enabling the cutting of ceramic extrusions to be performed by one person instead of two

**Volunteer.....****Research Mentor****Cambridge MA***Aerospace Controls Lab**2010–2014*

- Mentored several undergraduate researchers and senior projects

**The Church of Jesus Christ of Latter-day Saints****Rostov, Russia***Volunteer Representative**2005–2007*

- Provided leadership, development and training for 16 volunteer representatives
- Oversaw volunteer operations in a geographical area covering over 300 miles
- Developed leadership, teaching, personal and communication skills

**Awards****2010–2015:** National Science Foundation Graduate Fellow**2010–2011:** Aurora Flight Sciences Fellow**2004–2010:** Robert C. Byrd Honors Scholarship**Technical Highlights****Languages:** C/C++, PYTHON, MATLAB,  $\text{\LaTeX}$ , some HTML and CSS**Tools:** ROS, GIT, SVN, SOLIDWORKS

**Hardware:** Embedded microcontroller development (Microchip and TI), Circuit design (2- and 4-layer boards), Soldering (including SMD leadless components), Basic machining (mill, lathe, 3D printing)

**Professional Activities:** Paper reviewer for

- International Journal of Robotics Research
- IEEE Transactions on Automation Science and Engineering
- IEEE Transactions on Control Systems Technology
- ASME Journal of Dynamic Systems, Measurement and Control
- IEEE Control Systems Magazine
- Automatica
- Robotics: Science and Systems
- IEEE International Conference on Robotics and Automation
- IEEE International Conference on Intelligent Robots and Systems
- IEEE Conference on Decision and Control
- American Control Conference
- International Conference on Unmanned Aircraft Systems
- European Control Conference
- IFAC Symposium on Automatic Control in Aerospace

## Publications

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Journal Papers.....

**Cutler**, M., Walsh, T. J., and How, J. P. Real-world reinforcement learning via multi-fidelity simulators. *IEEE Transactions on Robotics*, 2014 (submitted).

**Cutler**, M. and How, J. P. Analysis and control of a variable-pitch quadrotor for agile flight. *ASME Journal of Dynamic Systems, Measurement and Control*, 2014 (submitted).

Barrett, W., Bowcutt, R., **Cutler**, M., Gibelyou, S., and Owens, K. Minimum rank of edge subdivisions of graphs. *Electronic Journal of Linear Algebra*, 18:530–563, 2009.

Peer-reviewed Conference Papers.....

**Cutler**, M. and How, J. P. Efficient reinforcement learning for robots using informative simulated priors. In *IEEE International Conference on Robotics and Automation (ICRA)*, Seattle, WA, May 2015. IEEE.

Chen, Y., **Cutler**, M., and How, J. P. Decoupled multiagent path planning via incremental sequential convex programming. In *IEEE International Conference on Robotics and Automation (ICRA)*, Seattle, WA, May 2015. IEEE.

**Cutler**, M., Walsh, T. J., and How, J. P. Reinforcement learning with multi-fidelity simulators. In *IEEE International Conference on Robotics and Automation (ICRA)*, pages 3888–3895, Hong Kong, June 2014.

Ure, N. K., Chowdhary, G., Chen, Y. F., **Cutler**, M., How, J. P., and Vian, J. Decentralized learning based planning multiagent missions in presence of actuator failures. In *International Conference on Unmanned Aircraft Systems (ICUAS)*, pages 1125–1134, Atlanta GA, May 2013.

**Cutler**, M., Michini, B., and How, J. P. Lightweight infrared sensing for relative navigation of quadrotors. In *International Conference on Unmanned Aircraft Systems (ICUAS)*, pages 1156–1164, Atlanta GA, May 2013.

Michini, B., **Cutler**, M., and How, J. P. Scalable reward learning from demonstration. In *IEEE International Conference on Robotics and Automation (ICRA)*, pages 303–308, Karlsruhe, Germany, May 2013.

Chowdhary, G., Wu, T., **Cutler**, M., and How, J. P. Rapid transfer of controllers between UAVs using learning based adaptive control. In *IEEE International Conference on Robotics and Automation (ICRA)*, pages 5409–5416, Karlsruhe, Germany, May 2013. IEEE.

**Cutler**, M. and How, J. P. Actuator constrained trajectory generation and control for variable-pitch quadrotors. In *AIAA Guidance, Navigation, and Control Conference (GNC)*, pages 1–15, Minneapolis, Minnesota, August 2012.

Chowdhary, G., Wu, T., **Cutler**, M., Ure, N. K., and How, J. Experimental results of concurrent learning adaptive controller. In *AIAA Guidance, Navigation, and Control Conference (GNC)*, pages 1–14, Minneapolis, MN, August 2012. AIAA. Invited.

**Cutler**, M., Ure, N. K., Michini, B., and How, J. P. Comparison of fixed and variable pitch actuators for agile quadrotors. In *AIAA Guidance, Navigation, and Control Conference (GNC)*, pages 1–17, Portland, OR, August 2011.

Michini, B., Redding, J., Ure, N. K., **Cutler**, M., and How, J. P. Design and flight testing of an autonomous variable-pitch quadrotor. In *IEEE International Conference on Robotics and Automation (ICRA)*, pages 2978–2979. IEEE, May 2011.

**Cutler**, M., McLain, T. W., Beard, R. W., and Capozzi, B. Energy harvesting and mission effectiveness for small unmanned aircraft. In *AIAA Guidance, Navigation, and Control Conference (GNC)*, pages 1–13, Toronto, Canada, August 2010.

Thomson, S. L., Mattson, C. A., Colton, M. B., Harston, S. P., Carlson, D. C., and **Cutler**, M. Experiment-based optimization of flapping wing kinematics. In *AIAA Proceedings of the 47th Aerospace Sciences Meeting*, pages 1–8, January 2009.

#### Other Papers.....

**Cutler**, M., Walsh, T. J., and How, J. P. Reinforcement learning with multi-fidelity simulators (poster). In *NIPS Transfer and Multi-Task Learning Workshop*, December 2013.

**Cutler**, M. Design and control of an autonomous variable-pitch quadrotor helicopter. Master's thesis, Massachusetts Institute of Technology, Department of Aeronautics and Astronautics, August 2012.

#### Interests

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| - My Kids     | - Robots           |
| - Electronics | - Racquet Sports   |
| - Skiing      | - Ultimate Frisbee |