MATTHEW KELLY

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EDUCATION

Cornell University, Ithaca NY   -   GPA 3.85
    Ph.D. Mechanical Engineering   (**minor:** Computer Science)   *May 2016*
    M.S. Mechanical Engineering   *August 2014*
    Award: National Science Foundation Graduate Fellowship

Tufts University, Medford MA   -   GPA 3.97
    B.S. Mechanical Engineering   (**minor:** Music)   *May 2011*
    Summa Cum Laude with Highest Thesis Honors
    Awards: Mechanical Engineering Prize, Benjamin G. Brown Scholarship

University of Canterbury, Christchurch, New Zealand
    Study abroad program in Mechanical Engineering   *July - November 2009*

RESEARCH & WORK EXPERIENCE

Rethink Robotics   June 2016 - present
Senior Robotics Engineer   *Boston, MA*

· Designed and implemented the algorithms that are used for trajectory generation on the Sawyer robot arm. These methods run in real-time and are used for both joint and end-effector motions. (C++)
· Implemented motion testing and analysis framework, some of which is open source. (ROS and Python)

Cornell Biorobotics and Locomotion Lab   November 2011 - May 2016
Ph.D. Research, Advisor: Andy Ruina   *Ithaca, NY*

· Designed and implemented robust walking controllers for the Cornell Ranger robot.
· Wrote an open source trajectory optimization library: `https://github.com/MatthewPeterKelly/OptimTraj`
· Developed my own simulation code for the Cornell Ranger walking robot
· Designed non-linear controllers for simple models of walking using variations on genetic algorithms, dynamic programming, and trajectory libraries.
· Website: **www.matthewpeterkelly.com** It includes an overview of my research and publications, several tutorials, and links to my open-source code on GitHub and Matlab file exchange.

Tufts Biomechanical Engineering Lab   November 2009 - August 2011
Advisor: Thomas James   *Medford, MA*

· Design, fabrication, and testing of a novel sagittal bone saw.
· Results: two proptotype saws and a test fixture, 400 hours of machine shop work, two full experiments, a conference presentation, journal publication, and a U.S. patent.

MIT Non-Newtonian Fluids Lab   January 2011 - August 2011
Advisor: Gareth McKinley (MIT), Chris Rogers (Tufts)   *Cambridge, MA*

· Non-linear control design and implementation on a filament-stretching rheometer (FiSER).
· Software: programmed a GUI in LabVIEW as well as real-time data acquisition, analysis, and control.
· Hardware: National Instruments cRIO and FPGA.

TEACHING EXPERIENCE

Head Teaching Assistant: Dynamics   Cornell University,   Spring 2013 & 2016
- Managed 12 teaching staff and organized 180 students.
- Taught recitation and interactive problem solving sessions.

Teaching Assistant: Mechatronics Lab   Cornell University,   Fall 2012
- Lab TA working with analog circuits and microprocessors for small robots.

TECHNICAL STRENGTHS

Programming
- Linux and Windows operating systems, Git version control.
- C++, Python, Matlab, Java, LabVIEW, LaTeX.

Trajectory Optimization and Generation
- Experience implementing multiple shooting, direct collocation, and orthogonal collocation methods.
- Wrote trajectory generation code that is used on the Sawyer Robot arm, for all motion types.

Simulation
- Implemented simulations on hundreds of models, including many walking robots.
- Time-stepping and event-based contact solvers.

Control
- Markov Decision Process, dynamic programming, reinforcement learning.
- Function approximation, trajectory libraries, trajectory tracking.
- Model-based estimation: Kalman filter, EKF, UKF, particle filter.
- Genetic algorithms and heuristic optimization.

Mechanical Engineering
- Built a trebuchet with a one-ton counter-weight and 40-foot arm.
- Machine design, SolidWorks modeling.
- Machine shop: manual mill & lathe, CNC Mill.
- Woodworking and cabinetry.

PUBLICATIONS

Kelly, M. P. "An introduction to trajectory optimization: how to do your own direct collocation" Society of Industrial and Applied Mathematics Review. December 2017.

Kelly, M. P., Ruina, Andy, "Non-linear robust control for inverted-pendulum 2D walking," International Conference on Robotics and Automation, Seattle, WA, May 26-30, 2015.

James, T. P., **Kelly, M. P.**, Lannin, Pearlman, J. J., and Saigal, A., "Sagittal Bone Saw with Orbital Blade Motion for Improved Cutting Efficiency," Journal of Medical Devices, 2013.

PATENTS

James, T. P. and **Kelly, M. P.**, "Novel Blade Path to Introduce Impulsive Thrust Loading in Sagittal Sawing," U.S. Patent 14/125,164, Aug 28, 2014.