Christopher M. Dellin

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Graduate Education

School: Robotics Institute, Carnegie Mellon University, Pittsburgh, PA
Degree: Master of Science in Robotics, December 2012
Degree: Doctor of Philosophy in Robotics, August 2016 (Expected)
QPA: Cumulative: 3.83

Efficient Manipulation Task Planning – Doctoral Work

Period: February 2014 – August 2016

Thesis committee: Siddhartha Srinivasa, Anthony Stentz, Maxim Likhachev, and Lydia Kavraki

The robots of tomorrow will be required to plan high-dimensional motions in the face of geometrically complex and changing environments, and do so under significant resource constraints. My doctoral research proposes a motion planning approach well-suited to articulated robots performing recurring multi-step manipulation tasks in semi-structured environments. The approach conducts an incremental lazy roadmap search guided by a utility function which captures both planning and execution costs, allowing efficient completion of motion tasks.

🖃 Dellin and Srinivasa, "A Unifying Formalism for Shortest Path Problems with Expensive Edge Evaluations via Lazy Best-First Search over Paths with Edge Selectors," ICAPS 2016, London, UK.

🖃 Dellin and Srinivasa, "A General Technique for Fast Comprehensive Multi-Root Planning on Graphs by Coloring Vertices and Deferring Edges," ICRA 2015, Seattle, WA, USA.

🖃 Dellin, Strabala, Haynes, Stager, and Srinivasa, "Guided Manipulation Planning at the DARPA Robotics Challenge Trials," ISER 2014, Marrakech and Essaouira, Morocco.

🖃 Dellin, "Efficient Manipulation Task Planning via a Reuse-Informed Optimization of Planning Effort," Thesis proposal, April 2015. http://dellin.net/static/proposal/dellin-proposal.pdf

🖃 Srinivasa, Johnson, Koval, Choudhury, Lee, Harding, Butterworth, King, Velagapudi, Dellin, and Thackston, "Exploiting Domain Knowledge for Multi-Step Mobile Manipulation: Architecture, Algorithms, and Experiments," ISER 2016, Tokyo, Japan.

🖰 Open-source motion planner: https://github.com/personalrobotics/lemur

Constrained Trajectory Optimization – Personal Robotics Lab

Period: June 2011 – September 2012

Developed algorithms for motion and manipulation planning on the HERB robotic platform using constrained trajectory optimization. Lead developer of an open-source implementation of the CHOMP optimizer.

🖃 King, Klingensmith, Dellin, Dogar, Velagapudi, Pollard, and Srinivasa, "Pregrasp Manipulation as Trajectory Optimization." RSS 2013, Berlin, Germany.

🖃 Zucker, Ratliff, Dragan, Pivtoraiko, Klingensmith, Dellin, Bagnell, and Srinivasa, "CHOMP: Covariant Hamiltonian Optimization for Motion Planning," IJRR 2013.

🖰 Open-source planning library: http://libcd.com, https://github.com/personalrobotics/or_cdchomp

DARPA Autonomous Robotics Manipulation Program

Period: June 2011 – September 2012

Developed planning and control software for both the SRI and the Carnegie Mellon teams. Designed and implemented shared-memory synchronized closed-chain torque controller for bimanual manipulation tasks. Implemented point-cloud markerless arm tracking system.

🖃 Klingensmith, Galluzzo, Dellin, Kazemi, Bagnell, and Pollard, "Closed-loop Servoing using Real-time Markerless Arm Tracking." ICRA 2013, Karlsruhe, Germany.

Teaching, Mentoring, and Other Academic Involvement

🖃 Dellin and Srinivasa, "A Framework for Extreme Locomotion Planning," ICRA 2012, St. Paul, MN, USA.

Organizer: Optimal Robot Motion Planning Workshop, ICRA 2015, Seattle, WA, USA.

Teaching Assistant: Kinematics, Dynamics, and Control, Spring 2012.

Qualifier Committee Member: William Martin, Matthew Klingensmith.

Reviewer: IJRR, IROS, ICRA.

Professional Experience

Carnegie Mellon Universirty, National Robotics Engineering Center (NREC) – Robotics Engineer

Period: January 2013 – January 2014

Location: Pittsburgh, PA

Result: Our team placed third out of 16 competitors at the Trials.

Lead manipulation and motion planning software architect for the CHIMP humanoid disaster response robot. Software team liaison to the hardware team during robot design phase, performing kinematic reachability and actuator analysis. Designed and developed components for operator interface, trajectory execution and monitoring. Implemented a general full-body multiple-contact inverse dynamics solver for humanoid robots. Performed as robot operator during the Trials competition in December 2013.

🖃 Stentz, Herman, Kelly, Meyhofer, Haynes, Stager, Zajac, Bagnell, Brindza, Dellin, George, Gonzalez-Mora, Hyde, Jones, Laverne, Likhachev, Lister, Powers, Ramos, Ray, Rice, Scheifflee, Sidki, Srinivasa, Strabala, Tardif, Valois, Vande Weghe, Wagner, and Wellington, "CHIMP, the CMU Highly Intelligent Mobile Platform," Journal of Field Robotics, 2015.

Barrett Technology, Inc. – Robotics Engineer

Period: June 2008 – August 2009

Location: Cambridge, MA

As one of the six engineers at the company (and one of two with a significant software engineering background), I developed and maintained our robotic software library, wrote embedded software for our motor controllers, performed support for customers at various research universities, and attended domestic and international conferences and trade shows. I developed a new version of Barrett's software library for the WAM^{TM} robotic arm (still used today), which featured a substantial rewrite of the hard-realtime control loop, articulated kinematics and inverse dynamics algorithms, joint-space and Cartesian-space torque controllers, a novel gravity compensation automatic calibration system, and trajectory execution. Designed and implemented demonstrations featuring real-time haptic feedback with real and simulated objects.

Undergraduate Education

School: Franklin W. Olin College of Engineering, Needham, MA
Degree: Bachelor of Science in Electrical and Computer Engineering, May 2008
GPA: Cumulative: 3.73; Engineering: 3.89; (A = 4.0)
Notes: Awarded a four-year, full-tuition merit scholarship.

Undergraduate robotics projects included an autonomous surface craft for underwater sonar collection for Schlumberger Ltd and snake robots which exhibited biologically-inspired locomotion gaits.

Skills

Robotics: Motion and manipulation planning, trajectory optimization, articulated kinematics, multi-contact dynamics, and control design and implementation, haptics and teleoperation.

Software: Principal development experience in C, C++, and Python in a Linux environment. Extensive experience with the ROS, OpenRAVE, and OMPL robotics frameworks, as well as the BGL and SBPL libraries. Experience with Qt and real-time systems.

Electrical: Experience with CAN bus, Ethernet, circuit design, component selection, and PCB layout.

Mechanical: Machine-shop trained with experience with SolidWorks and Autodesk Inventor.