Christopher Dellin

Curriculum Vitae & Project Portfolio

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Fields of Interest

I am broadly interested in performing research in the field of robotics. I have specific experience with biomimetics, manipulators, force-controlled robotics, and land and sea vehicles, along with limited experience with bipedal robots. I have also written software for haptic applications, tele-operation, and teach-and-playback interactions.

Undergraduate Education

School: Franklin W. Olin College of Engineering, Needham, MA
Degree: Bachelor of Science in *Electrical and Computer Engineering*, Awarded May 2008
GPA: Cumulative: 3.73; Engineering: 3.89; (A = 4.0)
Notes: Awarded a four-year, full-tuition merit scholarship worth approximately $125,000

Traditional coursework includes:

Controls	Microelectronic Circuits	Computer Architecture
Systems	Analog and Digital Communications	Computational Modeling
Linear Algebra	Engineering of Distributed Systems	Discrete Mathematics

Each Olin student participates in the Senior Capstone Program in Engineering (SCOPE) in conjunction with an outside, funding company. I also participated in four instances of underclassman research for credit.

During the fall of my Senior year, I performed a self-study on the topic of Series-Elastic Actuators (SEAs), which included both a research and a simulation component.

I served for as Class Representative for my class, and later as Vice President of Communication in Olin's student government organization.

For examples of my work, see: `http://dellin.net/Portfolio`

Projects & Research Experience

Empirical Gravity Compensation for Open-Chain Robotic Manipulators

Group: Barrett Technology, Inc. **Period:** June 2008 - September 2008

Description: While working at Barrett Technology, Inc. I developed an algorithm to empirically determine a set of first-moment parameters for a force-controlled, rigid-link robotic manipulator. The algorithm is derived from a Newton-Euler formulation of the robot equations of motion, and uses a linear regression to synthesize torque data recorded during a set of arbitrary robot configurations.

The algorithm was developed with the WAM^{TM} robotic arm, and is now included in Barrett's open-source `btclient` library that is provided to its customers. The theory is general and applies to any rigid-link manipulator that can be represented as an open kinematic chain.

See: "Newton-Euler First-Moment Gravity Compensation"

Autonomous Surface Platform for Acoustic Imaging

Group: Olin College of Engineering SCOPE Program
Schlumberger, Ltd.

Period: September 2007 - May 2008

Description: During my Senior year at Olin College, I led and worked with a team of 4 fellow students, in conjunction with Schlumberger, Ltd. to design, build, instrument, and program an autonomous surface platform for the purpose of underwater acoustic imaging. The platform, a 6-foot, 300-pound catamaran, includes twin electric motors, onboard GPS, compass/tilt, inertial navigation, and onboard computation. We performed several indoor and outdoor field tests to prove its effectiveness.

During parts of the project, I served as both project manager and technical lead for the electrical and embedded software components of the system. I developed an 8-channel 50-kHz hydrophone recording device, from prototyping to circuit and PCB layout design, including the firmware for the embedded Microchip PIC® microprocessor, and the corresponding Linux USB device driver. I also developed a data logging and access application to integrate each of our sensors, along with a Python interface for closed-loop control and UI development.

For more information, see: `http://dellin.net/Autonomous_Surface_Platform`

Force-Controlled Actuator Project

Group: Olin College of Engineering
Olin Biomimetic Robotics Lab

Period: September 2007 - January 2008

Description: I worked in a team of 6 students to ideate, design, and prototype a force-controlled actuator targeted at the high-end hobby market. We used the RoboCup teen-sized robotic soccer competition, which uses 3- to 5-foot bipedal robots as players, as a target application. The team produced a number of potential designs and prototypes, but determined after sufficient design iteration that an off-the-shelf combination of components was available that provided adequate performance. We also met weekly with an outside adviser, former Director of Engineering for Bluefin Robotics, to hone our project management skills.

For more information, see: `http://dellin.net/SERA_Actuator`

Initial Prototype for Replacement Control System for the FIRST Robotics Competition

Group: FIRST Robotics

Period: December 2006 - April 2007

Description: I worked with a group of fellow volunteers to design and develop a prototype robot control system for the FIRST Robotics Competition. During this process, we developed a working, modular prototype using the CAN-bus. I participated actively in bi-weekly planning meetings and developed embedded software for multiple subsystems, as well as a control library using National Instrument's LabVIEW software.

Due in part to the success of our prototype, the 2009 FIRST Robotics Competition is scheduled to include a brand-new control system, programmable in LabVIEW and using the NI Compact-RIO.

Robot Snake Project

Group: Olin College of Engineering
ENGR2210: Principles of Engineering
Olin Biomimetic Robotics Lab

Period: September 2005 - May 2006

Description: I worked in a team of 5 students to design and build novel snake robots, focusing primarily on mechanism design and biomimicry. The team explored a ribbed design using a flexible spinal member, actuated with off-the-shelf hobby servos. We used a laser-cut process with Delrin plastic for rapid prototyping, and tested 5 fully actuated designs. We produced two finished prototypes; the first exhibited the serpentine gait, and the second, the sidewinder and rectilinear gaits.

See: "The Advantages of Ribbed, Flexible Snake Robots"

For more information, see: `http://dellin.net/Snake_Project`

Bipedal Robotics – M2

Group: Olin College of Engineering
Olin Biomimetic Robotics Lab

Period: September 2005 - May 2006

Description: I developed a new realtime IEEE 1394 software interface to control the actuators of the humanoid bipedal robot M2, originally developed under the direction of Professor Gill Pratt at MIT's Leg Laboratory.

Olin Intelligent Vehicles Lab

Group: Olin College of Engineering
Olin Intelligent Vehicles Lab

Period: June 2005 - August 2005

Description: During the founding year of the Olin Intelligent Vehicles Lab, I developed software to real-time process depth-field images from a Point Grey Digiclops® stereo vision system, and also worked to integrate a SICK LIDAR unit into a child-ATV-sized autonomous vehicle.

Papers

The Advantages of Ribbed, Flexible Snake Robots

Authors: C. Dellin, M. Aasted, G. Pratt.

Abstract: The usefulness of snake-inspired robots is well documented; such devices have compelling advantages in applications such as search-and-rescue, exploration, inspection, and medical use. While the vast majority of robotic snakes have used a traditional "actuation-at-joints" approach, the "actuation-between-ribs" concept carries with it a number of significant benefits, including cost, simplicity, biomimicry, and actuator type flexibility. In addition, this approach allows us to discard the universal joint to explore the use of a flexible member as the "spine" of the robot, adding the advantage of inherent elasticity while mitigating the problems of complexity and the need for lubrication. We built two successful snake robots as examples of this approach.

This paper is currently unpublished, although we are looking forward to submission in the coming months.

Newton-Euler First-Moment Gravity Compensation

Authors: C. Dellin

Abstract: This document briefly describes an algorithm for gravity compensation applicable to any rigid-body robotic manipulator in an open kinematic chain. During calibration, the robot is made to hold a number of distinct poses, while torque measurements at each of the joints are taken. From these torque measurements, a vector μ is determined for each link j, using a linear regression. This vector μ_j represents the link's *cumulative first moment of the mass*, and are pose-independent when expressed in joint coordinates. Once the calibration step is performed, it is straightforward to calculate the necessary torques for each joint to enable compelling gravity-compensation performance with any mass distribution.

This paper is currently unpublished.

Teaching Experience

Course Assistant

During my second and third years as an undergraduate, I served as a Course Assistant for Olin's first-year integrated Math/Physics set of courses, with a typical enrollment of 80 students. In this role, I helped students during lecture and studio class periods, held regular problem sessions, served as an individual and group tutor, and handled a significant grading load.

Individual Tutor

I served as an individual tutor for several courses at Olin, under the Office of Student Life. Courses for which I've tutored students include:

Physics: Electromagnetism and Waves	Physics: Mechanics	Vector Calculus
Analog & Digital Communications	Differential Equations	Calculus
Probability & Statistics	Linear Algebra	

Professional Experience

Barrett Technology, Inc – Robotics Engineer

Period: June 2008 - Present

Location: Cambridge, MA

I'm currently working as a Robotics Engineer at Barrett Technology, Inc. As one of the six engineers at the company (and one of two with a significant software engineering background), my responsibilities include developing and maintaining our robotic software library, writing embedded software for our motor controllers, performing support for our customers at various research universities, and attending domestic and international conferences and trade shows.

I am currently developing a new version of our software library for the WAM^{TM} robotic arm, which features a substantial rewrite of the realtime control loop, including full support for the robot's kinematics and dynamics, and operations in both joint-space and Cartesian-space.

BBN – Network Engineering Intern

Period: June 2007 - August 2007

Location: Cambridge, MA

As an intern at BBN, I worked on the JAVeLEN, a complete wireless networking solution which consumes 100 to 1000 times less energy than today's wireless networks. Each JAVeLEN node uses a pseudo-random sequence to quickly toggle its radio between "on" and power-saving "off" states. Since each sequence is deterministic, neighboring nodes can use a routing algorithm to traverse the network.

Goldman Sachs – Network Technologies Intern

Period: June 2006 - August 2006

Location: Jersey City, NJ & New York, NY

At Goldman Sachs, I developed a traffic analysis program to correlate network flows with applications on the company's global network. The tool included a web interface to track traffic on a daily basis.

Skills

As a result of my undergraduate experience at Olin College of Engineering, I have experience with *project management*, many *team-based projects*, *teaching and tutoring*, and an array of technical tools and processes.

Software: I am an expert Linux user, and have significant programming experience in C, Python, and MatLab. Other experience includes LaTeX, Assembly, Java, LabVIEW, and various scripting languages.

Electrical: I have experience with circuit design, component selection, and PCB layout and population.

Mechanical: I am machine-shop trained, and have experience with SolidWorks and Autodesk Inventor.

Personal Information

I served for two years in my college student government association, including as Vice President of Communication.

I am a member of the Institute of Electrical and Electronics Engineers (IEEE).

I have represented my company at the following conferences:

- International Conference on Intelligent RObots and Systems (IROS) 2008 in Nice, France
- AAAI Conference on Artificial Intelligence 2008 in Chicago, Illinois

References

Contact information is available upon request.

- Gill Pratt - Professor of Electrical and Computer Engineering - Olin College of Engineering
- Brian Bingham - Assistant Professor of Mechanical Engineering - Olin College of Engineering
- William Townsend, PhD - President & CEO - Barrett Technology, Inc.