

# Brandon L. Rutter

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## Overarching Personal Goal

Fulfillment and happiness. For myself, and everybody else, in perpetuity.

## Academics

### Degrees

Bachelor of Science, Swarthmore College; May 2000. Major in Engineering, focus on Electronic.  
Concentration in Computer Science, focus on Artificial Intelligence.

Philosophiæ Doctor, Case Western Reserve University; 2009. Fellow of the NSF IGERT Neuromechanics program, in the Biorobotics Laboratory of the Department of Mechanical and Aerospace Engineering.

### Honors

National Merit Scholar

Inducted into Tau Beta Pi, the engineering honor society, 1999.

Won first place in the "Hors d'Oeuvres Anyone?" and Urban Search and Rescue competitions, and earned the Ben Wegbrait Award for Integration of Artificial Intelligence Technologies, at AAAI-2000 as part of the Swarthmore Robotics Team.

Case Western Reserve University 2002, Graduate Dean's Instructional Excellence Award.

### Projects

*Ph.D. project.* Implementation in robotic hardware of the Sensory Coordinated Action Switching Module (SCASM) control method for stepping control. This system is based on known neural pathways in the stick insect *Carausius morosus*, and involves ongoing collaboration with Ansgar Büschges' insect physiology lab in Cologne, Germany. Discovered best known demonstration of the combined neuromechanical nature of behavioral output, and adapted the system to a model of the cockroach *Blaberus discoidalis* middle leg, for both forward walking and inside turning behaviors. Includes advising of two summer project students, two senior project students, and several class project students.

(2005-2008)

*MS project.* Control of Braided Pneumatic Actuator(BPA)-actuated robot legs using EMGs recorded from behaving cockroaches. Developed and tested a muscle activation model to parallel the animal's neuromuscular transform, and found model parameters by conducting hardware-in-the-loop error minimization in the robot. Includes considerable work on low-level control of BPA-actuated joints using a custom-programmed RT-Linux system. Also included advising of senior project student, significant interactions with biologists, and conducting cockroach dissection and electrophysiological experiments.

(2003-2008)

*Team Case, DARPA Urban Challenge* Hardware technical lead. Responsible party for all things hardware on DEXTER, including automotive, sensory, and computer. Directly worked on improvements or design of braking, vehicle lighting, shift actuation, and LIDAR mounts. Oversaw work on vehicle maintenance, bumper design and mounting, and camera mounts. Additionally, I was responsible for the development of the team's safety protocol, transportation, a workshop in DEXTER's garage, regular hardware team meetings, and the instigation of planning and action to effectively meet the April video submission deadline. This succeeded, and DEXTER went on to reach the National Qualifying Event.

(Dec 2006- March 2007)

*IGERT Summer Project.* Worked with two IGERT trainees in biomedical engineering on electromyogram (EMG) control of robot legs. Introduced BME students to machining techniques in the biorobotics lab, and learned motion capture and human EMG recording techniques from them. Final project output was real-time control of two joints of a McKibben-actuated robot with live EMG data from a human subject.

(Summer 2002)

*Senior Engineering Design Project.* Part of a continuing project at Swarthmore to enable a Nomad SuperScout II to use elevators in building navigation without elevator modification or human intervention. During the course of my project I greatly improved both the robustness and extensibility of the hardware and software of the system. Once I had solidified this foundation for future work, I also implemented a simple visual servoing routine to press an elevator button once that button was within the servo camera's field of view. Various products of this project were used in the Swarthmore entry in the "Hors d'Oeuvres Anyone?" competition at AAAI-2000. (Fall 1999- Spring 2000)

*Senior Conference Project.* As the final project for this computer science seminar course dealing with distributed systems, I started the development of a means for making Java Remote Method Invocation robust to server failure. (Spring 2000)

*Mechanics of Materials Final Project.* As a final project in this course we held a design competition for a footbridge to be built in a professor's backyard. I was a member of the winning team, which made use of an asymmetric cable-stayed design. (Fall 1999)

*Computer Vision Final Project.* My lab partner and I did a preliminary practical evaluation of the usefulness of various color spaces for content based image retrieval and image segmentation. Basic conclusion: the rg chromaticity space is quite well suited for most applications, particularly when taking computational complexity into account. (Fall 1999)

### **Publications & Presentations**

B A Maxwell, L A Meeden, N S Addo, P Dickson, N Fairfield, N Johnson, E G Jones, S Kim, P Malla, M Murphy, B Rutter, E Silk. "REAPER: A Reflexive Architecture for Perceptive Agents", *Proceedings of AAAI Workshop on Mobile Robots*, August 2000. (also in *AI Magazine* 22(1): 53-66).

Quinn, R.D., Allen, T.J., Horchler, A.D., Pollack, A.J., Birch, M.C., Rutter, B.L., Mu, L., Bachmann, R.J., Ritzmann., R.E. (2002) Two Distinct but Complementary Strategies for Biorobotic Development. *Soc. Neuroci. Abstr.* 28, Orlando.

"Developing models to investigate the behavioral meaning of cockroach EMG signals", Presentation at IGERT Student Research Symposium, Center for the Neural Basis of Cognition at Carnegie Mellon University, Pittsburgh, June 27-29, 2003.

Jong-ung Choi, Brandon Rutter, Daniel Kinsley, Roy Earl Ritzmann, Roger, D. Quinn., (2005) A Robot with Cockroach Inspired Actuation and Control. *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM2005)*, July 24-28

B.L. Rutter, L. Mu, R.D. Quinn, R.E. Ritzmann. A Model that Transforms Insect Electromyograms into Pneumatic Muscle Control. Program No. 176.12. *2005 Abstract Viewer/Itinerary Planner*. Washington, DC: Society for Neuroscience, 2005. Online.

Rutter, Brandon, Laiyong Mu, Brian Taylor, Roger Quinn, Roy Ritzmann (2006) A Model that Transforms Insect Electromyograms into Pneumatic Muscle Control. *Research ShowCASE*, Cleveland, OH April 6

Rutter, Brandon, Laiyong Mu, Roy Ritzmann, Roger Quinn (2006) Transforming Insect Electromyograms into Pneumatic Muscle Control. *Proceedings of SPIE 6230 "Unmanned Systems Technology VIII"* June 2006. Online

Rutter, Brandon, Laiyong Mu, Roger D. Quinn, and Roy E. Ritzmann. (2006) A Model that Transforms Insect Electromyograms into Pneumatic Muscle Control. *International Symposium for Biologically-inspired Design and Engineering*. Atlanta, GA: Center for Biologically Inspired Design. Online

Lewinger, William A., Brandon L. Rutter, Marcus Blümel, Ansgar Büschges, Roger D. Quinn (2006) Sensory Coupled Action Switching Modules (SCASM) generate robust, adaptive stepping in legged robots. *Proceedings of CLAWAR 2006: 9th International Conference on Climbing and Walking Robots*, Brussels, Belgium September 12-14 2006 (Page numbers?)

Rutter, B.L., Lewinger, W., Taylor, B., Wilson, M., Blümel, M., Ekeberg, Ö., Büschges, A., Ritzmann, R.E., Quinn, R.D. (2006) Neurally-based robot control for neuromechanical modeling of insect stepping. Program No. 449.13. 2006 Abstract Viewer/Itinerary Planner. Atlanta, GA: Society for Neuroscience. Online.

Rutter, B.L., Lewinger, W.A., Blümel, M., Büschges, A., Quinn, R.D. (2007) Simple Muscle Models Regularize Motion in a Robotic Leg with Neurally-Based Step Generation. Proceedings of ICRA 2007, Rome

Rutter, B.L., Mu, L., Ritzmann, R.E., Quinn, R.D. (2007) Transforming Insect Electromyograms into Pneumatic Muscle Control. Proceedings of ICRA 2007, Rome

Rutter, B.L., Taylor, B.K., Mu, L., Ritzmann, R.E., (2007) A Functional Kinematic Model of the Cockroach Mesothoracic Leg. In Eighth International Congress of Neuroethology Vancouver, Canada July 22-27, 2007

Bender, J.A., Rutter, B.L., Simpson, E.M., Papay, T., Parker, D.A., Taylor, B.K., Quinn, R.D., Ritzmann, R.E. (2008) Robotic Control based on Cockroach 3D Leg Kinematics. In Fourth International Symposium on Adaptive Motion of Animals and Machines Cleveland, OH June 1-6 2008. Online: <http://amam.case.edu/AMAM%202008%20Abstracts.pdf>

Lewinger, W.A., Rutter, B.L., Quinn, R.D. (2008) Irregular Terrain Navigation and Leg Coordination Improve Walking Behavior for Small Legged Robots. In Fourth International Symposium on Adaptive Motion of Animals and Machines Cleveland, OH June 1-6 2008. Online: <http://amam.case.edu/AMAM%202008%20Abstracts.pdf>

Rutter, B.L., Bender, J.A., Papay, T., Parker, D.A., Taylor, B.K., Ritzmann, R.E., Quinn, R.D. (2008) Neuromechanically Based Robotic Models for Biological Experimentation. In Fourth International Symposium on Adaptive Motion of Animals and Machines Cleveland, OH June 1-6 2008. Online: <http://amam.case.edu/AMAM%202008%20Abstracts.pdf>

Rutter, B.L., Bender, J.A., Taylor, B.K., Ritzmann, R.E., Quinn, R.D. (2008) Experiments in Locomotion with Neuromechanically Based Robotic Insect Models. Program no. 198.7 2008 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience. Online.

Lewinger, W.A., Rutter, B.L., Quinn, R.D. (2008) Irregular Terrain Navigation and Leg Coordination Improve Walking Behavior for Small Legged Robots. Program no. 198.8 2008 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience. Online.

Wiegrefe, S. J., B. L. Rutter-Daywater, P. A. Rutter. (2012) Preliminary Success With Division Propagation of Neo-hybrid Hazelnut (*Corylus* ×) Removes Roadblock in Development of New Nut Crop. (Poster) 8<sup>th</sup> International Hazelnut Conference, March 19-21, Temuco, Chile

## Employment

### Badgersett Research Corporation

Canton, MN

*Intern Liaison.* Acted as a first source of knowledge for interns' questions on farm work and research practices and concepts. Instructed interns on various research tasks and equipment operation. (Summer 1998)

*Foreman.* In charge of field crew of 10 workers. Oriented new workers, enforced safety practices, maintained integrity of field data, and kept the crew operating smoothly. (Summers 1997/98)

*Mechanic.* Organized and conducted routine maintenance and emergency repairs for farm equipment, off-the-grid power and state-of-the-art watering system for production greenhouse. Also executed numerous design and construction/ fabrication projects including adaptation and installation of the greenhouse watering system. (1995-96, Summers 1997/98, 2000)

*Research Assistant.* First assisted, then independently took critical harvest data and made field observations. Also maintained order in and kept records of new plantings, including experiments, during '97 and '98. (1992-96, Summers 1997/98, 2000)

*Vice President.* Responsible for first-level information services, oversight of order processing and personnel, in addition to other necessary operational, development and research support. (Part-time 2007-2008, Half-time August 2008-present)

*Greenhouse Manager.* In charge of plant production and greenhouse nursery business. (Half-time January 2009-present)

*Chief Operating Officer.* Manager of employees, field operations, greenhouse operations, product quality control, IT, etc. Production and budget management as well as research implementation and planning. Short-term planning and management of organizational integration; frequent communication with CEO and other research staff regarding the driving long-term goals. (Full time January 2009-present)

### **Case Western Reserve University**

Cleveland, OH

*Intern, Biorobotics Laboratory.* Designed an integrated sensing/motion control hardware system for Robot III making use of DSP boards, mezzanine IO, and FPGAs. (Summer 1999)

*Teaching Assistant, Dynamics.* Graded student work, held a weekly review session including lecture and homework assistance, and developed some test material for this core mechanical engineering course under two different professors. (Fall 2001 and Spring 2002)

*Teaching Assistant, Introduction to Mechanical Engineering.* Graded student work and held a weekly review session for this introductory mechanical engineering course. (Fall 2002)

*Systems Administrator, Biologically Inspired Robotics Laboratory.* Administered a laboratory domain of 30 active users and 20 workstations implementing single sign-on between Windows and Macintosh workstations, controlled by Mac OS X server. Executed transition from NT4 to OS X domain controllers, and move to Linux servers for mass data and roaming profile storage. (2004-07)

### **NeoEdge, Inc.**

Canton, MN

*Design/Product Development Engineer.* Refine designs and make initial feasibility evaluations for this company specializing in intellectual property licensing and development. (June 2000-Sept. 2001)

*Project Manager, Village Friendly Crop Dehydrator.* In charge of the development and implementation of a crop dehydration process that promises to be particularly useful in developing areas. (Sept. 2000-Sept. 2001)

### **Wuhan Institute of Botany, Chinese Academy of Sciences**

Wuhan, Hubei Province, P.R. China

*Visiting Scholar.* The Institute hosted me during my initiation of the NeoEdge village-friendly crop dehydrator project. (Oct. 2000-Mar. 2001)

### **Institute for Animal Physiology, University of Cologne**

Cologne, Germany

*Visiting Research Scholar.* Conducted preliminary experiments regarding force response of the flexor tibialis of *Carausius morosus* to passive stretch and varying levels of neural stimulation. (Feb.-Mar. 2005)

### **Swarthmore College**

Swarthmore, PA

*Engineering Clinician.* Helped students in introductory mechanics and systems courses with problem formulation and applying basic concepts to problems in a pertinent fashion. (Spring 2000)

*Teaching Assistant, Engineering Methodology.* Debugged and explained the operation of MATLAB programs for students in computer classroom. Helped explain concepts and troubleshoot students' setups in electronics laboratory. (Fall 1998)

*Teaching Assistant, Problems in Technology.* Explained and helped students to discover the functions and underlying principles behind various engine components in the automobile-based labs. (Fall 1997)

## Membership

### **The Institute of Electrical and Electronics Engineers (1997-2010)**

*Chair, Swarthmore Student Branch.* Reinstated the practice of regular meetings, organized those meetings and directed branch operations. During my year as president the Swarthmore branch started a section-wide initiative to increase the activities of student branches in the Philadelphia section and facilitate their cooperation. (1999-2000)

*Secretary, Swarthmore Student Branch.* Organized special branch events, and was acting chair for much of the year. (1998-99)

### **The American Society of Mechanical Engineers (1998-2010)**

**Tau Beta Pi** (1999-present)

**The American Chestnut Foundation** (2006-present)

**The Land Institute** (2006-present)

**The National Arbor Day Foundation** (2006-present)

**Northern Nut Growers Association** (Life member, 2008-present)

### **A capella singing group "Sixteen Feet" (1996-2000)**

*Treasurer and Bass.* Acquired a van for this student-run group, and managed funds from both the college student activities fund and CD/performance profits. Synthesized the group's annual budget and defended it before the student budget committee. With the group for production of one CD and recording of another, as well as numerous tours and gigs, including Rockefeller Center. (1996-2000)

## Computer Skills

*Proficient:* Mac OS X(server), Filemaker Pro, MS Word, Excel, PowerPoint, iWork, iLife.

*Working Knowledge:* C, MATLAB, RT-Linux, Subversion, HTML, XML DTDs, Doxygen, Emacs. Mixed-OS domain system administration, Adobe Photoshop, Illustrator, DreamWeaver, Final Cut Pro, Motion.

## Other Activities and Interests

I enjoy singing and playing the clarinet, reading, travel, outdoor activities, fencing, the occasional sketch or painting, and fixing or tinkering with just about anything. Robotics, particularly research oriented towards the application of autonomous robots to space exploration, was a primary interest of mine throughout my formal education. Woody Agriculture is a concept I grew up with and have now returned to for my life's work, it being the path most in harmony with my personal overarching goal. My current main objective is to continue the rapid improvement in Badgersett's product and science output, in order to stabilize the company's revenue and knowledge assets, to more fully and certainly support the long-term goals of Woody Agriculture.