

Jason C. Derenick, Ph.D.

CONTACT INFORMATION

Mechanical Engineering & Applied Mechanics
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RESEARCH INTERESTS:

Networked control and planning for autonomous systems; robust estimation, perception, and data-fusion for real-time applications; real-time optimization for scalable multi-agent systems; topological algorithms for minimalistic (e.g., metric-free) sensor networks

EDUCATION

Lehigh University, Bethlehem, Pennsylvania USA

Ph.D., Computer Science, May, 2009

- Dissertation Topic: “A Convex Optimization Framework for Multi-agent Motion Planning”¹
- Advisor: John Spletzer, Ph.D.
- Committee: John Spletzer, Ph.D. (Lehigh); Camillo J. Taylor, Ph.D. (UPenn); Mooi Choo Chuah, Ph.D. (Lehigh); Hector Muñoz-Avila (Lehigh); Aurélie C. Thiele, Ph.D. (Lehigh)

Lehigh University, Bethlehem, Pennsylvania USA

M.S., Computer Science, May, 2005

University of Scranton, Scranton, Pennsylvania USA

summa cum laude

B.S., Computer Science;

B.S., Mathematics, May, 2003

HONORS AND AWARDS

2009 Elizabeth V. Stout Dissertation Award – The P.C. Rossin College of Engineering and Applied Science presents the award each year to one doctoral student who makes “unusually significant and original contributions” to his or her field of research (Lehigh University, 2009).

4th Place Finisher, 2007 DARPA Urban Challenge (Ben Franklin Racing Team) - “Little Ben” (our vehicle) took *fourth place* and was one of six robots to successfully complete the 57 mile course. Ben was one of eleven robots to ultimately qualify for the Urban Challenge Final Event (UFE) out of an international field comprised of 89 entrants (Lehigh University/University of Pennsylvania, 2007)

Best Presentation for Technical Audience in the 2nd Annual (Lehigh University) Computer Science and Engineering Research Poster Session – Poster Topic: “Optimal Shape Changes for Mobile Robot Teams” (Lehigh University, 2006).

Class of 2003 Award for Academic Excellence in Computer Science - The Department of Computer Science presents the award each year to one graduating senior having the highest GPA in major courses (University of Scranton, 2003).

Presidential Honors Student; Honors in Computer Science, Upsilon Pi Epsilon; Honors in Mathematics, Pi Mu Epsilon (University of Scranton, 2003)

¹Recipient of the *2009 Elizabeth V. Stout Dissertation Award* (see Honors and Awards)

Ignatius of Loyola Scholarship – Merit-based scholarships awarded to entering undergraduates who have demonstrated a strong level of academic achievement. (University of Scranton, 1999)

Patrick C. and Scotia P. Revello Memorial Scholarship (1999)

RESEARCH
EXPERIENCE

University of Pennsylvania, Philadelphia, Pennsylvania USA

Post-doctoral Fellow (Advisor: Vijay Kumar, Ph.D.)

January, 2009 – Present

Researching decentralized, multi-agent control and planning algorithms in support of the Micro-Autonomous Systems and Technology Collaborative Technology Alliance (MAST CTA). MAST CTA is a Penn lead partnership with colleagues at the Army Research Laboratory and ten participating institutions to include MIT, Georgia Tech, and UC Berkeley. Currently exploring the utility of algebraic topological constructs for controlling large-scale, multi-robot systems having minimalistic metric information (*e.g.*, range and bearing inferred from RSSI) while still affording substantial performance guarantees to include coverage repair and maintenance.

Served as the UPenn lead for the Networked Autonomous Systems Control (NASC) collaboration with industry partner BAE Systems. This project focused upon developing algorithms to enable simultaneous coverage and tracking (SCAT) and cooperative localization and mapping (CLAM) for heterogeneous teams of unmanned aerial/ground vehicles operating in dynamic environments.

Lehigh University, Bethlehem, Pennsylvania USA

Research Assistant (Advisor: John Spletzer, Ph.D.)

August, 2003 – January, 2009

Researched, developed, and adapted convex optimization techniques for the planning and control of modest to large-scale multi-robot systems. Emphasis was upon developing optimal formation control and networked coverage control algorithms with performance guarantees along with establishing application-specific complexity bounds for centralized, computationally distributed, and decentralized formulations.

- Worked with multiple in-house robot platforms, including ActivMedia Pioneers and Sony Aibos
- Designed and implemented software that allowed for easy interfacing with frequently used hardware components (*e.g.*, Garmin GPS USB 18, MicroStrain 3DMG Inclinometer)
- Supervised undergraduate and graduate students on various laboratory projects

University of Pennsylvania, Philadelphia, Pennsylvania USA

Visiting Ph.D. Student (Advisor: Daniel D. Lee, Ph.D.)

September – November, 2007

Continued work on 2007 DARPA Urban Challenge entry, “Little Ben” (a modified 2006 Toyota Prius).² Developed robust (LIDAR-based) terrain classification and traffic-line detection algorithms using the real-time range and remission values from Sick LMS 291-S14 LIDARs. Also, developed portions of Ben’s low-level C/C++ and Mex (Matlab executable) architecture to enable the real-time dissemination of measurements returned from the onboard Sick LMS and Sick LD LIDARs.

INDUSTRIAL
EXPERIENCE

Boston Dynamics, Waltham, Massachusetts USA

Software Intern, Multidimensional Mobility Robot (MDMR) Group

June – August, 2008

Designed and implemented a manual kinematic control system for a serpentine robot to perform tasks such as traversing rock gardens and climbing telephone poles. Resulting software system was successfully demonstrated as part of DARPA (MDMR) Phase II testing conducted at the Southwest Research Institute, San Antonio, TX. (Supervisor: Alfred Rizzi, Ph.D.)

Sagitta Marketing, Coopersburg, Pennsylvania USA

Part-time XHTML/CSS Developer

August, 2006 – June, 2008

²4th place finisher out of international field of 89 entrants (see Honors and Awards)

TEACHING
EXPERIENCE**University of Pennsylvania**, Philadelphia, Pennsylvania USA*Co-instructor***January, 2010 - May, 2010**

Co-instructed multidisciplinary, graduate-level course geared towards first and second year M.S. and Ph.D. students interested in robotics research. Covered topics pertaining to multi-agent control and planning (*e.g.*, algebraic graph theory, consensus in static and dynamic topologies, stable flocking, hybrid systems and control, *etc.*). Duties included: course lectures, preparing assignments, office hours, grades, and advising course projects.

- MEAM 620 – Advanced Robotics, Spring 2010 (graduate)

Lehigh University, Bethlehem, Pennsylvania USA*Teaching Assistant***August, 2006 - May, 2007**

Duties included: preparing and presenting substitute course lectures, conducting weekly lab sessions for multiple sections, holding regular office hours, proctoring exams, grading homework assignments, exams, and course projects.

- CSE 342 – Fundamentals of Internetworking, Fall 2006 (undergraduate)
- CSE 398/498 – Advanced Topics in Mobile Robotics, Spring 2007 (undergraduate/graduate)

Guest Lecturer

- CSE 360/460 - Introduction to Mobile Robotics, Spring 2008 (undergraduate/graduate)

PUBLICATIONS

Journal Articles and Book Chapters (3)

J. Derenick, J. Spletzer and M. Ani Hsieh, “An Optimal Approach to Collaborative Target Tracking with Performance Guarantees”, the Journal of Intelligent and Robotic Systems: Special Issue on Unmanned Autonomous Vehicles, Vol. 56, Issues 1–2, Pages 47–68, Sep, 2009

J. Bohren, T. Foote, J. Keller, A. Kushleyev, D. Lee, A. Stewart, P. Vernaza, J. Derenick, J. Spletzer and B. Satterfield, “Little Ben: The Ben Franklin Racing Team’s Entry into the 2007 DARPA Urban Challenge”, Journal of Field Robotics, Volume 25, No. 9, Pages 598–614, Sep, 2008.

J. Derenick and J. Spletzer, “Convex Optimization Strategies for Coordinating Large-scale Robot Formations”, IEEE Transactions on Robotics, Vol. 23, Issue 6, Pages 1252–1259, Dec, 2007

Book Chapters (2)

J. Derenick and J. Spletzer, “Second-order Cone Programming (SOCP) Techniques for Coordinating Large-scale Robot Teams in Polygonal Environments”, Advances in Cooperative Control and Optimization, Lecture Notes in Control and Information Science, Springer, Apr, 2007

J. Derenick, C. Thorne and J. Spletzer, “Hybrid Free-space Optics/Radio Frequency (FSO/RF) Networks for Mobile Robot Teams”, Multi-Robot Systems: From Swarms to Intelligent Automata, Alan C. Schultz and Lynne E. Parker (eds.), Springer, Mar, 2005.

Refereed Conference Proceedings (5+1 Submitted)

J. Derenick, J. Fink and V. Kumar, “Localization Using Ambiguous Bearing Estimates from Radio Signal Strength”, (submitted) The 2011 Robotics: Science and Systems Conference (RSS 2011), Los Angeles, CA, 2011

J. Derenick, J. Spletzer and V. Kumar, “A Semidefinite Programming Framework for Multi-robot Systems Operating in Dynamic Environments”, (to appear) 49th IEEE Conference on Decision and Control (CDC 2010), Atlanta, Georgia, Dec, 2010.

J. Derenick, V. Kumar and A. Jadbabaie, “Towards Simplicial Coverage Repair for Mobile Robot Teams”, Proceedings of the 2010 IEEE International Conference on Robotics and Automation (ICRA 2010), Anchorage, Alaska, May, 2010.

J. Derenick, J. Spletzer and M. Ani Hsieh, “A Graph Theoretic Approach to Optimal Target Tracking for Mobile Robot Teams”, Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2007), San Diego, CA, Nov, 2007

J. Derenick, C. Mansley and J. Spletzer, “Efficient Motion Planning Strategies for Large-scale Sensor Networks”, Proceedings of the Seventh International Workshop on the Algorithmic Foundations of Robotics (WAFR 2006), New York, NY, Jul, 2006

J. Derenick, C. Thorne and J. Spletzer, “On the Deployment of a Hybrid FSO/RF Mobile Ad-hoc Network”, Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2005), Edmonton, Alberta, Canada, Aug, 2005

Technical Reports (1)

J. Derenick and J. Spletzer, “Optimal Shape Changes for Robot Teams”, Lehigh University Technical Report LU-CSE-05-029

PRESENTATIONS

Refereed Presentations (4)

“A Semidefinite Programming Framework for Controlling Multi-robot Systems in Dynamic Environments”, The 49th IEEE Conference on Decision and Control, Atlanta, GA, Dec, 2010.

“Towards Simplicial Coverage Repair for Mobile Robot Teams”, 2010 IEEE International Conference on Robotics and Automation (ICRA 2010), Anchorage, Alaska, May, 2010.

“Efficient Motion Planning Strategies for Large-scale Sensor Networks”, Seventh International Workshop on the Algorithmic Foundations of Robotics (WAFR 2006), New York, NY, Jul, 2006

“On the Deployment of a Hybrid FSO/RF Mobile Ad-hoc Network”, IEEE/RSJ International Conference on Intelligent Robots and Systems, Edmonton, Alberta, Canada, Aug, 2005

Invited Lectures and Tutorials (5)

“Optimization-based and Topological Control for Robot Ensembles”, Department of Computer Science and Electrical Engineering Research Seminar, West Virginia University, Morgantown, WV, Dec, 2010.

“A Tutorial in Algebraic Topology with Applications to Wireless Sensor Networks”, United States Army Research Laboratory (ARL), Adelphi, MD, May, 2010.

“Mobile Robotics: A Transformative Technology”, ACM Lunch-time Lecture Series, University of Scranton, Scranton, PA, Oct, 2009

“A Tutorial in Algebraic Topology with Applications to Wireless Sensor Networks”, Control-group Summer Research Lecture Series, University of Pennsylvania, Philadelphia, PA, Aug, 2009.

“Planning and Estimation for Intelligent Vehicle Systems”, GRASP Laboratory Special Seminar, University of Pennsylvania, Philadelphia, PA, Dec, 2008

GRANT-WRITING EXPERIENCE **National Science Foundation (NSF) Travel Grant** – Seventh International Workshop on the Algorithmic Foundations of Robotics (WAFR 2006), New York, New York USA (2006)

MAST CTA Annual Project Proposal and Quarterly Reports – Co-supervised the assemblance and authored portions of the MAST CTA Annual Project Proposal (APP) for fiscal year 2010 and MAST CTA quarterly reports for 2009 and 2010 (for the Autonomy Center). Begun in 2008, MAST CTA is a multi-year, \$22 million dollar grant. It supports a collaborative effort with the Army Research Laboratory (ARL) and is lead by the University of Pennsylvania with partners at ten other participating institutions including MIT, Georgia Tech, Cal Tech, and UC Berkeley.

Systems of Micro Autonomous Robots and Sensors (SMARTS) Proposal – Supported and authored portions of a recently awarded, Lockheed Martin Corporation University proposal. Focus of this collaboration is upon developing algorithms for controlling heterogeneous systems of micro autonomous vehicles to facilitate situational awareness.

(FY 2011) Defense University Research Instrumentation Program (DURIP) Proposal - Supported and authored portions of a recently submitted DURIP proposal for fiscal year 2011. DURIP solicitation is done through the Department of Defense (DoD) as part of the University Research Initiative (URI), which is designed to support higher-education and research in areas central to national defense.

Autonomous Robotic Rotorcraft for Exploration, Surveillance and Transportation (ARREST) Proposal – Supported and authored portions of a recently submitted National Science Foundation Partnerships for Innovation (NSF PFI) proposal. Focus of this proposal is partnering small-business entrepreneurs in small rotorcraft and sensors with robotics researchers at GRASP to transition fundamental research results into products with societal benefits and commercial impact.

OPEN-SOURCE SOFTWARE **The Sick LIDAR Matlab/C++ Toolbox** (<http://sicktoolbox.sourceforge.net>)
Project Manager and Lead Developer

Provides (under FreeBSD license) multi-threaded C++ device drivers (RS-232/422 and TCP/IP), configuration utilities, Mex interfaces, and tutorials for Sick LMS and Sick LD LIDAR families. Utilized by academic/industry leaders in Canada, Europe, Australia, and the United States to include the Robotics Institute at Carnegie Mellon University, Stanford Artificial Intelligence Lab (SAIL), Texas A&M, Google, Inc., NASA, Willow Garage, and others. Recently integrated into the Robot Operating System (<http://www.ros.org>). Over 3,400 total downloads as of February, 2011.

SERVICE *Committees*

Lehigh University Computer Science and Engineering Departmental Advisory Board (Invited Member, 2009–2010) - Comprised of 10–12 leaders from industry, government, and academia, as well as three recent departmental graduates, the goal of this committee is to provide channels of valuable input regarding both undergraduate and graduate education and research.

Lehigh University Middle States Accreditation Compliance Subcommittee (MSCHE) (Invited Member, 2007) - Comprised of approximately 15 faculty and students from across the university, the goal of this subcommittee was to assemble material and author Chapter 4 (Compliance) for inclusion in the Decennial Accreditation Review Report for the Middle States Commission on Higher Education. As an invited graduate member, I assembled and authored subsections regarding campus resources available to the graduate student body.

Offices

President of the Pennsylvania Gamma Chapter of Upsilon Pi Epsilon (Elected Office, University of Scranton, 2002–2003)

Sessions/Symposia Chaired

- Regular Session Co-chair, Networked Robots, IEEE 2010 International Conference on Robotics and Automation (ICRA), Anchorage, Alaska, 2010
- Regular Session Co-chair (scheduled), Autonomous Robots II, 49th IEEE Conference on Decision and Control (CDC), Atlanta, Georgia, 2010

Reviewer (Journals and Conferences)

- IEEE Transactions on Robotics (T-RO)
- IEEE Transactions on Automatic Control (T-AC)
- IEEE Transactions on Mobile Computing (T-MC)
- International Journal of Robotics and Automation (IJRA)
- International Journal of Distributed Sensor Networks (IJDSN)
- ASME Journal of Dynamic Systems, Measurement and Control (JDSMC)
- International Journal on Wireless Sensor Networks (IJSNet)
- Journal of Electromagnetic Waves and Applications (JEMWA)
- Journal of Mobile Communication, Computation and Information (WI-NET)
- IEEE Conference on Decision and Control (CDC)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- American Control Conference (ACC)
- National Conference on Artificial Intelligence (AAAI)

MEDIA
COVERAGE

“Driving Innovation”, Resolve Magazine, Lehigh University, Vol. 1, 2008
http://www3.lehigh.edu/engineering/resolve3/driving_innovation.html

“Outsiders Challenged Big Guys at Robot Car Race”, Reuters, Nov, 2007³
<http://www.reuters.com/article/idUSN0420553020071104>

MEMBERSHIPS

- Institute of Electrical & Electronics Engineers (IEEE)
- IEEE Robotics and Automation Society (IEEE-RAS)
- Association for Computing Machinery (ACM)

SKILLS

- High-level Languages: C/C++, Java
- Web/Network Programming: TCP/IP Sockets, XHTML, PHP, CSS
- Image Processing: OpenCV, MIL-Lite, CalTech Camera Calibration Toolkit
- Optimization: MOSEK, SeDuMi, Matlab Optimization Toolkit
- Mathematics Software: Matlab, Maple
- Operating Systems: GNU/Linux, Mac OS X, Windows
- Versioning Systems: Git, SVN, CVS
- Robotics: ROS, Player/Stage
- Misc: Doxygen, GNU Autotools

³quoted

REFERENCES

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