Arthur W. Mahoney – Curriculum Vitae

CONTACT INFORMATION

Dept. of Mech. Engineering
Vanderbilt University
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RESEARCH INTERESTS

Surgical robotics, continuum robotics, microrobotics, magnetic actuation, motion planning, and biocentric robotics.

EDUCATION

University of Utah – Salt Lake City, UT
Ph.D., *Computing (Robotics)*, August 2014
Dissertation: "Advanced Methods for Controlling Untethered Magnetic Devices using Rotating Magnetic Fields"

Utah State University – Logan, UT
summa cum laude
B.S., *Computer Science* with *Honors*, May 2009
B.S., *Computational Mathematics*, May 2009
Honors Thesis: "A Parallel Approach to Motion Planning using Rapidly-exploring Random Trees"

HONORS AND AWARDS

Vanderbilt University:
- Postdoctoral Fellowship, Vanderbilt Initiative in Surgery and Engineering (2014)

Hertz Foundation:
- Hertz Graduate Fellowship Finalist (2009)

National Science Foundation:
- Graduate Research Fellowship (2009)

University of Utah:
- NSF IGERT Traineeship (Biocentric Robotics) (2009)
- Wayne Brown Fellowship (2009)

Undergraduate:

Computing Research Association Outstanding Undergraduate Award, Runner Up (2009), Outstanding Undergraduate Award, Finalist (2008)

Barry M. Goldwater Scholarship Program Barry M. Goldwater Scholarship (2007)

Undergraduate of the Year, Department of Computer Science (2009), Undergraduate Researcher of the Year, College of Science (2008), Lillywhite University Endowment Scholarship (2008), Helen B. and Lawrence O. Cannon Award (2008), HP and Multimedia Data Services Corp. Scholarship (2008), Phi Kappa Phi Honor Society Junior Scholarship (2008), Best Oral Presentation, USU Student Showcase (2008), Willard R. Eccles Undergraduate Research Fellowship (2007), Governor's Scholar, State of Utah (2006), Undergraduate Research Fellowship, Utah State University (2005), Presidential Scholarship (2005)

PUBLICATIONS

Journal Articles

A. Mahoney and J. Abbott, "5-DOF Manipulation of an Untethered Magnetic Device in Fluid using a Single Permanent Magnet with Application in Stomach Capsule Endoscopy," *International Journal of Robotics Research*, 2014. **(under review)**

A. Petruska, **A. Mahoney**, and J. Abbott, "Remote manipulation with a stationary computer-controlled magnetic dipole source," *IEEE Transactions on Robotics*, 2014. **(in press)**

A. Mahoney, N. Nelson, K. Peyer, B. Nelson, and J. Abbott, "Behavior of rotating magnetic microrobots above the step-out frequency with application to control of multi-microrobot systems," *Applied Physics Letters*, 104:144101, 2014.

A. Mahoney and J. Abbott, "Generating Rotating Magnetic Fields with a Single Permanent Magnet for Propulsion of Untethered Magnetic Devices in a Lumen," *IEEE Transactions on Robotics*, 30(2):411-420, 2014.

J. Greer, A. Petruska, **A. Mahoney**, M. Nambi, E. Bamberg, and J. Abbott, "Experimental investigation of wire electrical discharge machining of NdFeB permanent magnets with an RC-type machine," *Journal of Materials Engineering and Performance*, 23(4):1392-1401, 2014.

A. Mahoney, G. Podgorski, and N. Flann, "A Multiobjective Optimization Based-Approach for Discovering Novel Cancer Therapies," *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, 9(1):169–184, 2012. **(featured on journal cover)**

A. Mahoney and J. Abbott, "Managing Magnetic Force Applied to a Magnetic Device by a Rotating Dipole Field," *Applied Physics Letters*, 99(124103):1–3, 2011.

A. Mahoney, J. Sarrazin, E. Bamberg, and J. Abbott, "Velocity Control with Gravity Compensation for Magnetic Helical Microswimmers," *Advanced Robotics*, 25(8):1007–1028, 2011. **(one of "Advanced Robotics' most cited papers of 2011")**

Patents

A. Mahoney and J. Abbott, "Manipulation of an Untethered Magnetic Device With a Magnet Actuator," U.S. Patent 14/223,510, March 24, 2014. **(pending)**

A. Mahoney, S. Wright, and J. Abbott, "Spherical Mechanism for Magnetic Manipulation," U.S. Patent 61/834,387, June 12, 2013. **(pending)**

A. Mahoney and J. Abbott, "Control of Magnetically Actuated Tools in any Position using a Rotating Magnetic Source," U.S. Patent 13/330,300, December 19, 2011. **(pending)**

Refereed Conference Articles

*__A. Mahoney__ and J. Abbott, "5-DOF Manipulation of a Magnetic Capsule in Fluid using a Single Permanent Magnet," *Robotics: Science and Systems*, 2014. **(to appear)**

*__A. Mahoney__ and J. Abbott, "5-DOF Manipulation of a Magnetic Capsule in Fluid using a Single Permanent Magnet: Proof-of-Concept for Stomach Endoscopy," *Hamlyn Symp. on Medical Robotics*, pp. 114-115, 2013. **(Winner, Best Poster Award)**

*__A. Mahoney__, S. Wright, and J. Abbott, "Managing the Attractive Magnetic Force between an Untethered Magnetically Actuated Tool and a Rotating Permanent Magnet," *IEEE Int. Conf. Robotics and Automation*, pp. 5346-5351, 2013.

K. Popek, **A. Mahoney**, and J. Abbott, "Localization Method for a Magnetic Capsule Endoscope Propelled by a Rotating Magnetic Dipole Field" *IEEE Int. Conf. Robotics and Automation*, pp. 5328-5333, 2013.

*__A. Mahoney__, N. Nelson, E. Parsons, and J. Abbott, "Non-ideal Behaviors of Magnetically Driven Screws in Soft Tissue," *IEEE/RSJ Int. Conf. Intelligent Robots and Systems*, pp. 3559–3564, 2012.

K. Miller, **A. Mahoney**, T. Schmid, and J. Abbott, "Proprioceptive Magnetic-Field Sensing for Closed-loop Control of Magnetic Capsule Endoscopes," *IEEE/RSJ Int. Conf. Intelligent Robots and Systems*, pp. 1994–1999, 2012.

*__A. Mahoney__ and J. Abbott, "Control of Untethered Magnetically Actuated Tools with Localization Uncertainty using a Rotating Permanent Magnet," *IEEE Int. Conf. Biomedical Robotics and Biomechatronics*, pp. 1632–1637, 2012.

*__A. Mahoney__, D. Cowan, K. Miller, and J. Abbott, "Control of Untethered Magnetically Actuated Tools using a Rotating Permanent Magnet in any Position," *IEEE Int. Conf. on Robotics and Automation*, pp. 3375–3380, 2012.

*__A. Mahoney__, J. Bross, and D. Johnson, "Deformable Robot Motion Planning in a Reduced-Dimension Configuration Space," *IEEE Int. Conf. on Robotics and Automation*, pp. 5133–5138, 2010.

A. Mahoney, G. Newby, and D. Watson, "Scalable, Parallel, and Distributed Approximate Shortest Paths in Massive Graphs," *Int. Conf. on Parallel and Distributed Processing, Techniques, and Applications*, pp. 270-276, 2009.

A. Mahoney, B. Smith, N. Flann and G. Podgorski, "Discovering Novel Cancer Therapies: A Computational Modeling and Search Approach," *Proc. of IEEE Symp. on Computational Intelligence in Bioinformatics and Computational Biology*, pp. 233-240, 2008.

*__A. Mahoney__ and D. Watson, "Path Planning for Altruistically Negotiating Systems: The Near-sighted Tarzan Algorithm," *Proc. Int. Conf. on Parallel and Distributed Processing, Techniques, and Applications*, pp. 385-388, 2006.

C. Lo, K. Nagoti, **A. Mahoney**, Y. Chung, and C. Furse, "Detection and Mapping of Branched Wiring Networks from Reflectometry Responses," *Joint FAA/DoD/NASA Conf. on Aging Aircraft*, 2005.

** indicates presentation by A. Mahoney*

Book Chapters

K. Peyer, **A. Mahoney**, L. Zhang, J. Abbott, and B. Nelson, "Bacteria-Inspired Microrobots," in *Microbiorobotics: Biologically Inspired Microscale Robotic Systems*, M. J. Kim et al., Eds. Oxford:Elsevier, 2012, pp. 165–199.

Workshops and Abstracts

N. Flann, B. Smith, **A. Mahoney**, and G. Podgorski, "Evaluating Cancer Interventions by Simulating Tumor-Induced Angiogenesis, Blood Flow and Oxygen Delivery," Extended abstract published in *Proc. of European Conf. on Mathematical and Theoretical Biology*, 2008.

Research Experience

Medical and Electromechanical Design Laboratory – *Vanderbilt University*, Nashville, TN

Postdoctoral Researcher *August, 2014 - present*

I am working to develop new ways of designing and functionalizing concentric-tube robots. Concentric-tube instruments are tentacle-like devices that are particularly well suited for surgical applications in hard-to-reach areas of the human body. My work investigates new concentric-tube technologies for the next generation of surgical robots.

Advisor: Dr. Robert Webster

Utah Telerobotics Laboratory – *University of Utah*, Salt Lake City, UT

Graduate Research Assistant *September, 2009 - August, 2014*

As a Ph.D. student, I worked on developing robotic systems that wirelessly control capsule endoscopes in the human gastrointestinal system using magnetic fields generated by permanent magnets. The goal of this project was to produce a safe, fast, and inexpensive replacement for the traditional colonoscope in colorectal cancer screening. My work married applied physics, magnetics, and robotics.

Results – five primary-author journal publications, two co-author journal publications, seven primary-author conference pulications, two co-author conference publications, and three first-inventor U.S. patents pending.

Advisor: Dr. Jake Abbott

Utah State University – Logan, UT

Undergraduate Research Fellow *August, 2005 - June 2009*

As an undergraduate, I worked on three major projects: 1) developing novel parallel algorithms for extremely fast robotic motion planning using Rapidly-exploring Random Trees, 2) developing massively parallel search strategies for discovering novel cancer therapies, and 3) developing a parallel set of tools for hydrologic prediction and flood forecasting that scales to massive datasets.

Results – one primary-author journal publication, four primary-author conference publications, and one co-author conference publication.

Advisors: Dr. Daniel Watson and Dr. Nicholas Flann

Lawrence Livermore National Laboratory – Livermore, CA

Student Intern *May 2008 - August 2008*

I was a member of the Storage Intensive Supercomputing (SISC) research group evaluating novel parallel architectures. I worked on a comparison study of two reconfigurable computing architectures: an FPGA and the cutting edge Ambric parallel processor array architecture. The study will be used by the Department of Energy to determine how to best use both architectures to accomplish research objectives.

Advisor: Dr. Maya Gokhale

Arctic Region Supercomputing Center – Fairbanks, AK

Student Intern *June 2007 - August 2007*

I worked to adapt an algorithm traditionally used in motion planning, the Rapidly-exploring Random Tree (RRT), to compute approximate shortest paths in large graphs using massively parallel supercomputers. I developed a variation of the RRT that exhibited good speedup and scalability on the center's 2,312 processor supercomputer.

Results – My work as a student intern resulted in one primary-author conference publication.

Advisor: Dr. Greg Newby

Center of Excellence for Smart Sensors – *University of Utah*, Salt Lake City, UT

Student Researcher *October 2004 – March 2005*

While attending high school (i.e., secondary school), I performed research as a member of a graduate team tasked with developing software algorithms that discover network topology from Time Domain Reflectometry signals gathered from networks of aircraft wiring. I developed a genetic algorithm solution to the problem which was presented at the *Joint FAA/DoD/NASA Conference on Aging Aircraft* in 2005.

Results – My work as a high-school student resulted in one co-author conference publication.

Advisor: Dr. Cynthia Furse

Invited Talks

"Magnetic Manipulation Applied to Robotic Capsule Endoscopy," Robotics Institute, Carnegie Mellon University, 2014.

"Magnetic Manipulation Applied to Robotic Capsule Endoscopy," Department of Mechanical Engineering, Vanderbilt University, 2014.