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Chicago, IL 60637 USA <http://ttic.uchicago.edu/~mwalter/>
- EDUCATION** **Massachusetts Institute of Technology** Cambridge, MA
Woods Hole Oceanographic Institution Woods Hole, MA
Ph.D. Mechanical and Ocean Engineering, MIT/WHOI Joint Program in Applied Ocean Science and Engineering, February 2008
Thesis: **Sparse Bayesian Information Filters for Localization and Mapping**
John J. Leonard (chair), Hanumant Singh, Seth Teller
- University of Illinois at Urbana-Champaign** Urbana, IL
B.S. General Engineering, robotics and controls specialization, May 2000
- APPOINTMENTS** **Toyota Technological Institute at Chicago** November 2014–present
Assistant Professor
- Massachusetts Institute of Technology** February 2011–November 2014
Computer Science and Artificial Intelligence Laboratory
Research Scientist
- Massachusetts Institute of Technology** February 2008–February 2011
Computer Science and Artificial Intelligence Laboratory
Postdoctoral Associate
- RESEARCH EXPERIENCE** **Voice-commandable Autonomous Wheelchair**
MIT, CSAIL June 2011–present
Funding: Quanta Research, Army Research Laboratory
- Lead research that enables robots to acquire rich models of objects and space from interactions with humans. Developed an algorithm that learns accurate topological, metric, and semantic maps of a robot’s environment from a user’s natural language descriptions. The capabilities were demonstrated on an autonomous wheelchair under development to assist people with neurological afflictions.
 - Directly supervise three PhD students who are working on depth image segmentation and object detection, semantic mapping, and imitation learning.
- Anytime Optimal Motion Planning**
MIT, CSAIL June 2010–December 2011
Funding: Department of Defense: Research & Engineering
- Developed an algorithm that performs “anytime” optimal motion planning—it quickly identifies an initial plan and exploits additional computation time to improve the plan towards the optimum. The algorithm extends the RRT* planner to enable real-time asymptotically-optimal motion planning. The algorithm was demonstrated on a robotic forklift and an autonomous wheelchair.
 - Designed an asymptotically-optimal, sample-based planner that maintains a sparse search tree. The algorithm is three times faster than the RRT* and returns plans that

are twice as efficient as RRT plans. We implemented the algorithm on the Willow Garage PR2 robot and released the code as part of the Open Motion Planning Library.

Natural Language Interpretation for Navigation and Manipulation

MIT, CSAIL

January 2011–present

Funding: Army Research Laboratory

- Together with colleagues, developed a probabilistic model and inference algorithm that allows robots to learn to interpret commands spoken in natural language that direct navigation and manipulation.
- Successfully demonstrated the use of natural language speech to command a robotic forklift to manipulate and transport cargo.

Human-Robot Collaboration for Logistics in Unprepared Environments

MIT, CSAIL

March 2008–April 2011

Funding: Director of Defense Research & Engineering

- Technical lead for the Agile Robotics for Logistics project, an effort to enable mobile robots to safely join and contribute to human teams in unstructured environments. In this role, I coordinated the research of a multidisciplinary team that spanned the fields of perception, planning, control, manipulation, human-robot interaction, and speech and gesture recognition. The resulting research was realized on an autonomous forklift that works with military personnel, handling cargo in their facilities.
- Developed a one-shot visual appearance learning algorithm that persistently segments objects within images based upon a single training example. The method demonstrated 90% recall despite viewpoint changes, scene clutter, and lighting variation during a week-long series of tests in an outdoor storage facility.
- Developed a coupled perception and control strategy that allows the robotic forklift to manipulate cargo using a single laser range finder with a 95% success rate. The core perception algorithm is an $\mathcal{O}(n \log n)$ solution to robust optimization that detects pallet structure within noise-corrupted 2D scans in real-time.

Simultaneous Localization and Mapping (SLAM) in Large Environments

MIT, CSAIL

June 2004–March 2008

Funding: Office of Naval Research

- Contributed insights into the interpretation of SLAM as a Gaussian Markov Random Field (MRF) and the implications of sparse approximations to this MRF.
- Proposed a novel SLAM information filter that significantly improves scalability with computation cost and memory requirements that are linear in the size of the map. Unlike the previous state-of-the-art information filter, the algorithm deliberately maintains a sparse MRF approximation that preserves estimator consistency. A modified version of the algorithm was commercialized by Evolution Robotics, which iRobot subsequently purchased for their SLAM capabilities.
- Demonstrated the algorithm's ability to perform mapping and localization in large, unstructured environments that include a ship's hull that we mapped with an autonomous underwater vehicle using an imaging sonar.
- Collaborated with colleagues to improve SLAM information smoothing, based upon a Gaussian pose graph model. We derived an efficient mean recovery technique that is $\mathcal{O}(n \log n)$ in the number of states along with consistent data association methods. We employed the algorithms in vision-based SLAM to map the RMS Titanic.

Cooperative Mapping and Underwater Surveillance

MIT, Department of Ocean Engineering
Funding: NDSEG Fellowship

September 2002–June 2004

- Investigated cooperative mapping and localization with a team of heterogeneous robots.
- Maintained and operated two Odyssey-class autonomous underwater vehicles designed for acoustic detection and classification.
- Participated in two Generic Ocean Array Technology Sonar (GOATS) research cruises off of Pianosa, Italy involving two autonomous underwater vehicles and multiple autonomous surface craft.

Scale Model Design and Testing for the Sentry AUV

WHOI, Deep Submergence Laboratory
Funding: NDSEG Fellowship

June 2000–June 2001

- Worked under the supervision of Dana Yoerger on the construction of a working physical model of what would become WHOI's Sentry autonomous underwater vehicle. Performed tow tank tests to explore the unique dynamics of the AUV.

ADVISING &
MENTORING
EXPERIENCE

Co-supervisor, MSRP Student Darrell Deo

MIT Summer Research Program (MSRP)

Summer 2010

Prototype Vision-based Navigation System for the Visually Impaired

Supervisor, Visiting Student Alejandro Perez

MIT, CSAIL

January–August 2011

Anytime Optimal Motion Planning for Manipulation, lead to a 2011 IROS paper

Supervised Alejandro's research that extended his previous anytime motion planning work to large-scale manipulation problems. The resulting algorithms were developed on and applied to Willow Garage's PR2 robot. The software implementation is now part of the Open Motion Planning Library. The work resulted in a 2011 International Conference on Intelligent Robots and Systems publication, for which Alejandro was first author.

Supervisor, MSRP Student Alejandro Perez

MIT Summer Research Program (MSRP)

Summer 2010

Anytime Optimal Motion Planning, lead to a conference award and a 2011 ICRA paper

Advised the research of a visiting undergraduate student participating in MIT's MSRP program, which promotes diversity in graduate education. The student successfully implemented an optimal, sample-based motion planner that he then demonstrated on an outdoor mobile robot. The work lead to a first place award in the Student Technical Paper Competition at the 2010 National Society of Hispanic Professional Engineers Conference and a paper at the 2011 International Conference on Robotics and Automation.

Mentor and Guest Lecturer, Training Program for Underprivileged Youth

Year Up, Boston

May 2009–June 2010

Volunteered as a mentor and guest speaker for the Boston office of Year Up, an intensive workforce development program that provides underprivileged urban young adults with marketable job skills through technical training and corporate internships. As a mentor,

I worked with a Year Up student throughout his year in the program towards his goal of enrolling in college, which he realized in the Fall of 2010. I also had the opportunity to speak to students in information technology about its importance to the field of robotics and their options for further developing their skills in college.

Co-supervisor, Masters of Engineering Student Yuan Wei

MIT, EECS

September 2008–June 2009

A Perception-Guided Approach to Motion and Manipulation Planning

Co-advising a Masters of Engineering graduate student with Professor Nicholas Roy. The thesis considered the problem of robotic manipulation in the presence of uncertainty and proposes an exploratory planning strategy that closes the loop on target estimation and manipulation planning.

TEACHING
EXPERIENCE

Rapid Robotics: Autonomous Systems with Open Source Software

MIT

Summer 2013

Summer 2014

Served as a lecturer for an intensive, week-long introduction to applied robotics software programming. The course covered core concepts in localization, mapping, perception, planning, and control through lectures and hands-on lab sessions in which students developed software for an iRobot Create running ROS.

Teaching Assistant, Principles of Autonomy and Decision Making

MIT, Department of Aeronautics and Astronautics

Fall 2006

Responsible for grading problem sets and exams for this undergraduate and graduate course. Held weekly office hour sessions along with review sessions prior to midterm and final exams. Assisted in the development of problem sets and exams. Designed and taught two lectures on probabilistic modeling and estimation for systems subject to uncertainty.

Teaching Fellow Seminar

MIT, Department of Aeronautics and Astronautics

Fall 2006

Participant in workshop that met weekly to discuss effective teaching practices, with a focus on engineering education.

PUBLICATIONS

Manuscripts are available in electronic form at <http://ttic.uchicago.edu/~mwalter/>.

Journal Articles

- [J1] M. R. Walter, M. Antone, E. Chuangsuwanich, A. Correa, R. Davis, L. Fletcher, E. Frazzoli, Y. Friedman, J. Glass, J. P. How, J. H. Jeon, S. Karaman, B. Luders, N. Roy, S. Tellex, and S. Teller, “A situationally-aware voice-commandable robotic forklift working alongside people in unstructured outdoor environments,” *Journal of Field Robotics*, 2014 (accepted, to appear).
- [J2] M. R. Walter, S. Hemachandra, B. Homberg, S. Tellex, and S. Teller, “A framework for learning semantic maps from grounded natural language descriptions,” *International Journal of Robotics Research*, 2014 (accepted, to appear).

- [J3] M. R. Walter, Y. Friedman, M. Antone, and S. Teller, “One-shot visual appearance learning for mobile manipulation,” *International Journal of Robotics Research*, vol. 31, no. 4, pp. 554–567, April 2012.
- [J4] S. Tellex, T. Kollar, S. Dickerson, M. R. Walter, A. G. Banerjee, S. Teller, and N. Roy, “Approaching the symbol-grounding problem with probabilistic graphical models,” *AI Magazine*, vol. 32, no. 4, pp. 64–76, December 2011.
- [J5] J. Leonard, J. How, S. Teller, M. Berger, S. Campbell, G. Fiore, L. Fletcher, E. Frazzoli, A. Huang, S. Karaman, O. Koch, Y. Kuwata, D. Moore, E. Olson, S. Peters, J. Teo, R. Truax, M. Walter, D. Barrett, A. Epstein, K. Maheloni, K. Moyer, T. Jones, R. Buckley, M. Antone, R. Galejs, S. Krishnamurthy, and J. Williams, *A Perception-driven Autonomous Urban Vehicle*, ser. Springer Tracts in Advanced Robotics. Berlin, Heidelberg: Springer-Verlag, 2010, vol. 56, ch. 5, pp. 163–230.
- [J6] —, “A perception-driven autonomous urban vehicle,” *Journal of Field Robotics*, vol. 25, no. 10, pp. 727–774, October 2008.
- [J7] M. R. Walter, R. M. Eustice, and J. J. Leonard, “Exactly sparse extended information filters for feature-based SLAM,” *International Journal of Robotics Research*, vol. 26, no. 4, pp. 335–359, April 2007.
- [J8] R. M. Eustice, H. Singh, J. J. Leonard, and M. R. Walter, “Visually mapping the RMS Titanic: Conservative covariance estimates for SLAM information filters,” *International Journal of Robotics Research*, vol. 25, no. 12, pp. 1223–1242, December 2006.

Refereed Conference Publications

- [C1] S. Pillai, M. R. Walter, and S. Teller, “Learning articulated motions from visual demonstrations,” in *Proceedings of Robotics: Science and Systems (RSS)*, Berkeley, CA, July 2014.
- [C2] F. Duvallet, M. Walter, T. Howard, S. Hemachandra, J. Oh, S. Teller, N. Roy, and A. Stentz, “Inferring maps and behaviors from natural language instructions,” in *Proceedings of the International Symposium on Experimental Robotics (ISER)*, Marrakech, Morocco, June 2014.
- [C3] S. Hemachandra, M. R. Walter, S. Tellex, and S. Teller, “Learning spatially-semantic representations from natural language descriptions and scene classification,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, 2014.
- [C4] M. R. Walter, S. Hemachandra, B. Homberg, S. Tellex, and S. Teller, “Learning semantic maps from natural language descriptions,” in *Proceedings of Robotics: Science and Systems (RSS)*, Berlin, Germany, June 2013.
- [C5] A. Perez, S. Karaman, A. Shkolnik, E. Frazzoli, S. Teller, and M. R. Walter, “Asymptotically-optimal path planning for manipulation using incremental sampling-based algorithms,” in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, San Francisco, CA, September 2011, pp. 4307–4313.
- [C6] S. Tellex, T. Kollar, S. Dickerson, M. R. Walter, A. Banerjee, S. Teller, and N. Roy, “Understanding natural language commands for robotic navigation and mobile manipulation,” in *Proceedings of the National Conference on Artificial Intelligence (AAAI)*, San Francisco, CA, August 2011, pp. 1507–1514.

- [C7] S. Karaman, M. R. Walter, A. Perez, E. Frazzoli, and S. Teller, “Anytime motion planning using the RRT*,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Shanghai, China, May 2011, pp. 1478–1483.
- [C8] M. R. Walter, Y. Friedman, M. Antone, and S. Teller, “Vision-based reacquisition for task-level control,” in *Proceedings of the International Symposium on Experimental Robotics (ISER)*, New Delhi, India, December 2010.
- [C9] M. R. Walter, S. Karaman, E. Frazzoli, and S. Teller, “Closed-loop pallet engagement in unstructured environments,” in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Taipei, Taiwan, October 2010, pp. 5119–5126.
- [C10] S. Teller, M. R. Walter, M. Antone, A. Correa, R. Davis, L. Fletcher, E. Frazzoli, J. Glass, J. How, A. Huang, J. Jeon, S. Karaman, B. Luders, N. Roy, and T. Sainath, “A voice-commandable robotic forklift working alongside humans in minimally-prepared outdoor environments,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Anchorage, AK, May 2010, pp. 526–533.
- [C11] O. Koch, M. R. Walter, A. Huang, and S. Teller, “Ground robot navigation using uncalibrated cameras,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Anchorage, AK, May 2010, pp. 2423–2430.
- [C12] A. Correa, M. R. Walter, L. Fletcher, J. Glass, S. Teller, and R. Davis, “Multimodal interaction with an autonomous forklift,” in *Proceedings of the ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, Osaka, Japan, March 2010, pp. 243–250.
- [C13] A. Bahr, M. R. Walter, and J. J. Leonard, “Consistent cooperative localization,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Kobe, Japan, 2009, pp. 3415–3422.
- [C14] D. Moore, A. Huang, M. Walter, E. Olson, L. Fletcher, J. Leonard, and S. Teller, “Simultaneous local and global state estimation for robotic navigation,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Kobe, Japan, 2009, pp. 3794–3799.
- [C15] A. Shkolnik, M. Walter, and R. Tedrake, “Reachability-guided sampling for planning under differential constraints,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Kobe, Japan, May 2009, pp. 2859–2865.
- [C16] M. Walter, F. Hover, and J. Leonard, “SLAM for ship hull inspection using exactly sparse extended information filters,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Pasadena, CA, May 2008, pp. 1463–1470.
- [C17] M. Walter, R. Eustice, and J. Leonard, “A provably consistent method for imposing exact sparsity in feature-based SLAM information filters,” in *Proceedings of the International Symposium of Robotics Research (ISRR)*. San Francisco, CA: Springer, October 2005, pp. 214–234.
- [C18] R. Eustice, M. Walter, and J. Leonard, “Sparse extended information filters: Insights into sparsification,” in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Edmonton, Alberta, Canada, August 2005, pp. 641–648.

- [C19] R. Eustice, H. Singh, J. Leonard, M. Walter, and R. Ballard, “Visually navigating the RMS Titanic with SLAM information filters,” in *Proceedings of Robotics: Science and Systems (RSS)*, Cambridge, MA, June 2005, pp. 57–64.
- [C20] E. Olson, M. Walter, S. Teller, and J. Leonard, “Single-cluster spectral graph partitioning for robotics applications,” in *Proceedings of Robotics: Science and Systems (RSS)*, Cambridge, MA, July 2005.
- [C21] M. Walter and J. Leonard, “An experimental investigation of cooperative SLAM,” in *Proceedings of the IFAC Symposium on Intelligent Autonomous Vehicles (IAV)*, Lisbon, Portugal, July 2004.

Refereed Workshop Publications

- [W1] S. Hemachandra, M. R. Walter, and S. Teller, “Information theoretic question asking to improve spatial semantic representations,” in *Proceedings of the AAAI Fall Symposium*, Arlington, VA, 2014.
- [W2] T. M. Howard, I. Chung, O. Propp, M. R. Walter, and N. Roy, “Efficient natural language interfaces for assistive robots,” in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Workshop on Rehabilitation and Assistive Robotics*, Chicago, IL, September 2014.
- [W3] S. Hemachandra and M. R. Walter, “Learning semantic maps through dialog for a voice-commandable wheelchair,” in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Workshop on Rehabilitation and Assistive Robotics*, Chicago, IL, September 2014.
- [W4] S. Tellex, P. Thaker, J. Joseph, M. R. Walter, and N. Roy, “Toward learning perceptually grounded word meanings from unaligned parallel data,” in *Proceedings of the NAACL HLT Workshop on Semantic Interpretation in an Actionable Context*, Montréal, Canada, June 2012, pp. 7–14.
- [W5] S. Hemachandra, R. Finman, S. Teller, and M. R. Walter, “Towards enabling a robot to effectively assist people in human-occupied environments,” in *Proceedings of the AAAI Spring Symposium*, Palo Alto, CA, March 2012.
- [W6] A. Perez, S. Karaman, E. Frazzoli, S. Teller, and M. R. Walter, “Asymptotically-optimal path planning for manipulation using incremental sampling-based algorithms,” in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) PR2 Workshop*, San Francisco, CA, October 2011.
- [W7] S. Tellex, T. Kollar, S. Dickerson, M. R. Walter, A. Banerjee, S. Teller, and N. Roy, “Interpreting robotic mobile manipulation commands expressed in natural language,” in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA) Workshop on Manipulation Under Uncertainty*, Shanghai, China, May 2011.
- [W8] M. R. Walter, Y. Friedman, M. Antone, and S. Teller, “Appearance-based object reacquisition for mobile manipulation,” in *Proceedings of the IEEE Computer Vision and Pattern Recognition Workshops (CVPRW)*, San Francisco, CA, June 2010.
- [W9] S. Karaman, M. R. Walter, E. Frazzoli, and S. Teller, “Closed-loop pallet engagement in an unstructured environment,” in *Proceeding of the IEEE International Conference on Robotics and Automation (ICRA) Workshop on Mobile Manipulation*, Anchorage, AK, May 2010.

Publications In Progress

[J1] T. Kollar, S. Tellex, S. Dickerson, M. R. Walter, A. Huang, A. Bachrach, S. Hemachandra, E. Brunskill, A. Banerjee, D. Roy, S. Teller, and N. Roy, “Generalized grounding graphs: A probabilistic framework for understanding grounded language,” *Journal of Artificial Intelligence Research*, 2013 (submitted, under review).

INVITED TALKS *Inferring Cognitive Models of Space and Action from Natural Language*, Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, August 2014

Learning Semantic Maps from Natural Language Descriptions, Department of Computer Science, Worcester Polytechnic Institute, April 2014

Learning Semantic Maps from Natural Language Descriptions, Department of Computer Science, Cornell University, April 2014

Learning Cognitive Models from Machine Vision and Natural Language, Department of Computer Science, Northeastern University, April 2014

Learning Cognitive Models from Machine Vision and Natural Language, Department of Computer Science, Rutgers University, February 2014

Learning Cognitive Models from Machine Vision and Natural Language, Toyota Technological Institute at Chicago, February 2014

Acquiring Rich Models of Objects and Space Through Vision and Natural Language, Electrical Engineering and Computer Science School, Queensland University of Technology, July 2013

Acquiring Rich Models of Objects and Space Through Vision and Natural Language, NASA Ames Research Center, July 2013

Acquiring Rich Models of Objects and Space Through Vision and Natural Language, Research and Exploratory Development Department, Johns Hopkins University Applied Physics Laboratory, June 2013

Acquiring Rich Models of Objects and Space Through Vision and Natural Language, Department of Mechanical Engineering, Texas A&M University, May 2013

Acquiring Rich Models of Objects and Space Through Vision and Natural Language, School of Computer Science, University of Massachusetts Amherst, February 2013

Acquiring Rich Models of Objects and Space Through Vision and Natural Language, IROS Workshop on Active Semantic Perception, Vilamoura, Portugal, October 2012

Intuitive Interaction with Autonomous Robots in Unstructured Environments, Inria Paris-Rocquencourt, April 2012

Intuitive Interaction with Autonomous Robots in Unstructured Environments, Inria Sophia Antipolis-Méditerranée, April 2012

Intuitive Interaction with Autonomous Robots in Unstructured Environments, Vecna Technologies, Cambridge, MA, April 2012

Intuitive Interaction with Autonomous Robots in Unstructured Environments, Institute for Aerospace Studies, University of Toronto, February 2012

Persistent Visual Memories for Object Manipulation, MIT Intelligence Initiative Workshop, January 2012

Multimodal Interaction with an Autonomous Forklift, Spoken Language Systems Group, MIT, May 2010

PROFESSIONAL
ACTIVITIES

Oceanographic Expeditions

- Acoustic mapping of ship hulls with Bluefin HAUV, Panama City, June 2007
- Ocean-acoustic sampling and prediction with two Bluefin-21s and several autonomous surface craft, Focused Acoustic Forecasting (FAF), Pianosa, Italy, July 2005
- Cooperative acoustic navigation and mapping for mine counter measures with two Bluefin-21s, Generic Oceanographic Array Technology Systems (GOATS), Pianosa, Italy, July 2004

Service

- Invited lecturer for a full-day workshop on natural language understanding for robotics, RoCKIn Camp 2014, Rome, Italy, January 2014
- Co-founder and steering committee member, Northeast Robotics Colloquium (NERC)
- Co-organizer, first-annual Northeast Robotics Colloquium (NERC) with 175 participants from academia and industry, October 2012
- ISER 2014 Program Committee member
- RSS 2013 Program Committee member
- RSS 2012 Program Committee member
- Guest lecturer, MIT's Robotics: Science and Systems II, October 2010
- Guest lecturer, Center for Talented Youth (CTY) Robotics Workshop, April 2009
- Guest lecturer, MIT's Robotics: Science and Systems I, April 2009
- Guest lecturer, MIT's Maslab, January 2009
- Guest lecturer, MIT's Probabilistic Techniques for Mobile Robotics, October 2008
- Invited author of an information filter lab session, Summer School on Simultaneous Localization and Mapping, University of Oxford, Oxford, UK, August 2006

Affiliations

- Institute of Electrical and Electronics Engineers (IEEE)
- IEEE Robotics and Automation Society (RAS)
- American Association for the Advancement of Science (AAAS)

Reviewer

- IEEE Transactions on Robotics
- Autonomous Robots
- International Journal of Robotics Research
- International Journal of Computer Vision
- IEEE Journal of Oceanic Engineering
- IEEE Transactions on Systems, Man, and Cybernetics
- IEEE Transactions on Aerospace and Electronic Systems
- IEEE International Conference on Robotics and Automation (ICRA)

- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- Robotics: Science and Systems (RSS)
- National Conference on Artificial Intelligence (AAAI)
- International Conference on Field and Service Robotics (FSR)
- ACM/IEEE International Conference on Human-Robot Interaction (HRI)
- North East Student Colloquium on Artificial Intelligence (NESCAI)