

Wheeler Ruml

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<http://www.cs.unh.edu/~ruml>

Research Interests Artificial intelligence, robotics, operations research, cognitive science, information visualization.

Education HARVARD UNIVERSITY Ph.D. in Computer Science, 2002
Dissertation: *Adaptive Tree Search*. Advisor: Stuart M. Shieber.

HARVARD COLLEGE A.B. *cum laude* in Computer Science, 1993
Honors thesis: *Stochastic Approximation Algorithms for Number Partitioning*.

Honors

Senior Member, AAAI	2016
Best Student Paper Award, Symposium on Combinatorial Search	2015
Best Paper Award, Symposium on Combinatorial Search	2014
Best Student Paper Award, Symposium on Combinatorial Search	2014
Outstanding Assistant Professor Award, University of New Hampshire	2012
Best Paper Presentation Award, Symposium on Combinatorial Search	2010
Personal letter of commendation from the President of R&D, Xerox Corporation	2006
Golden Acorn Award for most valuable patent of the year (co-winner), PARC	2005
Best Application Paper Award, Int'l Conf. on Automated Planning and Scheduling	2005
Outstanding Performance Award, PARC	2003, 2005
Thomas T. Hoopes Prize for undergraduate research, Harvard College	1993

Professional Experience UNIVERSITY OF NEW HAMPSHIRE

<i>Professor</i>	August 2017–present
<i>Associate Professor</i>	August 2012–July 2017
<i>Assistant Professor</i>	July 2007–July 2012

Founded a research group in artificial intelligence.

LAAS-CNRS and INSA TOULOUSE

<i>Visiting Researcher</i>	August 2013–July 2014
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Sabbatical visitor in the planning and robotics group with Malik Ghallab and Félix Ingrand.

PALO ALTO RESEARCH CENTER

<i>Area Manager, Embedded Reasoning</i>	April 2005–June 2007
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Led a group of seven Ph.D.-level researchers in artificial intelligence and automatic control. Responsible for technical direction, sponsor relationships, hiring, discretionary budget, and evaluation of potential patents.

<i>Research Staff</i>	July 2002–March 2005
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Initiated group research direction in artificial intelligence planning. Designed and built core software for a major Xerox robotics project.

Edited Proceedings Steve Chien, Alan Fern, Wheeler Ruml, and Minh Do (eds), *Proceedings of the Twenty-fourth International Conference on Automated Planning and Scheduling (ICAPS-14)*, AAAI Press, 564 pp., 2014.

Daniel Borrajo, Ariel Felner, Richard Korf, Maxim Likhachev, Carlos Linares López, Wheeler Ruml, and Nathan Sturtevant (eds), *Proceedings of the Fifth International Symposium on Combinatorial Search (SoCS-12)*, AAAI Press, 232 pp., 2012.

David Furcy, Sven Koenig, Wheeler Ruml, and Rong Zhou (eds), *Proceedings of the First International Symposium on Search Techniques in Artificial Intelligence and Robotics (STAIR-08)*, AAAI Press Technical Report WS-08-10, 184 pp., 2008.

Ian Miguel and Wheeler Ruml (eds), *Abstraction, Reformulation, and Approximation: Proceedings of the Seventh International Symposium*, Springer Lecture Notes in Artificial Intelligence, volume 4612, 418 pp., 2007.

Raja Bala, Linda Emberley, Patrick Mazeau, Howard Mizes, Emily Moore, Peter Odell, Sudhendu Rai, Palghat Ramesh, Cheryl Roland, Wheeler Ruml, and Tracie Zanders (eds), *Proceedings of the First Annual Xerox Innovation Group Research and Technology Conference*, 328 pp., 2006. (not distributed externally)

Wheeler Ruml and Frank Hutter (eds), *Learning for Search: Papers from the AAAI Workshop*, AAAI Press Technical Report WS-06-11, 154 pp., 2006.

Journal Publications

Christopher Wilt and Wheeler Ruml, “Effective Heuristics for Suboptimal Best-First Search,” *Journal of Artificial Intelligence Research*, 57, pp. 273–306, 2016.

Scott Kiesel, Ethan Burns, and Wheeler Ruml, “Achieving Goals Quickly Using Real-time Search: Experimental Results in Video Games,” *Journal of Artificial Intelligence Research*, 54, pp. 123–158, 2015.

Jarad Cannon, Kevin Rose, and Wheeler Ruml, “Real-time Heuristic Search for Motion Planning with Dynamic Obstacles,” *AI Communications*, 27, pp. 345–362, 2014.

Ethan Burns, Wheeler Ruml, and Minh B. Do, “Heuristic Search When Time Matters,” *Journal of Artificial Intelligence Research*, 47, pp. 697–740, 2013.

Ethan Burns and Wheeler Ruml, “Iterative-Deepening Search with On-line Tree Size Prediction,” *Annals of Mathematics and Artificial Intelligence*, pp. 1–23, April, 2013.

Wheeler Ruml, Minh Binh Do, Rong Zhou, and Markus P. J. Fromherz, “On-line Planning and Scheduling: An Application to Controlling Modular Printers,” *Journal of Artificial Intelligence Research*, 40, pp. 415–468, 2011.

Ethan Burns, Sofia Lemons, Wheeler Ruml, and Rong Zhou, “Best-First Heuristic Search for Multicore Machines,” *Journal of Artificial Intelligence Research*, 39, pp. 689–743, 2010.

Yi Shang, Wheeler Ruml, and Markus P. J. Fromherz, “Positioning using Local Maps,” *Ad Hoc Networks*, 4(2), pp. 240–253, 2006.

Wheeler Ruml, Alfonso Caramazza, Rita Capasso, and Gabriele Miceli, “Interactivity and Continuity in Language Production: An Investigation Using Italian Aphasics,” *Cognitive Neuropsychology*, 22(2), pp. 131–168, 2005.

Yi Shang, Wheeler Ruml, Ying Zhang, and Markus P. J. Fromherz, “Localization from Connectivity in Sensor Networks,” *IEEE Transactions on Parallel and Distributed Systems*, 15(11), pp. 961–974, 2004.

Alfonso Caramazza, Costanza Papagno, and Wheeler Ruml, “The Selective Impairment of Phonological Processing in Speech Production,” *Brain and Language*, 75(3), pp. 428–450, 2000.

Wheeler Ruml, Alfonso Caramazza, Jennifer R. Shelton, and Doriana Chialant, “Testing Assumptions in Computational Theories of Aphasia,” *Journal of Memory and Language*, 43(2), pp. 217–248, 2000.

Wheeler Ruml and Alfonso Caramazza, “An Evaluation of a Computational Model of Lexical Access: Comment on Dell et al. (1997),” *Psychological Review*, 107(3), pp. 609–634, 2000.

Wheeler Ruml, J. Thomas Ngo, Joe Marks, and Stuart Shieber, “Easily Searched Encodings for Number Partitioning,” *Journal of Optimization Theory and Applications*, 89(2), pp. 251–291, 1996. Also appeared as Harvard CS Technical Report TR-10-94r.

Conference Publications

Bence Cserna, William J. Doyle, Jordan S. Ramsdell, and Wheeler Ruml, “Avoiding Dead Ends in Real-time Heuristic Search,” *Proceedings of the Thirty-Second AAAI Conference on Artificial Intelligence (AAAI-18)*, 2018.

Scott Kiesel, Tianyi Gu, and Wheeler Ruml, “An Effort Bias for Sampling-based Motion Planning,” *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-17)*, 2017.

Bence Cserna, Marek Petrik, Reazul Hasan Russel, and Wheeler Ruml, “Value Directed Exploration in Multi-Armed Bandits with Structured Priors,” *Proceedings of the Thirty-third Conference on Uncertainty in Artificial Intelligence (UAI-17)*, 2017.

Bence Cserna, Wheeler Ruml, and Jeremy Frank, “Planning Time to Think: Metareasoning for On-line Planning with Durative Actions,” *Proceedings of the Twenty-seventh International Conference on Automated Planning and Scheduling (ICAPS-17)*, 2017.

Matthew Hatem, Scott Kiesel, and Wheeler Ruml, “Recursive Best-First Search with Bounded Overhead,” *Proceedings of the Twenty-ninth AAAI Conference on Artificial Intelligence (AAAI-15)*, 2015.

Matthew Hatem and Wheeler Ruml, “Simpler Bounded Suboptimal Search,” *Proceedings of the Twenty-eighth AAAI Conference on Artificial Intelligence (AAAI-14)*, 2014.

Matthew Hatem and Wheeler Ruml, “External Memory Best-First Search for Multiple Sequence Alignment,” *Proceedings of the Twenty-seventh AAAI Conference on Artificial Intelligence (AAAI-13)*, 2013.

Christopher Wilt and Wheeler Ruml, “Robust Bidirectional Search via Heuristic Improvement,” *Proceedings of the Twenty-seventh AAAI Conference on Artificial Intelligence (AAAI-13)*, 2013.

Nathan R. Sturtevant, Ariel Felner, Maxim Likhachev, and Wheeler Ruml, “Heuristic Search Comes of Age (invited paper),” *Proceedings of the Twenty-sixth AAAI Conference on Artificial Intelligence (AAAI-12)*, 2012.

Scott Kiesel, Ethan Burns, Christopher Wilt, and Wheeler Ruml, “Integrating Vehicle Routing and Motion Planning,” *Proceedings of the Twenty-second International Conference on Automated Planning and Scheduling (ICAPS-12)*, 2012.

Ethan Burns, J. Benton, Wheeler Ruml, Minh Do, and Sungwook Yoon, “Anticipatory On-line Planning,” *Proceedings of the Twenty-second International Conference on Automated Planning and Scheduling (ICAPS-12)*, 2012.

Jordan Thayer, Roni Stern, Ariel Felner, and Wheeler Ruml, “Faster Bounded-Cost Search Using Inadmissible Estimates,” *Proceedings of the Twenty-second International Conference on Automated Planning and Scheduling (ICAPS-12)*, 2012.

Matthew Hatem, Ethan Burns, and Wheeler Ruml, “Heuristic Search for Large Problems With Real Costs,” *Proceedings of the Twenty-fifth AAAI Conference on Artificial Intelligence (AAAI-11)*, 2011.

Jordan T. Thayer and Wheeler Ruml, “Bounded Suboptimal Search: A Direct Approach Using Inadmissible Estimates,” *Proceedings of the Twenty-second International Joint Conference on Artificial Intelligence (IJCAI-11)*, 2011.

Jordan T. Thayer, Austin Dionne, and Wheeler Ruml, “Learning Inadmissible Heuristics During Search,” *Proceedings of the Twenty-first International Conference on Automated Planning and Scheduling (ICAPS-11)*, 2011.

Bradford Larsen, Ethan Burns, Wheeler Ruml, and Robert C. Holte, “Searching Without a Heuristic: Efficient Use of Abstraction,” *Proceedings of the Twenty-fourth AAAI Conference on Artificial Intelligence (AAAI-10)*, 2010.

Sungwook Yoon, Wheeler Ruml, J. Benton, and Minh B. Do, “Improving Determinization in Hindsight for On-line Probabilistic Planning,” *Proceedings of the Twentieth International Conference on Automated Planning and Scheduling (ICAPS-10)*, 2010.

Silvia Richter, Jordan T. Thayer, and Wheeler Ruml, “The Joy of Forgetting: Faster Anytime Search via Restarting,” *Proceedings of the Twentieth International Conference on Automated Planning and Scheduling (ICAPS-10)*, 2010.

Ethan Burns, Seth Lemons, Wheeler Ruml, and Rong Zhou, “Suboptimal and Anytime Heuristic Search on Multi-Core Machines,” *Proceedings of the Nineteenth International Conference on Automated Planning and Scheduling (ICAPS-09)*, 2009.

Jordan T. Thayer and Wheeler Ruml, “Using Distance Estimates in Heuristic Search,” *Proceedings of the Nineteenth International Conference on Automated Planning and Scheduling (ICAPS-09)*, 2009.

Ethan Burns, Seth Lemons, Rong Zhou, and Wheeler Ruml, “Best-First Heuristic Search for Multi-Core Machines,” *Proceedings of the Twenty-first International Joint Conference on Artificial Intelligence (IJCAI-09)*, 2009.

Jordan Thayer and Wheeler Ruml, “Faster than Weighted A*: An Optimistic Approach to Bounded Suboptimal Search,” *Proceedings of the Sixteenth International Conference on Automated Planning and Scheduling (ICAPS-08)*, 2008.

Minh B. Do, Rong Zhou, and Wheeler Ruml, “Planning for Modular Printers: Beyond Productivity,” *Proceedings of the Sixteenth International Conference on Automated Planning and Scheduling (ICAPS-08)*, 2008.

Minh B. Do, Wheeler Ruml, and Rong Zhou, “On-line Planning and Scheduling: An Application to Controlling Modular Printers,” *Proceedings of the Twenty-Third AAAI Conference on Artificial Intelligence (AAAI-08)*, 2008.

Wheeler Ruml and Minh B. Do, “Best-first Utility-guided Search,” *Proceedings of the Twentieth International Joint Conference on Artificial Intelligence (IJCAI-07)*, pp. 2378–2384, 2007.

Haitham Hindi and Wheeler Ruml, “Network Flow Modeling for Flexible Manufacturing Systems with Re-entrant Lines,” *Proceedings of the 45th IEEE Conference on Decision and Control (CDC-06)*, 2006.

Minh B. Do and Wheeler Ruml, “Lessons Learned in Applying Domain-independent Planning to High-speed Manufacturing,” *Proceedings of the Sixteenth International Conference on Automated Planning and Scheduling (ICAPS-06)*, pp. 370–373, 2006.

Wheeler Ruml, Minh B. Do, and Markus P. J. Fromherz, “On-line Planning and Scheduling for High-speed Manufacturing,” *Proceedings of the Fifteenth International Conference on Automated Planning and Scheduling (ICAPS-05)*, pp. 30–39, 2005. Winner of the Best Application Paper Award.

Hai Fang and Wheeler Ruml, “Complete Local Search for Propositional Satisfiability,” *Proceedings of the Nineteenth National Conference on Artificial Intelligence (AAAI-04)*, pp. 161–166, 2004.

Yi Shang and Wheeler Ruml, “Improved MDS-Based Localization,” *Proceedings of the 23rd Conference of the IEEE Communications Society (Infocom '04)*, pp. 2640–2651, 2004.

Yi Shang, Wheeler Ruml, Ying Zhang and Markus P. J. Fromherz, “Localization from Mere Connectivity,” *Proceedings of the Fourth ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc '03)*, pp. 201–212, 2003.

Wheeler Ruml, “Constructing Distributed Representations using Additive Clustering,” *Advances in Neural Information Processing Systems 14 (NIPS-01)*, pp. 107–114, 2001. Preliminary version appeared as “Assigning Features using Additive Clustering,” Harvard CS Technical Report TR-04-01.

Wheeler Ruml, “Incomplete Tree Search using Adaptive Probing,” *Proceedings of the Seventeenth International Joint Conference on Artificial Intelligence (IJCAI-01)*, pp. 235–341, 2001.

Joe Marks, Brad Andalman, Paul Beardsley, William Freeman, Sarah Gibson, Jessica Hodgins, Tom Kang, Brian Mirtich, Hanspeter Pfister, Wheeler Ruml, Kathy Ryall, Josh Seims, and Stuart Shieber, “Design Galleries: A General Approach to Setting Parameters for Computer Graphics and Animation,” *Proceedings of SIGGRAPH '97*, pp. 389–400, 1997.

**Symposium
and Workshop
Publications**

Alison Paredes and Wheeler Ruml, “Real-Time Planning for Traffic Signal Control,” *Proceedings of the AAAI-18 Workshop on AI Enhanced IoT Data Processing for Intelligent Applications (SmartIoT)*, 2018.

Alison Paredes and Wheeler Ruml, “Goal Reasoning as Multilevel Planning,” *Proceedings of the ICAPS-17 Workshop on Integrated Execution of Planning and Acting (IntEx-17)*, 2017.

Scott Kiesel and Wheeler Ruml, “A Bayesian Effort Bias for Sampling-based Motion Planning,” *Proceedings of the ICAPS-15 Workshop on Planning and Robotics (PlanRob-16)*, 2016.

Bence Cserna, Mike Bogochow, Stephen Chambers, Michaela Tremblay, Sammie Katt, and Wheeler Ruml, “Anytime versus Real-Time Heuristic Search for On-Line Planning,” *Proceedings of the Symposium on Combinatorial Search (SoCS-16)*, 2016.

Dylan O’Ceallaigh and Wheeler Ruml, “Metareasoning in Real-time Heuristic Search,” *Proceedings of the Symposium on Combinatorial Search (SoCS-15)*, 2015. Winner of the Best Student Paper Award. A mildly augmented version entitled “Metareasoning for Concurrent Planning and Acting” appeared in *Proceedings of the ICAPS-15 Workshop on Planning and Robotics (PlanRob-15)*.

Christopher Wilt and Wheeler Ruml, “Building a Heuristic for Greedy Search,” *Proceedings of the Symposium on Combinatorial Search (SoCS-15)*, 2015.

Alon Palombo, Roni Stern, Rami Puzis, Ariel Felner, Scott Kiesel, and Wheeler Ruml, “Solving the Snake in the Box Problem with Heuristic Search: First Results,” *Proceedings of the Symposium on Combinatorial Search (SoCS-15)*, 2015.

Roni Stern, Scott Kiesel, Rami Puzis, Ariel Felner, and Wheeler Ruml, “Max is More than Min: Solving Maximization Problems with Heuristic Search,” *Proceedings of the Symposium on Combinatorial Search (SoCS-14)*, 2014. Winner of the Best Paper Award.

Christopher Wilt and Wheeler Ruml, “Speedy versus Greedy Search,” *Proceedings of the Symposium on Combinatorial Search (SoCS-14)*, 2014. Winner of the Best Student Paper Award.

Matt Hatem and Wheeler Ruml, “Bounded Suboptimal Search in Linear Space: New Results,” *Proceedings of the Symposium on Combinatorial Search (SoCS-14)*, 2014.

Scott Kiesel and Wheeler Ruml, “Planning Under Temporal Uncertainty Using Hindsight Optimization,” *Proceedings of the ICAPS-14 Workshop on Planning and Robotics (PlanRob-14)*, 2014.

Ethan Burns, Scott Kiesel, and Wheeler Ruml, “Experimental Real-time Heuristic Search Results in a Video Game,” *Proceedings of the Symposium on Combinatorial Search (SoCS-13)*, 2013.

Matthew Hatem, Roni Stern, and Wheeler Ruml, “Bounded Suboptimal Heuristic Search in Linear Space” *Proceedings of the Symposium on Combinatorial Search (SoCS-13)*, 2013.

Scott Kiesel, Ethan Burns, Wheeler Ruml, J. Benton and Frank Kreimendahl, “Open World Planning for Robots via Hindsight Optimization,” *Proceedings of the ICAPS-13 Workshop on Planning and Robotics (PlanRob-13)*, 2013.

Jarad Cannon, Kevin Rose, and Wheeler Ruml, “Real-time Motion Planning with Dynamic Obstacles,” *Proceedings of the Symposium on Combinatorial Search (SoCS-12)*, 2012.

Christopher Wilt and Wheeler Ruml, “When does Weighted A* Fail?,” *Proceedings of the Symposium on Combinatorial Search (SoCS-12)*, 2012.

Ethan Burns, Matthew Hatem, Michael J. Leighton, and Wheeler Ruml, “Implementing Fast Heuristic Search Code,” *Proceedings of the Symposium on Combinatorial Search (SoCS-12)*, 2012.

Scott Kiesel, Ethan Burns, and Wheeler Ruml, “Abstraction-guided Sampling for Motion Planning,” *Proceedings of the Symposium on Combinatorial Search (SoCS-12)*, 2012. Extended version available as UNH Technical Report 12-01, 2012

Ethan Burns and Wheeler Ruml, “Iterative-Deepening Search with On-line Tree Size Prediction,” *Proceedings of the Sixth International Conference on Learning and Intelligent Optimization (LION-12)*, 2012. Earlier version available as UNH Technical Report 11-01, 2011.

Austin J. Dionne, Jordan T. Thayer, and Wheeler Ruml, “Deadline-Aware Search Using On-line Measures of Behavior,” *Proceedings of the Symposium on Combinatorial Search (SoCS-11)*, 2011.

Michael J. Leighton, Wheeler Ruml, and Robert C. Holte, “Faster Optimal and Suboptimal Hierarchical Search,” *Proceedings of the Symposium on Combinatorial Search (SoCS-11)*, 2011.

Christopher Wilt and Wheeler Ruml, “Cost-Based Heuristic Search is Sensitive to the Ratio of Operator Costs,” *Proceedings of the Symposium on Combinatorial Search (SoCS-11)*, 2011.

Kevin Rose, Ethan Burns, and Wheeler Ruml, “Best-first Search for Bounded-depth Trees,” *Proceedings of the Symposium on Combinatorial Search (SoCS-11)*, 2011.

David Biegelsen, Lara Crawford, Minh Do, Dave Duff, Craig Eldershaw, Markus Fromherz, Haitham Hindi, Greg Kott, Dan Larner, Barry Mandel, Steve Moore, Bryan Preas, Wheeler Ruml, Greg Schmitz, Lars Swartz, and Rong Zhou, “Integrated Parallel Printing Systems with Hypermodular Architecture,” *IS&T/SPIE Conference on Electronic Imaging, Symposium on Parallel Processing for Imaging Applications*, 2011.

Jordan Thayer and Wheeler Ruml, “Finding Acceptable Solutions Faster Using Inadmissible Information,” *Proceedings of the Symposium on Combinatorial Search (SoCS-10)*, 2010. Extended version available as UNH CS Technical Report 10-01, 19pp.

Wheeler Ruml, “The Logic of Benchmarking: A Case Against State-of-the-Art Performance,” *Proceedings of the Symposium on Combinatorial Search (SoCS-10)*, 2010.

David M. Bond, Niels A. Widger, Wheeler Ruml and Xiaoxun Sun, “Real-Time Search in Dynamic Worlds,” *Proceedings of the Symposium on Combinatorial Search (SoCS-10)*, 2010.

Jordan Thayer and Wheeler Ruml, “Anytime Heuristic Search: Frameworks and Algorithms,” *Proceedings of the Symposium on Combinatorial Search (SoCS-10)*, 2010.

- Christopher Wilt, Jordan Thayer and Wheeler Ruml, “A Comparison of Greedy Search Algorithms,” *Proceedings of the Symposium on Combinatorial Search (SoCS-10)*, 2010.
- Ethan Burns, Sofia Lemons, Wheeler Ruml, and Rong Zhou, “Parallel Best-First Search: The Role of Abstraction,” *Proceedings of the AAAI-10 Workshop on Abstraction, Reformulation, and Approximation (WARA-10)*, 2010.
- Seth Lemons, J. Benton, Wheeler Ruml, Minh B. Do, and Sungwook Yoon, “Continual On-line Planning as Decision-Theoretic Incremental Heuristic Search,” *Proceedings of the AAAI Spring Symposium on Embedded Reasoning*, 2010.
- Ethan Burns, Seth Lemons, Wheeler Ruml, and Rong Zhou, “Parallel Best-First Search: Optimal and Suboptimal Solutions,” *Proceedings of the International Symposium on Combinatorial Search (SoCS-09)*, 2009.
- Silvia Richter, Jordan T. Thayer, and Wheeler Ruml, “The Joy of Forgetting: Faster Anytime Search via Restarting,” *Proceedings of the International Symposium on Combinatorial Search (SoCS-09)*, 2009.
- Jordan T. Thayer, Wheeler Ruml, and Jeff Kreis, “Using Distance Estimates in Heuristic Search: A Re-evaluation,” *Proceedings of the International Symposium on Combinatorial Search (SoCS-09)*, 2009.
- Allen Hubbe, Wheeler Ruml, Sungwook Yoon, J. Benton, and Minh B. Do, “On-line Anticipatory Planning,” *Proceedings of the ICAPS-08 Workshop on A Reality Check for Planning and Scheduling Under Uncertainty*, 2008.
- Jordan T. Thayer, Wheeler Ruml, and Ephrat Bitton, “Fast and Loose in Bounded Suboptimal Heuristic Search,” *Proceedings of the First International Symposium on Heuristic Search in Artificial Intelligence and Robotics (STAIR-08)*, pp. 120–126, 2008.
- Minh B. Do, Rong Zhou, and Wheeler Ruml, “Beyond Planning for Productivity,” *Proceedings of the Second Xerox Innovation Group Research and Technology Conference*, 6 pp., 2008. (not distributed externally)
- J. Benton, Minh B. Do, and Wheeler Ruml, “A Simple Testbed for On-line Planning,” *Proceedings of the ICAPS-07 Workshop on Moving Planning and Scheduling Systems into the Real World*, 8 pp., 2007. Also appeared in the *Proceedings of the Second International Competition on Knowledge Engineering for Planning and Scheduling (ICKEPS-07)*.
- Wheeler Ruml, “Tightly Integrated Parallel Printing: An Overview”, *Proceedings of the First Annual Xerox Innovation Group Research and Technology Conference*, pp. 84–85, 2006. (not distributed externally)
- Minh B. Do, Wheeler Ruml, and Rong Zhou, “Beyond Scheduling: Using On-line Planning to Control Printers,” *Proceedings of the First Annual Xerox Innovation Group Research and Technology Conference*, pp.91–94, 2006. (not distributed externally)
- Wheeler Ruml and Elisabeth H. Crawford, “Best-first Utility-Guided Search,” *Working Notes of the IJCAI-05 Workshop on Planning and Learning in A Priori Unknown or Dynamic Domains*, pp. 103–109, 2005.
- Ying Lu, Lara S. Crawford, Wheeler Ruml, Markus P. J. Fromherz, “Feedback Control for Real-Time Solving,” *Working Notes of the CP-04 Workshop on Constraint Solving under Change and Uncertainty (Changes-04)*, pp. 21–35, 2004.
- Wheeler Ruml and Markus P. J. Fromherz, “On-line Planning and Scheduling in a High-speed Manufacturing Domain,” *Proceedings of the ICAPS-04 Workshop on Integrating Planning into Scheduling*, pp. 60–66, 2004.

Wheeler Ruml, “Heuristic Search in Bounded-depth Trees: Best-Leaf-First Search,” *Working Notes of the AAAI-02 Workshop on Probabilistic Approaches in Search*, pp. 45–51, 2002. Preliminary version appeared as Harvard CS Technical Report TR-01-02.

Wheeler Ruml, “Using Prior Knowledge with Adaptive Probing,” *Proceedings of the 2001 AAAI Fall Symposium on Using Uncertainty Within Computation* (AAAI Technical Report FS-01-04), pp. 116-120, 2001.

Wheeler Ruml, “Stochastic Tree Search: Where to Put the Randomness?,” *Proceedings of the IJCAI-01 Workshop on Stochastic Search*, pp. 43–47, 2001.

Wheeler Ruml, “Learning to Search Trees,” selected for oral presentation at *The AAAI-2000 Workshop on Leveraging Probability and Uncertainty in Computation*, 2000.

Wheeler Ruml, “Alan W. Biermann, *Great Ideas in Computer Science*” (book review), *Mind and Machines*, 9(3), pp. 417–421, 1999.

Joe Marks, Wheeler Ruml, Stuart Shieber, and Tom Ngo, “A Seed-Growth Heuristic for Graph Bisection,” *Proceedings of Algorithms and Experiments '98*, pp. 76–87, 1998. Also appeared as Harvard CS Technical Report TR-01-98.

Brad Andalman, Kathy Ryall, Wheeler Ruml, Joe Marks, and Stuart Shieber, “Design Gallery Browsers Based on 2D and 3D Graph Drawing,” *Proceedings of the International Symposium on Graph Drawing (GD '97)*, Lecture Notes in Computer Science, vol. 1353, Springer-Verlag, pp. 322-329, 1998.

Trade Publications

Lara S. Crawford, Minh Binh Do, Wheeler Ruml, Haitham Hindi, Craig Eldershaw, Rong Zhou, Lukas Kuhn, Markus P.J. Fromherz, David Biegelsen, Johan de Kleer, Daniel Larner, “On-line Reconfigurable Machines,” *AI Magazine*, Fall, pp. 73–88, 2013.

Matthew Hatem, Ethan Burns, and Wheeler Ruml, “Problem Solving with Heuristic Search and Java,” *IBM developerWorks*, July, 2013, 24 pp. Chinese, Japanese, and Russian translations, January, 2014.

Theses

Wheeler Ruml, *Adaptive Tree Search*. Ph.D. thesis, Harvard University, May, 2002, 144 pp.

Wheeler Ruml, *Stochastic Approximation Algorithms for Number Partitioning*. Undergraduate honors thesis and Harvard CS Technical Report TR-17-93, April, 1993, 79 pp.

Unrefereed Publications

Christopher Wilt, Jordan Thayer, and Wheeler Ruml, “Selecting a Greedy Search Algorithm,” UNH CS Technical Report 10-07, 18 pp.

Wheeler Ruml, Adam Ginsburg, and Stuart Shieber, “Speculative Pruning for Boolean Satisfiability,” Harvard CS Technical Report TR-02-99, 18 pp.

Wheeler Ruml, Joe Marks, Stuart Shieber, and Tom Ngo, “Seed-Growth Heuristics for Graph Bisection,” Harvard CS Technical Report TR-10-99, 33 pp.

Grants

Research Experiences for Undergraduates Supplement Summer, 2015
NSF Robust Intelligence Program, \$6,160.

Visiting Researcher Fellowship August, 2013–May, 2014
LAAS-CNRS and INSA Toulouse.

From Heuristic Search To Robotics September, 2013–May, 2014
UNH Faculty Scholars Program, sabbatical teaching release.

Time-Aware Heuristic Search June, 2012–May, 2017
NSF Career Program, \$498,403.

- International Collaboration Supplement Summer, 2011
NSF Robust Intelligence Program, \$18,508.
- Research Experiences for Undergraduates Supplement Summer, 2011
NSF Robust Intelligence Program, \$12,000.
- Time-aware Optimization for Battlespace Management* June, 2010–May, 2013
DARPA Computer Science Study Group Program, \$396,120.
- A Symposium on Combinatorial Search* July, 2009–June, 2010
Co-PIs: Sven Koenig, Rong Zhou. NSF Robust Intelligence Program, \$30,971.
- International Development Grant Summer, 2009
UNH Center for International Education, \$500.
- Lightweight Metareasoning for Ubiquitous Optimization* March, 2009–May, 2010
DARPA Computer Science Study Group Program, \$99,220.
- Combinatorial Search Algorithms as Rational Agents* September, 2008–August, 2012
NSF Robust Intelligence Program, \$448,192.
- A Symposium Series on Heuristic Search and Its Applications* June, 2008–May, 2009
Co-PIs: David Furcy, Sven Koenig, Rong Zhou. NSF Robust Intelligence Program, \$14,646.

Patents

- Sungwook Yoon, Wheeler Ruml, Minh B. Do, “AI Planning-based Quasi-Montecarlo Simulation Method for Probabilistic Planning,” US patent 8,473,447 issued June, 2013.
- Wheeler Ruml, Minh B. Do, Rong Zhou, and Haitham Hindi, “System and Method for Real-Time System Control Using Precomputed Plans,” US patent 7,925,366, issued April, 2011.
- Minh B. Do, Wheeler Ruml, and Rong Zhou, “Model-Based Planning with Multi-Capacity Resources,” US patent 9,250,967 issued February, 2016. Also filed in Europe.
- Wheeler Ruml, Minh B. Do, and Rong Zhou, “System and Method for On-Line Planning Utilizing Multiple Planning Queues,” US patent 7,590,464 issued September, 2009 and US patent 8,463,416 issued June, 2013. Also filed in Japan.
- Wheeler Ruml, “System and Method for Bounded Sub-Optimal Problem-Solving,” US patent 7,966,336, issued June, 2011. Also filed in Japan.
- Wheeler Ruml and Minh B. Do, “Exception Handling,” US parent 8,145,335, issued March 2012. Also filed in Japan.
- Wheeler Ruml, Robert M. Lofthus, and Minh B. Do, “Model-Based Planning Using Query-Based Model Components,” US patent 7,689,311, issued March, 2010. Also filed in Japan.
- Wheeler Ruml, “System and Method for Solving Multiple Interacting State-Space Search Problems,” US patent 8,086,595, issued December, 2011.
- Meera Sampath, Markus P. J. Fromherz, Dusan G. Lysy, Rajinderjeet S. Minhas, Naveen Sharma, William J. Hannaway, Wheeler Ruml, “Fault Management for a Printing System,” US patent 8,607,102 issued December, 2013.
- Haitham Hindi and Wheeler Ruml, “System and Method for Manufacturing System Design and Shop Scheduling Using Network Flow Modeling,” US patent 8,407,077, issued March, 2013.
- Wheeler Ruml and Elisabeth H. Crawford, “System and Method for Time-aware Path Finding,” US patent 7,389,279, issued June, 2008.
- Lara S. Crawford, Haitham A. Hindi, Markus P. J. Fromherz, Craig Eldershaw, Wheeler Ruml, and Kimon D. Roufas, “Distributed Control Systems and Methods that Selectively Activate Respective Coordinators for Respective Tasks,” US patent 7,873,962 issued January, 2011.

Wheeler Ruml and Markus P. J. Fromherz, “System and Method for Production Planning Utilizing On-line State-space Planning,” US patent 7,451,132, issued November, 2008.

Yi Shang and Wheeler Ruml, “Node Localization in Communication Networks,” US patent 7,457,860, issued November, 2008.

Wheeler Ruml, Robert M. Lofthus, Ronald J. Root, Markus P. J. Fromherz, and Marc W. Webster, “Exception Handling in Manufacturing Systems Combining On-line Planning and Predetermined Rules,” US patent 7,043,321, issued May, 2006. Also filed in Europe and Japan.

Wheeler Ruml and Markus P. J. Fromherz, “System and Method Utilizing Temporal Constraints to Coordinate Multiple Planning Sessions,” US patent 6,898,475, issued May, 2005. Also filed in Europe and Japan. Co-winner of 2005 PARC Golden Acorn Award for most valuable patent of the year.

Wheeler Ruml, Joseph Marks, Kathleen Ryall, and Stuart M. Shieber, “User Interface for Creation of Image Generation and Transformation Functions,” US patent 6,421,050, issued July, 2002. Also filed in Europe and Japan.

**Invited
Presentations**

Invited Talks

“Planning: When Optimal Is Just Not Good Enough”

New Mexico State University (the 2015-16 Frank Harary Distinguished Lecture), April 2016

“Robots: Today and Tomorrow”

Kendal at Hanover Retirement Community, January 2015

“Two General Approaches for Fast Planning”

MIT, October 2014

“Better Than Optimal Planning: Balancing Search Time and Solution Cost”

Ben-Gurion University of the Negev, Israel, March 2014

Universität Basel, Switzerland, March 2014

LAAS-CNRS, France, February 2014

ONERA Toulouse, France, January 2014

“The Symposium on Combinatorial Search: What’s Hot”

AAAI, July 2013

“What Your Mama Didn’t Tell You About Heuristic Search”

ICAPS, June 2013

“Integrating Vehicle Routing and Motion Planning”

ICRA Workshop on Combining Task and Motion Planning, May 2013

“Planning Algorithms: When Optimal Just Isn’t Good Enough”

Vassar College, November 2012

Harvard University, September 2012

Tufts University, September 2012

University of Massachusetts, Lowell, November 2011

“Search Algorithms as Agents”

Symposium on Combinatorial Search, July 2011

“Best-first Graph Search on Multicore Machines”

Dagstuhl Seminar on Graph Search Engineering, November 2009

“Job Hunting in Industry and Academia”

ICAPS Doctoral Consortium, September 2008, May 2010, June 2013, June 2015

“Planning Under Time Pressure”

Williams College, October 2007

- “Heuristic Search and Rational Agents”
 University of New Hampshire, March 2007
 Worcester Polytechnic Institute, February 2007
 Pomona College, February 2007
- “Learning to Search Trees”
 Stanford University, March 2006
- “On-line Planning for High-speed Manufacturing”
 University of Nebraska, Lincoln, November 2005
 University of Alberta, Edmonton, November 2005
- “Best-first Search for Combinatorial Optimization”
 University of California, Berkeley, April 2002
 SRI International, April 2002
 Palo Alto Research Center, April 2002
- “Computational Modeling of Lexical Access”
 U.S. Army Research Laboratory, Aberdeen Proving Ground, February, 2000

Tutorials

- “Recent Directions in Heuristic Search”
 with Ariel Felner and Nathan Sturtevant, AAAI 2016
- “Heuristic Search: The Basics and Beyond”
 with Jordan Thayer, ICAPS 2012 and AAAI 2012
- “Using Solution Length Estimates in Heuristic Search”
 with Jordan Thayer, ICAPS 2011
- “A Survey of Suboptimal Search Algorithms”
 with Jordan Thayer, ICAPS 2011

Panel Presentations

- Symposium on Combinatorial Search, 2015 (moderator)
 Symposium on Combinatorial Search, 2010 (moderator)
 ICAPS Workshop on Planning and Learning, 2007
 ICAPS Workshop on Planning Under Uncertainty and Execution Control for Autonomous
 Systems, 2006
 AAAI Fall Symposium on Using Uncertainty Within Computation, 2001

Teaching Experience

UNIVERSITY OF NEW HAMPSHIRE

Instructor

- | | |
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| Introduction to Artificial Intelligence Algorithms | Spring 2008–present
Fall 2010–present |
| Planning for Robots | Spring 2013, Fall 2014–present |
| Combinatorial Search and Heuristic Optimization | Fall 2008–2009, Spring 2011–2012 |
| Classic Papers in Artificial Intelligence | Fall 2008 |
| Undergraduate Presentation Seminar | Fall 2007, Spring 2008 |

PALO ALTO RESEARCH CENTER

Guest Lecturer

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|--|-----------|
| Foundations of Constraint Processing (University of Nebraska, Lincoln) | Fall 2005 |
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HARVARD UNIVERSITY

Instructor

- | | |
|---|-----------|
| Introduction to Artificial Intelligence | Fall 2001 |
|---|-----------|

Co-lecturer

Introduction to Artificial Intelligence Fall 1999, 2000

Guest Lecturer

Introduction to Computer Science II (Harvard Summer School) Summer 1998, 1999

Theory of Computation Fall 1997

Theory of Computation (Harvard Extension School) Fall 1997

**Students
Supervised**

UNIVERSITY OF NEW HAMPSHIRE

*Ph.D. Dissertations*Scott Kiesel, *Robotics Needs Non-classical Planning* Fall 2010–Summer 2016Matt Hatem, *Heuristic Search with Limited Memory* Fall 2010–Spring 2014Chris Wilt, *Steps Towards a Science of Heuristic Search* Summer 2009–Spring 2014Ethan Burns, *Planning Under Time Pressure* Fall 2008–Spring 2013Jordan Thayer, *Heuristic Search Under Time and Cost Bounds* Summer 2007–Spring 2012*M.S. Theses*Dylan O’Ceallaigh, *Metareasoning in Real-time Heuristic Search* Spring 2013–Fall 2014Frank Kreimendahl, *Stacker Crane Problem State Space Reduction* Summer 2012–Spring 2013Chris Sexton, *Anytime Solving by Solution Refinement* Fall 2011–Fall 2012Mike Leighton, *Faster Optimal and Suboptimal Hierarchical Search* Summer 2010–Spring 2012Jarad Cannon, *Robot Motion Planning Using Real-time Heuristic Search* Fall 2010–Fall 2011Kevin Rose, *Real-time Sampling-based Motion Planning with* Summer 2010–Fall 2011*Dynamic Obstacles*Austin Dionne, *Heuristic Search Under a Deadline* Summer 2010–Spring 2011*M.S. Projects*Kasra Dalvand, *Exploring a Maze Using a Pioneer 3-DX Robot* Spring 2014–Spring 2015Jake Mandel, *Scheduling for Quality* Fall 2007–Fall 2009*Graduate Research*Jordan Ramsdell, *Real-time search* Spring 2017–Summer 2017Nate Beaulieu, *Suboptimal search* Fall 2016–Summer 2017Alison Paredes, *Open-world planning* Summer 2016–presentWill Doyle, *Real-time search* Summer 2016–presentTianyi Gu, *Motion planning* Summer 2016–presentPatrick Merrill, *Multi-level planning* Spring–Summer 2015Bence Cserna, *Real-time search* Spring 2015–presentSimon Obgamichael, *Class sectioning* Summer 2014Stephen Dunn, *Motion planning* Summer 2013–Summer 2014David Bond, *Real-time search* Spring–Fall 2009Sofia Lemons, *Multi-core search, continual planning* Fall 2008–2010*Ph.D. External Examiner*Rick Valenzano, *Design Decisions in Suboptimal Heuristic Search-based Systems*, University of Alberta, September, 2014.David Tolpin, *Rational Metareasoning in Problem-Solving Search*, Ben-Gurion University of the Negev, January, 2014.Santiago Franco, *Automatic Heuristic Selection, on a Problem by Problem Basis, Using an Analytical Model and In Situ Sampling*, University of Auckland, November, 2010.*Ph.D. Committee Member*Dan Pineo, *The Application of Computational Modeling to Data Visualization*, University of New Hampshire, December, 2010.*M.S. Committee Member*Chris Hebert, *Inferring Types to Eliminate Ownership Checks in an Intentional JavaScript Compiler*, University of New Hampshire, May, 2015

Doctoral Mentoring Programs

International Joint Conference on Artificial Intelligence (IJCAI) 2011
 International Conference on Automated Planning and Scheduling (ICAPS) 2007, 2008, 2010, 2013

Senior Theses

Shane Kochvi, *Does Fast Beat Thorough?: Comparing Real-Time Search Algorithms*
LSS-LRTA and RTAA** Fall 2016–2017
 Adam Nastasia, *Explorations with a Custom RGBD Camera System* Fall 2016–Spring 2017
 Dylan O’Ceallaigh, *Enhanced Real-time Search for Dynamic Worlds* Fall 2012–Spring 2013
 Chris Hebert, *Real-time Cooperative Path-finding* Spring 2012–2013
 Kevin Rose, *Best-first Search for Solving Constraint Satisfaction Problems* Spring 2009–2010

Undergraduate Research

Tyler Slabinski, Motion planning Summer 2015
 Jennifer Baker, Real-time search Fall 2010–2011
 Allen Hubbe, Modeling heuristic error Summer 2008
 Austin Dionne, Shortest-path search under a deadline Fall 2007–Spring 2008

Senior Projects

Matin Masimli, Aung Khant Nyar; model fitting Fall 2017–Spring 2018
 Bradley Snay, Zachary Specht; class sectioning Fall 2015–Spring 2016
 William Breen, Tyler Janowski, Alex Schwartz; robotic manipulation Fall 2012–Spring 2013
 Bryan Custer, Zach Piispanen, Jeremy Smith; robot navigation Fall 2012–Spring 2013

Secondary School Research

Bernard Suwirjo (Pinkerton Academy), Robotics Fall 2015–Summer 2016

PALO ALTO RESEARCH CENTER

Graduate Interns

J. Benton (Arizona State), On-line continual planning Summer 2006
 Elisabeth Crawford (Carnegie Mellon), Time-aware search Summer 2004
 Hai Fang (Yale), Complete local search Summer–Fall 2003

Undergraduate Interns

Ephrat Bitton (Berkeley), Fast shortest-path search Summer 2006–Spring 2007
 Kevin Canini (Cornell), Data structures for temporal planning Summer 2005
 Daniel Hsu (Berkeley), Local search algorithms Summer 2003

Doctoral Mentoring Program

International Conference on Automated Planning and Scheduling (ICAPS) 2004, 2005

HARVARD UNIVERSITY

Senior Theses

Gaby Pollack, Cognitive modeling of brain-damaged picture naming Spring 1999–Spring 2000
 Ellis Verosub, Heuristic search for protein folding Spring 1997–Spring 1998
 Nailah Robinson, Analysis of algorithms for boolean satisfiability Spring 1997–Spring 1998
 Adam Ginsburg, Heuristic search for boolean satisfiability Fall 1996–Spring 1997

Undergraduate Research

Paul Gusmorino, Visualization for combinatorial optimization Fall 2001
 Lea Sullivan, Estimating probabilities for human naming errors Fall 2000–Spring 2001
 Jeffrey Enos, Heuristic tree search algorithms Spring 2000
 Jeffrey Shneidman, Heuristic tree search algorithms Spring 2000
 Kevin Cheung, Stochastic search algorithms Spring 2000
 Emil Gilliam, Local search algorithms for additive clustering Fall 1999
 Joseph Turian, Move strategies for local search Fall 1998–Spring 1999

Pavel Vasilyev, Heuristic search and geometric embedding Fall 1997–Fall 1999
 Angelos Kottas, Cognitive modeling of brain-damaged picture naming Fall 1997–Winter, 1999
 Joshua Von Korff, Cross-validation for clustering Fall 1997–Spring 1998

Professional Activities

Steering Committees

International Conference on Automated Planning and Scheduling (ICAPS), 2014–2020.
 Councilor, Treasurer (2015–2019).
 International Symposium on Combinatorial Search (SoCS), 2008–present.
 Co-founder (2008), President (2008–2016), Past President (2016–present),
 Co-treasurer (2010–2014).

Conference Organization

Co-chair, ICAPS-17 Doctoral Consortium, 2017.
 Co-chair, International Conference on Automated Planning and Scheduling (ICAPS-14), 2014.
 Co-chair, International Symposium on Combinatorial Search (SoCS-12), 2012.
 Co-chair, International Symposium on Combinatorial Search (SoCS-09), 2009.
 Co-chair, International Symposium on Search Techniques in Artificial Intelligence and Robotics (STAIR-08), 2008.
 Co-chair, Seventh International Symposium on Abstraction, Reformulation, and Approximation (SARA-07), 2007.
 Organizing committee, International Knowledge Engineering Competition for Planning and Scheduling, 2007.
 Organizing committee, First Annual Xerox Innovation Group Research and Technology Conference, 2006. (attendance restricted to employees)
 Co-chair, AAAI-06 Workshop on Learning for Search, 2006.

Editorial Board

Journal of Artificial Intelligence Research, 2006–2014. Associate editor, 2014–2017.

Program Reviewing

Plymouth State University

Grant Reviewing

Australian Research Council
 Comisión Nacional de Investigación Científica y Tecnológica (Chile)
 Israel Science Foundation
 L'Agence Nationale de la Recherche (France)
 National Science Foundation
 Natural Sciences and Engineering Research Council of Canada
 Swiss National Science Foundation
 U.S. Army Research Office
 U.S.-Israel Binational Science Foundation

Manuscript Reviewing

Morgan Kaufmann Publishers

Journal Reviewing

ACM Transactions on Intelligent Systems and Technology
 Ad Hoc Networks
 Advances in Artificial Intelligence
 AI Communications
 Artificial Intelligence
 Cognitive Neuropsychology
 Computer Networks
 Constraints
 IBM Journal of Research and Development
 IEEE Transactions on Mobile Computing

IEEE Transactions on Robotics
 International Journal of Robotics Research
 International Journal on Artificial Intelligence Tools
 Journal of Artificial Intelligence Research
 Journal of Automated Reasoning
 Journal of Combinatorial Optimization
 Journal of Heuristics
 Journal of Machine Learning Research
 Journal of Mathematical Modelling and Algorithms
 Journal of Scheduling
 Operations Research
 Psychological Review
 Robotics and Autonomous Systems
 Telecommunication Systems

Trade Magazine Reviewing
 AI Magazine

Conference Reviewing
 AAAI Conference on Artificial Intelligence
 European Conference on Artificial Intelligence
 IEEE International Conference on Robotics and Automation
 IEEE/RSJ International Conference on Intelligent Robots and Systems
 IEEE Wireless Communications and Networking Conference
 International Conference on Automated Planning and Scheduling
 International Conference on Autonomous Agents and Multiagent Systems
 International Conference on Machine Learning
 International Federation of Automatic Control World Congress
 International Florida Artificial Intelligence Research Society Conference
 International Joint Conference on Artificial Intelligence
 International Symposium on Artificial Intelligence and Mathematics
 International Workshop on Parallel and Distributed Methods in Verification
 International Workshop on the Algorithmic Foundations of Robotics
 Learning and Intelligent Optimization
 Robotics: Science and Systems
 SIGGRAPH
 Symposium on Abstraction, Reformulation, and Approximation
 Symposium on Combinatorial Search
 Workshop of the UK Planning and Scheduling Special Interest Group
 and various other international workshops

Membership
 Association for Computing Machinery
 Association for the Advancement of Artificial Intelligence (Senior Member as of 2016,
 life member as of 2003)
 IEEE and the IEEE Robotics and Automation Society
 including the Technical Committee on Algorithms for
 Planning and Control of Robot Motion

**University
 Activities**

Department
 Faculty search committee, 2011, 2012-13, 2013-14, 2015-16 (chair)
 Library representative, 2012–present
 Graduate program committee, 2007–present
 Video colloquium, founder and organizer, 2007–2014, 2016–present

College

Robotics Seminar, co-organizer, 2015–present
Integrated Applied Math Program, affiliated faculty

University

Faculty Senate, 2015-2017. Co-chair, IT Committee (2016-17)
Ad hoc Committee on Data Science, 2016–present
Undergraduate research advisory committee, 2007–2012

Citizenship U.S.A.