

# Kyle Hollins Wray

---

CONTACT INFORMATION	Computer Science Building 140 Governors Drive University of Massachusetts, Amherst Amherst, MA 01003, USA	<i>Email:</i> wray@cs.umass.edu <i>Website:</i> www.kylewray.com
RESEARCH INTERESTS	My research interests are contained within the <b>artificial intelligence</b> domains of <b>automated planning</b> , <b>autonomous robots</b> , and <b>machine (reinforcement) learning</b> , in both single- and multi-agent scenarios. In particular, I am interested in the mathematically principled design of MDPs, POMDPs, and Dec-POMDPs to solve complex real-world problems by leveraging hierarchical and multiple objective structures. Additionally, I develop highly parallelizable algorithms (with NVIDIA GPUs and CUDA) to solve them, both offline and online, for use in applied robotic settings such as high degree of freedom path/motion planning and real-time decision-making with integrated learning. The specific application domains in which I work include mobile humanoid service robots (UMass' uBots) and autonomous vehicles (Nissan's fully-operational prototypes).	
EDUCATION	<b>University of Massachusetts Amherst</b> <b>Ph.D. Candidate in Computer Science</b> <b>M.S. in Computer Science</b>	<i>Expected May 2019</i> <i>May 2016</i>
	<b>The Pennsylvania State University</b> <b>M.A. in Mathematics</b> <b>M.S. in Computer Science and Engineering</b> <b>B.S. in Computer Science</b> <b>B.S. in Mathematics</b>	<i>August 2013</i> <i>December 2012</i> <i>December 2009</i> <i>December 2009</i>
HONORS AND AWARDS	Nissan's Patent Research Award Outstanding Graduate Research Award Passed Ph.D. Qualifying Exam and Portfolio with Distinction Outstanding Teaching Assistant Award Computational Science Graduate Minor Dean's List	<i>June 2018</i> <i>March 2016</i> <i>November 2015</i> <i>March 2014</i> <i>December 2012</i> <i>July 2008 - December 2009</i>
RESEARCH EXPERIENCE	<b>University of Massachusetts, Amherst, Massachusetts, USA</b> <b>Hierarchical and Multi-Objective (PO)MDPs Applied to Autonomous Robots</b>	<i>May 2014 - present</i>
	<b>Nissan Research Center - Silicon Valley, Sunnyvale, CA, USA</b> <b>Decision-Making for Autonomous Vehicles</b>	<i>May 2017 - August 2017</i> <i>May 2016 - September 2016</i>
	<b>Applied Research Laboratory, State College, Pennsylvania, USA</b> <b>Multiagent Learning in Highly Dynamic Environments</b>	<i>August 2010 - August 2013</i>
PATENTS	<ul style="list-style-type: none"><li>• Primary inventor on <b>seven</b> international patents for autonomous vehicles in 2018.</li><li>• Primary inventor on <b>four</b> international patents for autonomous vehicles in 2017.</li></ul>	
CONFERENCE PAPERS	<ul style="list-style-type: none"><li>• Justin Svegliato, <b>Kyle H. Wray</b>, and Shlomo Zilberstein. "Meta-Level Control of Anytime Algorithms with Online Performance Prediction." In Proceedings of the Twenty-Seventh International Conference on Artificial Intelligence (IJCAI), pages ??-??, Stockholm, Sweden, July 2018. (Presentation) (Acceptance Rate: 20.5%)</li><li>• <b>Kyle H. Wray</b>, Akshat Kumar, and Shlomo Zilberstein. "Integrated Cooperation and Competition in Multi-Agent Decision-Making." In Proceedings of the Thirty-Second Conference on</li></ul>	

Artificial Intelligence (AAAI), pages 4751–4758, New Orleans, Louisiana, USA, February 2018. (Presentation) (Acceptance Rate: 24.5%)

- **Kyle H. Wray** and Shlomo Zilberstein. “Approximating Reachable Belief Points in POMDPs.” In Proceedings of the Thirtieth International Conference on Intelligent Robots and Systems (IROS), pages 117–122, Vancouver, Canada, September 2017. (Presentation) (Acceptance Rate: 44.8%)
- **Kyle H. Wray**, Stefan J. Witwicki, and Shlomo Zilberstein. “Online Decision-Making for Scalable Autonomous Systems.” In Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (IJCAI), pages 4768–4774, Melbourne, Australia, August 2017. (Presentation) (Acceptance Rate: 25.9%)
- Luis Pineda, **Kyle H. Wray**, and Shlomo Zilberstein. “Fast SSP Solvers Using Short-Sighted Labeling.” In Proceedings of the Thirty-First Conference on Artificial Intelligence (AAAI), pages 3629–3635, San Francisco, CA, USA, February 2017. (Presentation) (Acceptance Rate: 25%)
- **Kyle H. Wray**, Dirk Ruiken, Rod A. Grupen, and Shlomo Zilberstein. “Log-Space Harmonic Function Path Planning.” In Proceedings of the Twenty-Ninth International Conference on Intelligent Robots and Systems (IROS), pages 1511–1516, Daejeon, South Korea, October 2016. (Interactive Poster) (Acceptance Rate: 48%)
- **Kyle H. Wray**, Luis Pineda, and Shlomo Zilberstein. “Hierarchical Approach to Transfer of Control in Semi-Autonomous Systems.” In Proceedings of the Twenty-Fifth International Joint Conference on Artificial Intelligence (IJCAI), pages 517–523, New York City, NY, USA, July 2016. (Presentation) (Acceptance Rate: 25%)
- **Kyle H. Wray** and Shlomo Zilberstein. “A POMDP Formulation of Proactive Learning.” In Proceedings of the Thirtieth Conference on Artificial Intelligence (AAAI), pages 3202–3208, Phoenix, AZ, USA, February 2016. (Presentation) (Acceptance Rate: 26%)
- **Kyle H. Wray** and Shlomo Zilberstein. “Multi-Objective POMDPs with Lexicographic Reward Preferences.” In Proceedings of the Twenty-Fourth International Joint Conference on Artificial Intelligence (IJCAI), pages 1719–1725, Buenos Aires, Argentina, July 2015. (Presentation) (Acceptance Rate: 28.8%)
- **Kyle H. Wray**, Shlomo Zilberstein, and Abdel-illah Mouaddib. “Multi-Objective MDPs with Conditional Lexicographic Reward Preferences.” In Proceedings of the Twenty-Ninth Conference on Artificial Intelligence (AAAI), pages 3418–3424, Austin, TX, USA, January 2015. (Poster) (Acceptance Rate: 26.7%)

REFEREED  
LONG PAPERS

- **Kyle H. Wray** and Shlomo Zilberstein. “Approximating Reachable Belief Points in POMDPs with Applications to Robotic Navigation and Localization.” ICAPS Workshop on Planning and Robotics, pages 104–110, Pittsburgh, PA, USA, June 2017. (Presentation)
- Luis Pineda, **Kyle H. Wray**, and Shlomo Zilberstein. “Fast SSP Solvers Using Short-Sighted Labeling.” IJCAI Fourth Workshop on Goal Reasoning, New York City, NY, USA, July 2016. (Presentation)
- Luis Pineda, **Kyle H. Wray**, and Shlomo Zilberstein. “Revisiting Multi-Objective MDPs with Relaxed Lexicographic Preferences.” AAAI Fall Symposium on Sequential Decision Making for Intelligent Agents, pages 63–68, Arlington, Virginia, USA, November 2015. (Presentation)
- **Kyle H. Wray** and Benjamin B. Thompson. “An Application of Multiagent Learning in Highly Dynamic Environments.” AAAI Workshop on Multiagent Interaction without Prior Coordination, pages 42–48, Quebec City, Canada, July 2014. (Presentation)
- **Kyle H. Wray** and Benjamin B. Thompson. “A Distributed Communication Architecture for Dynamic Multiagent Systems.” AAAI Workshop on Multiagent Interaction without Prior Coordination, pages 49–55, Quebec City, Canada, July 2014. (Presentation)

REFEREED  
SHORT PAPERS

- **Kyle H. Wray**, Luis Pineda, and Shlomo Zilberstein. “Hierarchical Approach to Transfer of Control in Semi-Autonomous Systems (Extended Abstract).” In Proceedings of the Fifteenth International Conference on Autonomous Agents and Multiagent Systems (AAMAS), Singapore, May 2016. (Poster) (Acceptance Rate: 48.7%)

- **Kyle H. Wray** and Shlomo Zilberstein. “A Parallel Point-Based POMDP Algorithm Leveraging GPUs (Extended Abstract).” AAAI Fall Symposium on Sequential Decision Making for Intelligent Agents, pages 95–96, Arlington, Virginia, USA, November 2015. (Presentation)

#### THESES

- **Kyle H. Wray**. (Adviser: Dr. Eli Byrne) “Altruists and Egoists: A Local Interaction Model of Imitation in Social Graphs.” The Pennsylvania State University, August 2013.
- **Kyle H. Wray**. (Adviser: Dr. Benjamin Thompson) “A Game Theoretic Approach to Multi-Agent Systems in Highly Dynamic, Information-Sparse, Role Assignment Scenarios.” The Pennsylvania State University, December 2012.

#### INVITED TALKS

- “POMDPs for Robots with Applications to Autonomous Vehicles.” Artificial Intelligence Research Group, University of New Hampshire, May 2018.
- “POMDPs for Robots with Applications to Autonomous Vehicles.” Humanity-Centered Robotics Initiative (HCRI), Brown University, February 2018.
- “POMDPs for Robots with Applications to Autonomous Vehicles.” Berkeley Artificial Intelligence Research (BAIR) Laboratory, University of California, Berkeley, July 2017.
- “MODIA: AV Decision-Making.” Nissan Advanced Technology Center, Atsugi, Japan, June 2017.
- “A POMDP Approach to Proactive Learning.” Data Science Tea, University of Massachusetts Amherst, November 2015.
- “Proactive Learning and Sequential Optimization.” Research Process and Advice Talk, Research Experience for Undergraduates (REU), University of Massachusetts Amherst, July 2015.
- “Defender: A Dynamic Predator-Prey Problem.” ARLab, Office of Naval Research (ONR) Government Sponsor Presentation, Applied Research Laboratory, July 2012.

#### FUNDING AND GRANTS

National Science Foundation (NSF) Grant (Shadow Wrote 1/3) (\$700,000)	<i>August 2017 - present</i>
University of Massachusetts Amherst Research Assistantship	<i>August 2014 - present</i>
NVIDIA Hardware Grant (\$3000 Graphics Card)	<i>January 2018</i>
Travel Grant, AAAI 2016 (\$125)	<i>February 2016</i>
Travel Grant, IJCAI 2015 (\$575)	<i>July 2015</i>
Travel Grant, University of Massachusetts (\$300 - \$400)	<i>January, November 2015</i>
University of Massachusetts Amherst Teaching Assistantship	<i>August 2013 - December 2014</i>
Applied Research Laboratory (ARL) Research Assistantship	<i>August 2010 - August 2013</i>

#### PROFESSIONAL EXPERIENCE

<b>Nissan Research Center - Silicon Valley: Research Consultant</b> <i>Supervised by Dr. Stefan J. Witwicki</i>	<i>Autonomous Vehicle Team August 2017 - present</i>
<b>Nissan Research Center - Silicon Valley: Research Intern</b> <i>Supervised by Dr. Stefan J. Witwicki</i>	<i>Autonomous Vehicle Team May 2017 - August 2017 May 2016 - September 2016</i>
<b>Applied Research Laboratory: Research Assistant</b> <i>Supervised by Dr. Benjamin B. Thompson</i>	<i>Tactical Processing August 2010 - December 2012</i>
<b>Applied Research Laboratory: Software Engineer</b> <i>Supervised by Dr. Daniel Finke Supervised by Brice Toth</i>	<i>Weapon Systems Engineering January 2013 - August 2013 April 2009 - August 2010</i>

#### TEACHING EXPERIENCE

<b>University of Massachusetts, Amherst, Massachusetts, USA</b> <b>Teaching Assistant</b>	<i>August 2013 - August 2015</i>
<ul style="list-style-type: none"> <li>• Artificial Intelligence (CMPSCI 683) – Graduate-level core AI course</li> <li>• Reasoning Under Uncertainty (CMPSCI 240) – Sophomore-level probability theory and ML</li> </ul>	

- Introduction to Problem Solving (CMPSCI 121) – Freshmen-level programming with Java

PROFESSIONAL SERVICE	Neural Information Processing Systems (NIPS), Reviewer	2018
	Reasoning and Learning in Real-World Systems for Long-Term Autonomy (AAAI Fall Symposium), Chair and Co-organizer	2018
	International Conference on Automated Planning and Scheduling (ICAPS), Subreviewer	2018
	AAAI Spring Symposium, Subreviewer	2018
	Multi-Objective Decision-Making (MODeM) (AAMAS Workshop), Co-organizer	2017
	International Joint Conference on Artificial Intelligence (IJCAI), Subreviewer	2016
	International Conference on Planning and Scheduling (ICAPS), Subreviewer	2016
	International Joint Conference on Artificial Intelligence (IJCAI), Program Committee	2015
Journal of Robotics and Autonomous Systems (RAS), Reviewer	2014	

UNIVERSITY SERVICE	New Student Committee, Member	September 2014 - present
	Graduate Women in STEM (GWiS), Committee Member	September 2014 - December 2015
	Liberty Elementary School CS Education Week, Volunteer	December 2015
	Data Mining in Python Workshops (Sponsored by GWiS), Instructor	September 2014 - May 2015
	Thursday Tea, Volunteer	September 2014 - December 2014
	Women in Engineering and Computing Career Day, Volunteer	October 2014
	Eureka! One-Week Workshop (Sponsored by Girls Inc.), Volunteer	July 2014
Computer Science Librarian	January 2014 - August 2014	

MEMBERSHIPS	Phi Kappa Phi, Member	2016 - present
	Association for the Advancement of Artificial Intelligence (AAAI), Student	2011 - present
	Institute of Electrical and Electronics Engineers (IEEE), Student	2011 - present
	Association for Computing Machinery (ACM), Student	2011 - present

RELEVANT COURSEWORK	Artificial Intelligence	Robotics	Machine Learning
	Graphical Models	Vision-Based Tracking	Numerical Optimization
	Data Mining	Computer Vision	Game Theory
	Numerical ODEs	Stochastic Processes	Computer Graphics

TECHNICAL SKILLS	<i>Languages (Expert):</i> C/C++, Python		
	<i>Languages (Advanced):</i> CUDA, Java		
	<i>Languages (Intermediate):</i> C#, MATLAB, Ruby (on Rails)		
	<i>Languages (Basic):</i> Lua, R, Visual Basic 6.0, OCaml, Scheme, Postgresql, Javascript, HTML/CSS		
	<i>Libraries:</i> ROS, OpenGL, Numpy/Scipy, Scikit-Learn, Kivy, SDL2, OpenCV		
<i>Platforms:</i> Linux (Arch, Elementary OS, OpenSuse, Fedora, Ubuntu), Mac OSX, Windows			

REFERENCES	<b>Dr. Shlomo Zilberstein</b>	University of Massachusetts Amherst
	Professor of Computer Science	Phone: (413) 545-4189
	Ph.D. Research Advisor 2013-present	Email: shlomo@cs.umass.edu
	<b>Dr. Stefan J. Witwicki</b>	Nissan Research Center - Silicon Valley
	Research Scientist	Phone: n/a
	Nissan Research Supervisor 2016-present	Email: stefan.witwicki@nissan-usa.com
	<b>Dr. Rod A. Grupen</b>	University of Massachusetts Amherst
	Professor of Computer Science	Phone: (413) 545-3280
	Robotics Research Advisor 2015-present	Email: grupen@cs.umass.edu
	<b>Dr. Benjamin B. Thompson</b>	Applied Research Laboratory

R&D Engineer IV, Tactical Processing Department Head  
ARL Research Advisor 2010-2012, ONR Contract

*Phone:* (814) 865-5556  
*Email:* bbt10@arl.psu.edu

**Dr. Daniel Finke**  
Research Associate  
ARL Supervisor 2013, DARPA Contract

Applied Research Laboratory  
*Phone:* (801) 696-8715  
*Email:* daf903@arl.psu.edu

**Brice Toth**  
R&D Engineer III  
ARL Supervisor 2009-2010

Applied Research Laboratory  
*Phone:* (814) 865-2016  
*Email:* zyx1@arl.psu.edu

**Dr. Robert Collins**  
Associate Professor of Computer Science and Engineering  
Collaborated on computer vision project, professor for two courses

The Pennsylvania State University  
*Phone:* (814) 863-1944  
*Email:* rcollins@cse.psu.edu