

Christopher M. Reardon

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RESEARCH MISSION

- *Mission:* Enabling robust human-robot teaming in real-world environments through AI and multimodal interaction.
- *Interests:* AI-enabled human-robot interaction and teaming; emergent technologies and wearables for interaction; heterogeneous, multi-robot, air-ground teams; real-world and field robotics applications; cognitive and perception systems to enable the above.

EDUCATION

- **University of Tennessee** Knoxville, Tennessee, USA
Ph.D. in Computer Science May 2016
 - Advisor: Dr. Lynne E. Parker
 - Dissertation: *An Intelligent Robot and Augmented Reality System for Instruction*
- **University of Tennessee** Knoxville, Tennessee, USA
M.S. in Computer Science Aug. 2008
 - Advisor: Dr. Lynne E. Parker
 - Thesis: *Using Automated Task Solution Synthesis to Generate Critical Junctures for Management of Planned and Reactive Cooperation between a Human-Controlled Blimp and an Autonomous Ground Robot*
- **Berry College** Mount Berry, Georgia, USA
B.S. in Computer Science, Biology Minor May. 2002

PROFESSIONAL EXPERIENCE

- **University of Denver** Denver, CO
Assistant Professor, Tenure Track – Department of Computer Science Nov. 2020 – Present
 - Founder / Director Autonomous Robotics and Interactive Systems Experimental (ARISE) Laboratory.
- **U.S. Army Research Laboratory** Adelphi, MD
Joint Faculty Appointment Apr. 2021 – Present
 - Co-PI for “Synergistic Deception vs. Multimodal Perception in Swarm/IADS Engagements,” Directors Future Ventures Science for Intelligent Swarm/Counter-Swarm (\$500k/yr Phase 1).

Computer Scientist – Computational & Information Sciences Sept. 2016 – Oct. 2020

 - Led research efforts in computational methods to enable human-robot teaming for autonomous mobility / maneuver (see *Research Experience*).
 - PI for TTCP Contested Urban Environment Strategic Challenge 2019 and 2020 projects enabling teaming humans with autonomous mobile robotics in challenging urban environments using mixed reality and multimodal interaction. Performed in collaboration with coalition researchers.
 - Co-CAM for 10 DARPA Lifelong Learning Machines (L2M) “seedling” projects (~\$3.3M) on research in AI/ML for continuous learning and adaptation without forgetting.
 - Reviewer and subject matter expert for DoD robotics and autonomy programs.
 - Alternate scientific member of the ARL human research protection Institutional Review Board.
 - Mentor and supervisor for student research fellowships.

Postdoctoral Researcher – Computational & Information Sciences May – Aug. 2016

Research Intern – Computational & Information Sciences May – Aug. 2015

 - Research for Human-Robot Team Surveillance of Complex 3-D Environments (see *Research Exp.*).
- **Office of Information Technology, University of Tennessee** Knoxville, TN
Programmer Analyst – Systems Group Jan. 2004 – Aug. 2011

- Full-lifecycle software engineering, system administration, system integration, database design, database administration, user support, testing, planning, problem analysis, solution synthesis, and documentation.
- Small team agile software development lead.
- Zend Certified Engineer (ZCE) & Red Hat System Administrator (RHSA).

- **GE Global Research** Niskayuna, NY
Research & Development Intern – Distributed Intelligent Systems Lab May – Aug. 2013
 - Research for Veterans Affairs Perioperative Surgical Instrument Processing project (see *Research Exp.*).
- **Graduate Assistantships at the University of Tennessee** Knoxville, TN
Chancellor’s Fellow - University of Tennessee July 2014 – May 2016
 - Fully-funded fellowship award with stipend.
- Graduate Assistant - Network Services* Jan. 2013 – July 2014
 - Programming and system administration to support campus network infrastructure.
- Grad. Research Assistant - Nat’l Institute for Computational Sciences* Jan. 2012 – Jan. 2013
 - Research for PoPLAR science gateway project (see *Research Experience*).
- Grad. Teaching Assistant - Dept. of Electrical Eng. & Computer Science* Aug. – Dec. 2011
 - Teaching Assistant for Autonomous Mobile Robotics (grad/undergrad) taught by Prof. Lynne Parker.
 - Contributed significantly to creation of lab assignments and quizzes.
 - Determined evaluation criteria and graded assignments.
 - Taught lab sessions and supervised lab assignments using \$50K+ of robotics equipment.
- Graduate Research Assistant - Distributed Intelligence Laboratory* Aug. 2002 – Jan. 2004
 - Research for DARPA Software for Distributed Robotics Project (see *Research Experience*).

RESEARCH EXPERIENCE

Computational & Information Sciences at U.S. Army Research Laboratory, Adelphi, MD:

- Emergent Technologies for Robust Human-Robot Teaming in Field Environments *Jan 2017 – Pres*
 - Combining augmented reality, gaze, gesture, and dialogue to communicate metric and symbolic information between robotic and human teammates in unstructured, uninstrumented environments to improve team performance through shared understanding.
- Human Shaping of Autonomously Generated Surveillance Solutions *May 2016 – 2018*
 - Created an integrated human, autonomous planning system to explore space of surveillance solutions based on limited human interactions to maximize both quantitative task-performance and qualitative operator satisfaction.
- Human-Robot Team Surveillance of Complex 3-D Environments *May – Aug. 2015*
 - Built a human-robot team using ground and aerial autonomous robots to observe and protect a stationary human team member from threats by surveilling the team’s surroundings, identifying threats, and notifying the human team member.
 - Created an interface that visualizes threat targets and allows a human team member to create and modify the surveillance plan.

Distributed Intelligence Laboratory at the University of Tennessee:

- PhD Dissertation: Intelligent Robot and Augmented Reality Instruction *Jan. 2012 – May 2016*
 - Creation of an intelligent robot and augmented reality system for providing instruction to students, specifically focusing on teaching socially valid life skills to students with intellectual disabilities.
 - Formulation of response prompting education methodology for cognitive decision making in real-world, automated, intelligent systems.
 - Experimental validation of complete system using humanoid robot and augmented reality head-mounted display to instruct students.

- Engineering a Software Suite for the Meka Humanoid Robot *Aug. 2013 – Jan. 2015*
 - Led team of fellow graduate student researchers in developing ROS-compatible software stack for Meka M3 humanoid robot, including motion planning, manipulation, localization, vision, human tracking, speech synthesis, and speech recognition.
- Cyton Alpha Arm ROS Package *Aug. – Dec. 2011*
 - Created Cyton Alpha 1G 7-DOF arm manipulator library in ROS.
- Master’s Thesis: Automated Cooperation in Human-Robot Teams *Jan. 2007 – August. 2008*
 - “Using Automated Task Solution Synthesis to Generate Critical Junctures for Management of Planned and Reactive Cooperation between a Human-Controlled Blimp and an Autonomous Ground Robot”
 - Demonstrated algorithmic identification of Critical Junctures, i.e. synergistic points for team cooperation and Environmentally Dependent Information (EDI) to identify such points.
 - Statistically validated the benefits of cooperation via identification of Critical Junctures, both online during task execution and a priori, in live, human-robot team experiments.
- Large-Scale Intruder Detection for DARPA SDR Project *Aug. 2002 – Jan. 2004*
 - Software behavior team member for DARPA 100-Robot “Software for Distributed Robotics” project.
 - Developed and implemented code for distributed auditory target tracking on 70+ robots.
 - Project culminated in a live, week-long demonstration before DARPA sponsors during which auditory target tracking provided 100% successful target detection with no false positives.

GE Global Research, Niskayuna, NY:

- Intelligent Safety System for Surgical Instrument Processing by Robots *May – Aug. 2013*
 - Constructed a cognition-based system to enhance the safety of humans in a surgical instrument processing environment alongside robots that leverages the perception, reasoning, and action capabilities of the robots in the system to detect humans, evaluate risk, and select appropriate actions.
 - Implemented intelligent sorting of surgical instruments on a Rethink Robotics Baxter Research Robot.

National Institute for Computational Sciences at the University of Tennessee:

- PoPLAR: Portal for Petascale Lifescience Applications and Research *Jan. 2012 – Jan. 2013*
 - Developed an automated, web-based system for submission of large data-set queries with input/output dependencies through multiple chem- and bio-informatics tools on clusters and supercomputers.
 - Scaled single-server informatics workflow applications to HPC environments.

TECHNICAL SKILLS

Research-focused: Robot Operating System (ROS), C++, Python, OpenCV, OpenNI/NiTE, Player-Stage, NaoQI, Choregraphe, Git, SVN, R, MATLAB, Maple, Android, L^AT_EX

Robots & hardware: Clearpath Robotics Jackal/Husky/Warthog, Microsoft HoloLens, Meka Robotics M3, Rethink Robotics Baxter, Aldebaran Nao, MobileRobotics Pioneer 2 and 3, Cyton Alpha 1G Manipulator Arm, Microsoft Kinect, Asus Xtion, Primsense, Leapmotion, Point Grey Bumblebee3 and Flea3, Google Glass

System & database administration: Red Hat Linux (RHSA), CentOS, Fedora, Debian, Ubuntu, BASH, MySQL, VMWare, MSSQL, Sharepoint, BMC Remedy, Active Directory

Web technologies: PHP (ZCE), Apache, Web Services (SOAP, JSON), Javascript, JQuery, XHTML, XML, Java, JSP, Tomcat, Wordpress, Joomla!, Drupal

JOURNAL PUBLICATIONS

[1] M. Pavliv, Fabrizio Schiano, **C. Reardon**, D. Floreano, and G. Loianno,, “Tracking and Relative Localization of Drone Swarms with a Vision-based Headset”, *IEEE Robotics & Automation Letters*, 2021.

[2] L. Yuan, **C. Reardon**, G. Warnell, G. Loianno, “Human Gaze-Driven Spatial Tasking of an Autonomous MAV”, *IEEE Robotics & Automation Letters*, 2019.

[3] **C. Reardon**, H. Zhang, R. Wright and L. Parker, “Robots Can Teach Students With Intellectual Disabilities: Educational Benefits of Using Robotic and Augmented Reality Applications”, *IEEE Robotics & Automation Magazine*, Jun. 2019.

[4] **C. Reardon**, H. Zhang, J. Fink, “Shaping of Shared Autonomous Solutions With Minimal Interaction”, *Frontiers in Neurobotics*, Aug. 2018.

- [5] H. Zhang, **C. Reardon**, L.E. Parker, “Real-Time Multiple Human Perception with Color-Depth Cameras on a Mobile Robot”, *IEEE Transactions on Systems, Man, and Cybernetics (SMC-B)*, Oct. 2013.
- [6] B. Rekepalli, P. Giblock, **C. Reardon**, “PoPLAR: Portal for Petascale Lifescience Applications and Research”, *BMC Bioinformatics*, Jun. 2013.

CONFERENCE PUBLICATIONS

- [1] B. Reily, M. Don, J.G. Rogers, **C. Reardon**, “Role Discovery in Observed Multi-Agent Systems Over Time through Matrix Factorization”, *IEEE International Symposium on Multi-Robot and Multi-Agent Systems (MRS)*, November 2021.
- [2] B. Reily, J.G. Rogers, **C. Reardon**, “Balancing Mission and Comprehensibility in Multi-Robot Systems for Disaster Response”, *IEEE International Symposium on Safety, Security and Rescue Robotics (SSRR)*, October 2021.
- [3] **C. Reardon**, K. Haring, J. Gregory, J.G. Rogers, “Evaluating Human Understanding of a Mixed Reality Interface for Autonomous Robot-Based Change Detection”, *IEEE International Symposium on Safety, Security and Rescue Robotics (SSRR)*, October 2021.
- [4] **C. Reardon**, J. Gregory, C. Nieto-Granda, J.G. Rogers, “Designing a Mixed Reality Interface for Autonomous Robot-Based Change Detection”, *SPIE Virtual, Augmented, and Mixed Reality (XR) Technology for Multi-Domain Operations*, April 2021.
- [5] B. Reily, **C. Reardon**, H. Zhang, “Multimodal Sensor Fusion and Selection for Enhanced Situational Awareness”, *SPIE Virtual, Augmented, and Mixed Reality (XR) Technology for Multi-Domain Operations*, April 2021.
- [6] B. Reily, **C. Reardon**, H. Zhang, “Leading Multi-Agent Teams to Multiple Goals While Maintaining Communication”, *Robotics: Science and Systems*, July 2020.
- [7] **C. Reardon**, J. Gregory, C. Nieto-Granda, J.G. Rogers, “Enabling Situational Awareness via Augmented Reality of Autonomous Robot-Based Environmental Change Detection”, *HCI Virtual, Augmented, and Mixed Reality Conference (VAMR) (invited)*, July 2020.
- [8] B. Reily, **C. Reardon**, H. Zhang, “Representing Multi-Robot Structure through Multimodal Graph Embedding for the Selection of Robot Teams”, *IEEE Int’l Conference on Robotics and Automation (ICRA)*, June 2020.
- [9] B. Reily, Q. Zhu, **C. Reardon**, H. Zhang, “Simultaneous Learning from Human Pose and Object Cues for Real-Time Activity Recognition”, *IEEE International Conference on Robotics and Automation (ICRA)*, June 2020.
- [10] M. Dennison, **C. Reardon**, J. Gregory, T. Trout, J.G. Rogers, “Creating a Mixed Reality Common Operating Picture Across C2 Echelons for Human-Autonomy Teams”, *SPIE Virtual, Augmented, and Mixed Reality (XR) Technology for Multi-Domain Operations*, April 2020.
- [11] S. Paul, **C. Reardon**, T. Williams, H. Zhang, “Designing Augmented Reality Visualizations for Synchronized and Time-Dominant Human-Robot Teaming”, *SPIE Virtual, Augmented, and Mixed Reality (XR) Technology for Multi-Domain Operations*, April 2020.
- [12] J. Gregory, **C. Reardon**, K. Lee, G. White, K. Ng, C. Sims, “Enabling Intuitive Human-Robot Teaming Using Augmented Reality and Gesture Control”, *AAAI Fall Symposium on AI-HRI*, November 2019.
- [13] **C. Reardon**, K. Lee, J. G. Rogers, J. Fink, “Communicating with Augmented Reality for Human-Robot Teaming in Field Environments”, *IEEE Int’l. Symposium on Safety, Security and Rescue Robotics*, Sept. 2019.
- [14] **C. Reardon**, K. Lee, J. G. Rogers, J. Fink, “Augmented Reality for Field Robotics”, *HCI Virtual, Augmented, and Mixed Reality Conference (VAMR) (invited)*, July 2019.
- [15] **C. Reardon**, K. Lee, J. G. Rogers, J. Fink, “Come See This! Augmented Reality to Enable Human-Robot Cooperative Search”, *IEEE Int’l. Symposium on Safety, Security and Rescue Robotics (SSRR)*, August 2018.
- [16] **C. Reardon**, F. Han, H. Zhang, J. Fink, “Optimizing Autonomous Surveillance Route Solutions from Minimal Human-Robot Interaction”, *IEEE Int’l. Symposium on Safety, Security and Rescue Robotics (SSRR)*, Oct. 2017.
- [17] **C. Reardon**, J. Fink, “Towards Joint Human-Robotic Solutions to Surveillance Problems”, *AAAI Int’l. Florida Artificial Intelligence Research Society Conference (FLAIRS)*, May 2017.
- [18] F. Han, X. Yang, **C. Reardon**, Y. Zhang, H. Zhang, “Simultaneous Feature and Body-Part Learning for Real-Time Robot Awareness of Human Behaviors”, *IEEE International Conference on Robotics and Automation (ICRA)*, May 2017.
- [19] F. Han, **C. Reardon**, L. E. Parker, H. Zhang, “Minimum Uncertainty Latent Variable Models for Robot Recognition of Sequential Human Activities”, *IEEE Int’l. Conf. on Robotics and Automation (ICRA)*, May 2017.
- [20] **C. Reardon**, J. Fink, “Air-Ground Robot Team Surveillance of Complex 3D Environments”, *IEEE International Symposium on Safety, Security and Rescue Robotics (SSRR)*, October 2016.

- [21] **C. Reardon**, R. Wright, D. Cihak, L.E. Parker, “Intelligent Context-Aware Augmented Reality to Teach Students with Intellectual and Developmental Disabilities”, *AAAI International Florida Artificial Intelligence Research Society Conference (FLAIRS)*, May 2016.
- [22] H. Zhang, **C. Reardon**, F. Han, L.E. Parker, “SRAC: Self-Reflective Risk-Aware Artificial Cognitive Models for Robot Response to Human Activities”, *IEEE Int’l. Conf. on Robotics and Automation (ICRA)*, May 2016.
- [23] **C. Reardon**, H. Zhang, R. Wright, L.E. Parker, “Response Prompting for Intelligent Robot Instruction of Students with Intellectual Disabilities”, *IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, August 2015. (**Distinguished Interdisciplinary Research Award Candidate**)
- [24] H. Zhang, **C. Reardon**, C. Zhang, L.E. Parker, “Adaptive Human-Centered Representation for Activity Recognition of Multiple Individuals from 3D Point Cloud Sequences”, *IEEE International Conference on Robotics and Automation (ICRA)*, May 2015.
- [25] **C. Reardon**, H. Tan, B. Kannan, L. DeRose, “Towards Safe Robot-Human Collaboration Systems using Human Pose Detection”, *IEEE Int’l Conf. on Technologies for Practical Robot Applications (TePRA)*, May 2015.
- [26] H. Zhang, W. Zhou, **C. Reardon**, L.E. Parker, “Simplex-Based 3D Spatio-Temporal Feature Description for Action Recognition”, *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Jun. 2014.
- [27] B. Rekepalli, P. Giblock, **C. Reardon**, “Bioinformatics: Desktop Applications to Peta-Scale Architectures with Web-Based Portals”, *International Symposium on Bioinformatics Research and Applications (ISBRA)*, May 2012.
- [28] L. E. Parker, **C. Reardon**, H. Choxi, and C. Bolden, “Using Critical Junctures and Environmentally-Dependent Information for Management of Tightly-Coupled Cooperation in Heterogeneous Robot Teams”, *IEEE International Conference on Robotics and Automation (ICRA)*, 2009.
- [29] L. E. Parker, B. Birch, **C. Reardon**, “Indoor Target Intercept Using an Acoustic Sensor Network and Dual Wavefront Path Planning”, *IEEE International Conference on Intelligent Robots and Systems (IROS)*, 2003.

WORKSHOP ORGANIZATION

- [1] H. Christensen, N. Roy, H. Yanco, J. Shah, D. Baran, E. Stump, **C. Reardon**, C. Neito-Granda, “Human-Robot Teaming From Data to Systems (3rd RT-DUNE)”, *IEEE International Conference on Robotics and Automation (ICRA)*, Paris, France, May 2020..
- [2] H. Christensen, N. Roy, S. Chernova, M. A. Hsieh, S. Young, D. Baran, E. Stump, C. Neito-Granda, **C. Reardon**, “Human-Robot Teaming Beyond Human Operational Speeds (2nd RT-DUNE)”, *IEEE International Conference on Robotics and Automation (ICRA)*, Montreal, Canada, May 2019.
- [3] H. Zhang, **C. Reardon**, K. Sun, C. Yue, “Adversarial Robotics”, *Robotics Science and Systems (RSS)*, Pittsburgh, PA, June 2018.
- [4] N. Roy, H. Christensen, D. Fox, M. A. Hsieh, S. Young, S. Ng, D. Schulz, E. Stump, C. Neito-Granda, **C. Reardon**, “Robot Teammates Operating in Dynamic, Unstructured Environments (RT-DUNE)”, *IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, Australia, May 2018.

POSTERS

- [1] **C. Reardon**, F. Han, H. Zhang, J. Fink, “Autonomous Surveillance Route Solutions from Minimal Human-Robot Interaction”, *IEEE International Conference on Intelligent Robots and Systems (IROS)*, Sept. 2017.
- [2] F. Han, **C. Reardon**, C. Ye, H. Zhang, “Robot Understanding of Human Intents in Gesture-based Interaction”, *IEEE International Conference on Intelligent Robots and Systems (IROS) Shared Autonomy Workshop*, Sept. 2017.
- [3] **C. Reardon**, F. Han, H. Zhang, J. Fink, “Shaping Autonomous Surveillance Route Solutions from Minimal Human-Robot Interaction”, *IEEE International Conference on Intelligent Robots and Systems (IROS) Shared Autonomy Workshop*, Sept. 2017.
- [4] B. Rekepalli, P. Giblock, **C. Reardon**, S. Sarkar, M. Fahey, “Web-Enabled Systems Biology Science Gateway on Supercomputers,”, *ACM Conference on Bioinformatics, Computational Biology and Biomedicine 2012 (ACM-BCB)*, Oct. 2012.
- [5] B. Rekepalli, P. Giblock, **C. Reardon**, M. Fahey, “Petascale Informatics Applications Development on XSEDE Supercomputers”, *Extreme Science and Engineering Discovery Environment (XSEDE12)*, Jul. 2012. (**Best Poster**)

STUDENT ADVISING

Graduate Students

- Kai Velagapudi (M.S. Thesis) *June 2022 (expected)*
- Aniekan Inyang (M.S. Thesis) *June 2023 (expected)*

Undergraduate Research Students

- Khai Lai (B.S. with distinction) *June 2021*

- Ori Miller (B.S. with distinction)

March 2022 (expected)

TEACHING AND OUTREACH

Instructor

- Machine Learning for Intelligent Robotics *Fall 2021 (planned)*
- Robot Ethics (graduate/undergraduate) *Spring 2021 (20 students)*
- Software for AI Robotics (graduate/undergraduate) *Winter 2021 (12 students)*

Outreach

- Vice Chair, IEEE Denver Computer, Information Theory, and Robotics Society *2021-Present*
- Judge Volunteer, FLL Robotics *2012-15, 2017-2021*
- Computer Science Instructor & Mentor, U. of Tennessee Pre-College Upward Bound *2005-2006*

AWARDS & HONORS

- Elected Senior Member, IEEE *June 2019*
- Chancellor's Fellowship, University of Tennessee *2014-2016*
- Chancellor's Award for Outstanding Professional Promise, University of Tennessee *May 2016*
- College Qualified Leader, U.S. Army Research Laboratory *May 2015*
- Winner, Award for Best Poster, XSEDE12 Conference *Jul. 2012*
- 1st Place / Team Captain, Link Analytics Project in Data Mining *May 2011*
- 1st Place / Team Captain, Capital One Challenge in Data Mining *Apr. 2011*
- Student Government Association Representative, Berry College *1999-2002*
- O. Wayne Rollins Student Work Award for exceptional performance *2001-2002*
- Member, Berry College Honors Program Student Association *1998-2002*
- Berry College Dean's List *1999-2002*
- Student Government Association Vice President for Student Services, Berry College *2000-2001*
- Member, Berry College Sigma Delta Pi National Spanish Honor Society *2000*

PROFESSIONAL SERVICE

Professional Memberships and Service

- Senior Member, IEEE *2019-Present*
- IEEE, Robotics and Automation Society *2013-Present*
- Alternate Member, U.S. Army DEVCOM ARL Institutional Review Board *2019-2020*

Organizing Committees

- Program Chair, IEEE Symposium on Safety, Security, and Rescue Robotics *2021*
- Publication Chair, IEEE Symposium on Safety, Security, and Rescue Robotics *2019*

Conference Program Committees

- Virtual, Augmented, and Mixed Reality (XR) Technology for Multi-Domain Operations *2020-21*
- International Conference on Autonomous Agents & Multiagent Systems *2019*
- International Florida Artificial Intelligence Research Society Conference *2017*
- International Joint Conference on Artificial Intelligence *2016*

Paper Reviews

- Reviewer, IEEE Robotics and Automation Magazine
- Reviewer, IEEE International Conference on Robotics and Automation
- Reviewer, IEEE International Conference on Intelligent Robots and Systems
- Reviewer, IEEE Symposium on Safety, Security, and Rescue Robotics
- Reviewer, ACM/IEEE International Conference on Human-Robot Interaction