Brian J. Reily

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Research Interests

My research interests focus on enabling effective representations of multi-robot systems, often with the goal often of easier interaction with humans. Specifically, I'm interested in *representations for multi-robot structure* that make multi-robot systems easier to understand and analyze; *representations for multi-robot control* that enable efficient multi-robot movement, control, and collaborative perception; and *representations for human-robot teaming* that enable robots to understand the behaviors and intents of their human teammates.

Education

Colorado School of Mines, Golden, Colorado
Ph.D. in Computer Science, GPA: 4.0/4.0 **Jan 2018 - May 2021**

Dissertation: "Representation Learning for Human-Robot Teaming with Multi-Robot Systems."

Colorado School of Mines, Golden, Colorado
M.S. in Computer Science, GPA: 4.0/4.0 **Sep 2014 - May 2016**

Thesis: "Human Activity Recognition and Gymnastics Analysis Through Depth Imagery."

University of Virginia, Charlottesville, Virginia
B.A. in Computer Science **Sep 2006 - May 2009**

Research Experience

Army Research Laboratory **May 2018 - Aug 2018, Nov 2020 - Present**
Journeyman Research Fellow, Adelphi Laboratory

- Developed novel methods to model the internal structures of multi-robot systems based on multiple observation modalities.
- Proposed approaches to discover roles in multi-agent systems and to control multi-robot systems in order to make roles understandable.

Human-Centered Robotics Lab **Jan 2015 - May 2021**
Department of Computer Science, Colorado School of Mines

- Developed novel methods based on multi-modal graph embedding and graph representation learning to understand the structure of multi-robot systems.
- Proposed new methods for multi-robot control utilizing game theory, regularized optimization, and sensor fusion.
- Developed new methods for human activity recognition, incorporating information from teammates relationships and nearby objects.
- Designed and built a multi-robot research platform, enabling the evaluation of methods to control and integrate sensing data of multiple robots.

Awards and Honors

- 2nd Place presentation (Computation and Electronics Session) at 2020 Graduate Research and Discovery Symposium (GRADS)
- Best poster finalist at CSM C-MAPP 2016
- Finalist at the Amazon Picking Challenge, ICRA 2015
- Honor Graduate of US Army Officer Candidate School
- Honor Graduate of US Army Basic Combat Training
- Distinguished Honor Graduate of US Army CBRN Operations School

Publications

- **Brian Reily**, Michael Don, John G. Rogers, and Christopher Reardon. "Role Discovery in Observed Multi-Agent Systems Over Time through Matrix Factorization." *International Symposium on Multi-Robot and Multi-Agent Systems* **(MRS)**, 2021.

- **Brian Reily**, John G. Rogers, and Christopher Reardon. "Balancing Mission and Comprehensibility in Multi-Robot Systems for Disaster Response." *International Symposium on Safety, Security, and Rescue Robotics* **(SSRR)**, 2021.
- **Brian Reily**, Peng Gao, Fei Han, Hua Wang, and Hao Zhang. "Real-Time Recognition of Team Behaviors by Multisensory Graph-Embedded Robot Learning." *International Journal of Robotics Research* **(IJRR)**, 2021.
- **Brian Reily**, Terran Mott and Hao Zhang. "Adaptation to Team Composition Changes for Heterogeneous Multi-Robot Sensor Coverage." *International Conference on Robotics and Automation* **(ICRA)**, 2021.
- **Brian Reily** and Hao Zhang. "Team Assignment for Heterogeneous Multi-Robot Sensor Coverage through Graph Representation Learning." *International Conference on Robotics and Automation* **(ICRA)**, 2021.
- Lyujian Lu, Hua Wang, **Brian Reily**, and Hao Zhang. "Robust Real-Time Group Activity Recognition of Robot Teams." *Robotics and Automation Letters* **(RA-L)**, 2021.
- **Brian Reily**, Christopher Reardon, and Hao Zhang. "Multi-Modal Sensor Fusion and Selection for Enhanced Situational Awareness." *SPIE Digital Forum on Virtual, Augmented, and Mixed Reality Technology for Multi-Domain Operations*, 2021.
- **Brian Reily**, Christopher Reardon and Hao Zhang. "Leading Multi-Agent Teams to Multiple Goals While Maintaining Communication." *Robotics: Science and Systems* **(RSS)**, 2020.
- **Brian Reily**, Qingzhao Zhu, Christopher Reardon, and Hao Zhang. "Simultaneous Learning from Human Pose and Object Cues for Real-Time Activity Recognition." *International Conference on Robotics and Automation* **(ICRA)**, 2020.
- **Brian Reily**, Christopher Reardon, and Hao Zhang. "Representing Multi-Robot Structure through Multimodal Graph Embedding for the Selection of Robot Teams." *International Conference on Robotics and Automation* **(ICRA)**, 2020.
- Peng Gao, **Brian Reily**, Savannah Paul, and Hao Zhang. "Visual Reference of Ambiguous Objects for Augmented Reality-Powered Human-Robot Communication in a Shared Workspace." *International Conference on Virtual, Augmented, and Mixed Reality* **(VAMR)**, 2020.
- **Brian Reily**, Qingzhao Zhu, and Hao Zhang. "Activity Recognition by Learning from Human and Object Attributes." *Workshop of International Conference on Robotics and Automation* **(ICRA)**, 2019.
- **Brian Reily**, Christopher Reardon, and Hao Zhang. "Graph Embedding for the Division of Robotic Swarms." *Workshop of International Conference on Robotics and Automation* **(ICRA)**, 2019.
- **Brian Reily**, Fei Han, Lynne Parker, and Hao Zhang. "Skeleton-Based Bio-Inspired Human Activity Prediction for Real-Time Human-Robot Interaction." *Autonomous Robots* **(AuRo)**, vol. 42, pp. 1281-1298, 2018.
- **Brian Reily**, Hao Zhang, and William Hoff. "Real-Time Gymnast Detection and Performance Analysis With a Portable 3D Camera." *Computer Vision and Image Understanding* **(CVIU)**, vol. 159, pp. 154-163, 2017.
- Fei Han*, **Brian Reily***, William Hoff, and Hao Zhang. "Space-Time Representation of People Based on 3D Skeletal Data: A Review." *Computer Vision and Image Understanding* **(CVIU)**, vol. 158, pp. 85-105, 2017. *Contributed equally to this work.

Publications Under Review

- **Brian Reily** and Hao Zhang. "Enabling Simultaneous View and Feature Selection for Collaborative Multi-Robot Perception." *International Journal of Advanced Robotic Systems* **(IJARS)**, Under Review, 2021.
- **Brian Reily** and Hao Zhang. "Fusion and Clustering of Multilayer Graphs through Regularized Bistochastic Approximation." *Information Fusion*, Under Review, 2021.
- Peng Gao, **Brian Reily**, Rui Guo, Hongsheng Lu, Qingzhao Zhu, and Hao Zhang. "Asynchronous Collaborative Localization by Integrating Spatiotemporal Graph Learning with Model-Based Estimation." *International Conference on Robotics and Automation* **(ICRA)**, Under Review, 2021.
- **Brian Reily**, Terran Mott and Hao Zhang. "Decentralized and Communication-Free Multi-Robot Navigation through Distributed Games." *International Conference on Robotics and Automation* **(ICRA)**, Under Review, 2021.

Reviewing Experience

SSRR	*IEEE International Symposium on Safety, Security, and Rescue Robotics*	**2021**
MRS	*IEEE International Symposium on Multi-Robot and Multi-Agent Systems*	**2021**
IROS	*IEEE/RSJ International Conference on Intelligent Robots and Systems*	**2019, 2021**
AuRo	*Autonomous Robots*	**2021**
ICAPS	*International Conference on Automated Planning and Scheduling*	**2021**
ICRA	*IEEE International Conference on Robotics and Automation*	**2019, 2020**
RA-L	*IEEE Robotics and Automation Letters*	**2019, 2020**
ISR	*Journal of Intelligent Service Robotics*	**2020**
TAAS	*ACM Transactions on Autonomous and Adaptive Systems*	**2019**
Humanoids	*IEEE International Conference on Humanoid Robots*	**2018, 2019**
TIP	*IEEE Transactions on Image Processing*	**2019**
SSRR	*IEEE International Symposium on Safety, Security, and Rescue Robotics*	**2019**
ICIAP	*International Conference on Image Analysis and Processing*	**2019**
Sensors	*Affective and Immersive HCI via Effective Sensor and Sensing*	**2018**
CVIU	*Computer Vision and Image Understanding*	**2016**

Teaching Experience

Teaching Assistant for **CS498/598: Human Centered Robotics** **Spring 2019**

- Assisted in teaching students how robots perceive and react to human behaviors through learning and 3D perception, utilizing ROS, Python, C++, and OpenCV.

Teaching Assistant for **CS473/573: Robot Planning and Manipulation** **Spring 2019**

- Assisted in teaching students robot kinematics and planning algorithms with symbolic logic, SAT planning, and Lisp.

Other Work Experience

United States Army **2010 - 2013**
Transportation Officer - 82nd Airborne Division

Brigade Transportation Officer

- Coordinated the movement of over 10000 soldiers in support of more than 150 training events around the world.
- Integrated assets from multiple brigades across the Army to successfully accomplish objectives.
- Supervised RFID tracking of more than $100 million worth of equipment.
- Planned sustainment for 4 major training exercises; ensuring over 5000 soldiers were supplied with food, water, fuel, ammunition, and other essential supplies.

Distribution Platoon Leader

- Supervised 25 employees and maintained accountability of over $7 million worth of equipment, including more than 30 vehicles.
- Executed the successful issue and recovery of nearly $5 million worth of supplies and ammunition to support training objectives.
- Managed over 50 successful convoys during simulated combat, transporting supplies through hostile territory.
- Tracked the arrival of over 300 pieces of equipment as the airfield control officer for 2 major training events.

Additional Training

- Officer Candidate School (Honor Graduate)
- Airborne Qualified
- Unit Movement Officer
- CBRN Operations Officer (Distinguished Honor Graduate)
- Environmental Compliance Officer