

# Joydeep Biswas

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## Current Appointment

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Assistant Professor, Computer Science Department, University of Texas at Austin

Adjunct Assistant Professor, College of Information and Computer Sciences, University of Massachusetts Amherst

Technical Advisor, Consumer Robotics, Amazon Lab 126

## Education

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2014	Ph.D. in Robotics	Carnegie Mellon University
2010	M.S. in Robotics	Carnegie Mellon University
2008	B.Tech. in Engineering Physics	Indian Institute of Technology, Bombay

## Achievements and Awards

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2021	NSF CAREER Award
2019	Student Best Poster Award, Northrop Grumman University Symposium
2019	IJCAI Early Career Spotlight
2019	Amazon Research Award
2018	JP Morgan AI Faculty Research Award
2018	Best Demo Award, AAMAS 2018
2018	5th place, RoboCup 2018 Small Size League, <i>UMass MinuteBots</i> , Faculty Team Leader
2017	Lower Bracket 1st place, RoboCup 2017 Small Size League, <i>UMass MinuteBots</i> , Faculty Team Leader
2015	Siebel Scholar, Class of 2015
2015	1st place, RoboCup 2015 Small Size League, <i>CMDragons</i> , Student Team Leader
2014	2nd place, RoboCup 2014 Small Size League, <i>CMDragons</i> , Student Team Leader
2013	2nd place, RoboCup 2013 Small Size League, <i>CMDragons</i> , Student Team Leader
2010	2nd place, RoboCup 2010 Small Size League, <i>CMDragons</i> , Team Member

## Employment History

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2019 - Present	Assistant Professor	Computer Science Department, University of Texas at Austin, TX, USA
2019 - Present	Adjunct Assistant Professor	College of Information and Computer Sciences, University of Massachusetts Amherst, MA, USA
2015 - 2019	Assistant Professor	College of Information and Computer Sciences, University of Massachusetts Amherst, MA, USA
2015	Post-Doctoral Fellow	Computer Science Department, Carnegie Mellon University, Pittsburgh, PA, USA
2012	Summer Intern	Google Research, Mountain View, CA, USA
2010	Summer Intern	Intel Research, Pittsburgh, PA, USA

## Funding

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### Federal Funding

**NSF Award “NRT-AI: Convergent, Responsible, and Ethical Artificial Intelligence Training Experience for Roboticists”**

Role: Co-PI.

Period: September 2021 – August 2026.

Amount: \$2,999,999.

**NSF Award “CAREER: Robust Perception and Customization for Long-Term Autonomous Mobile Service Robots”**

Role: PI.

Period: April 2021 – March 2026.

Amount: \$590,469.

**NSF Award “RI: Medium: Introspective Perception and Planning for Long-Term Autonomy”**

Collaborators: Shlomo Zilberstein (UMass)

Role: PI.

Period: July 2020 – June 2023.

PI Biswas’ share: \$600,000.

**NSF Award “SHF: Small: Interactive Synthesis and Repair For Robot Programs”**

Collaborators: Arjun Guha (UMass)

Role: Co-PI.

Period: June 2020 – May 2023.

PI Biswas’ share: \$250,001.

**DARPA Award “Advancing Learning via Probabilistic Causal Analysis for Competency Awareness”**

Collaborators: Charles River Analytics, David Jensen (UMass).

Role: Co-PI.

Period: October 2019 – September 2022.

PI Biswas’ share: \$587,810.

**Army Futures Command Robotics Center of Excellence “Persistent Fully Autonomous Multi-Robot Tactics in Complex Environments”**

Collaborators: Peter Stone, Luis Sentis, Justin Hart

Role: Co-PI.

Period: October 2019 – December 2022.

Total funding: \$1,457,250.

**NSF Award “S&AS: FND: Reliable Semi-Autonomy with Diminishing Reliance on Humans”**

Collaborators: Shlomo Zilberstein (UMass)

Role: Co-PI.

Period: September 2017 – August 2020.

Total funding: \$699,512.

**DARPA Award “Intelligent Model-Based Adaptation for Mobile Robotics”**

Collaborators: Jonathan Aldrich (CMU), David Garlan (CMU), Manuela Veloso (CMU), Christian Kaestner (CMU), Claire Le Gouess (CMU).

Role: Co-PI.

Period: November 2015 – November 2019.  
PI Biswas' share: \$377,019.

### **Competitive Industry Awards**

#### **Northrop Grumman Mission Systems' Research in Applications for Learning Machines (REALM) Consortium**

Collaborators: Shaoshuai Mou (Purdue), Daniel A. DeLaurentis (Purdue), Bing Liu (UIC)

Role: Co-PI.

Period: January 2019 – December 2021.

Total funding: \$1,200,000. PI Biswas' share: \$302,668

#### **JP Morgan AI Research Award, 2019**

Role: PI.

Period: September 2019 – August 2020.

Amount: \$147,424.

#### **Amazon Research Award, 2018**

Role: PI.

Period: September 2019 – August 2020.

Amount: \$80,000.

### **Industry Funding**

#### **Amazon Unrestricted Gift**

Award Date: December 2021

Amount: \$70,000.

Award Date: December 2020

Amount: \$80,000.

#### **Amazon Unrestricted Gift**

Award Date: March 2020

Amount: \$80,000.

#### **Amazon Unrestricted Gift**

Award Date: March 2019

Amount: \$40,000.

#### **Amazon Unrestricted Gift**

Award Date: September 2018

Amount: \$40,000.

## Teaching Experience

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**Instructor, CS 393R, Fall 2020: Autonomous Robots**

Graduate course, University of Texas at Austin

**Instructor, CS 378F, Spring 2020, Spring 2021: F1/10 Autonomous Driving**

Undergraduate course, University of Texas at Austin

**Instructor, COMPSCI 220, Fall 2017, Fall 2018: Programming Methodology**

Undergraduate course, University of Massachusetts Amherst

**Instructor, COMPSCI 403, Fall 2016, Spring 2018 : Introduction To Robotics**

Undergraduate course, University of Massachusetts Amherst

**Instructor, COMPSCI 603, Spring 2016, Spring 2017, Spring 2019 : Robotics**

Graduate course, University of Massachusetts Amherst

**Instructor, COMPSCI 691BR, Spring 2017 : Building A Robot Soccer Team**

Graduate Seminar, University of Massachusetts Amherst

## Invited Talks

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Deploying Autonomous Service Mobile Robots, And Keeping Them Autonomous  
*Nvidia*, March 2021

Anticipating and Avoiding Failures Using Introspective Perception and Physics-Informed Program Synthesis  
*MIT Embodied Intelligence Seminar*, February 2021

Building Robots For Long-Term Autonomy, And Keeping Them Autonomous  
*Yale University*, April 2019

The Quest for "Always-On" Autonomous Mobile Robots  
*IJCAI 2019 Early Career Spotlight Talk*, August 2019

Deploying Autonomous Service Mobile Robots, And Keeping Them Autonomous  
*ICRA 2018 Workshop: Long-term Autonomy and Deployment of Intelligent Robots in the Real-world*, May 2018

Building Robots For Long-Term Autonomy, And Keeping Them Autonomous  
*Carnegie Mellon University*, March 2018

Deploying Autonomous Service Mobile Robots, And Keeping Them Autonomous  
*Amazon*, November 2017

Deploying Autonomous Service Mobile Robots, And Keeping Them Autonomous  
*IROS 2017 Workshop: Assistance and Service Robotics in a Human Environment*, September 2017

Autonomous Mobile Robot Perception for Changing Environments  
*ICRA 2016 Workshop: AI for Long-term Autonomy*, May 2016

Deploying Autonomous Service Mobile Robots, And Keeping Them Autonomous.  
*University of New Hampshire Robotics Seminar Series*, March 2016

The Quest for Robust, Reliable, Autonomous Mobile Robots.  
*Williams College Computer Science Department Colloquium*, November 2015

The Quest for Robust, Reliable, Autonomous Mobile Robots.  
*Vecna Robotics*, September 2015

The Quest for Robust, Reliable, Autonomous Mobile Robots.  
*University of Minnesota, Computer Science & Engineering*, April 2015

Vector Map-Based, Non-Markov Localization for Long-Term Deployment of Autonomous Mobile Robots  
*Google X*, April 2015

The Quest for Robust, Reliable, Autonomous Mobile Robots.  
*University of Massachusetts Amherst, School of Computer Science*, March 2015

The Quest for Robust, Reliable, Autonomous Mobile Robots.  
*University of Massachusetts Amherst, School of Computer Science*, March 2015

## Panels

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Panel Moderator, Ethics Aware Design of AI  
*2020 Global Analytics Summit: Ethics in AI, Texas McCombs*, November 2020

Discussion Panel, Record of Robotics at CMU Part II, A Live Interview with Manuela Veloso.  
*CMU Record of Robotics Series*, October 2020

Last Mile Autonomous Delivery Systems: A Live Webcast Demonstration, and Panel Discussion  
*UT Good Systems Webinar*, September 2020

The Call for an Accelerated Autonomy – Robotics on the Frontlines of a Crisis  
*Computing In Our New Normal: A UTCS Webinar*, May 2020

Panel Chair, Reasoning and Learning in Real-World Systems for Long-Term Autonomy  
*AAAI 2018 Fall Symposium*, October 2018

## Professional Service

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### Outreach Activities

- Science on Screen Series at Amherst Cinema, Amherst MA, 31 October 2018: Presented a introduction to “Christine” within the scientific context of actual self-driving cars. *The Radical Future of Self-Driving Cars*.
- SciTech Cafe, Northampton MA, 23 January 2017: Presented a scientific talk to a general public audience. “Where am I?” and Other Fundamental Questions Robotcs Think Long and Hard to Answer

- HolyokeCodes, Holyoke MA, 8–12 July 2019: Co-Organized with Arjun Guha, a week-long robotics workshop for high-school students with state-of-the-art soccer-playing robots that we used to compete with at RoboCup. We covered the basic robot sense-plan-act control cycle, computational geometry, and simple adversarial planning. Students implemented building blocks of increasingly complex robot behaviors, leading up to a robot soccer tournament.

### **Track Chair / Associate Editor**

- Associate Editor, Elsevier Robotics and Autonomous Systems: 2019 – present
- RoboCup Federation Trustee: 2021 – Present
- Diversity and Inclusion Co-Chair, AAAI Conference on Artificial Intelligence (AAAI): 2022
- RoboCup Executive Committee, Small Size League: 2015 – 2021
- Robot Exhibitions Co-Chair, International Joint Conference on Artificial Intelligence (IJCAI): 2021
- RoboCup Symposium Co-Chair: 2020-2021
- Robotics Track Co-Chair, International Conference on Autonomous Agents and Multiagent Systems (AAMAS): 2019
- Associate Editor, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS): 2016

### **Senior Program Committee**

- AAAI Conference on Artificial Intelligence (AAAI): 2020
- International Conference on Autonomous Agents and Multiagent Systems (AAMAS): 2021
- Autonomous Robots and Multirobot Systems Workshop (ARMS): 2016

### **Program Committee / Reviewer**

- Autonomous Robots and Multirobot Systems Workshop (ARMS): 2020
- AAAI Symposium on Educational Advances in Artificial Intelligence: 2021
- RoboCup Symposium: 2015, 2016, 2017, 2018, 2019
- AAAI Undergraduate Consortium: 2021
- IEEE/SICE International Symposium on System Integration (SII): 2019
- Robotics: Science and Systems (RSS): 2015, 2016, 2019
- International Symposium on Multi-Robot and Multi-Agent Systems (MRS): 2019
- International Conference on Autonomous Agents and Multiagent Systems (AAMAS): 2017, 2018
- International Conference on Automated Planning and Scheduling (ICAPS) : 2016, 2018, 2021

- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS): 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020
- IEEE International Conference on Robotics and Automation (ICRA): 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021
- IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN): 2010
- IEEE Conference on Human-Robot Interaction (HRI): 2016
- International Joint Conference on Artificial Intelligence (IJCAI): 2016
- International Conference on Autonomous Agents and Multiagent Systems (AAMAS): 2016

### **Journal Reviewing**

- IEEE Robotics and Automation Letters (RA-L): 2017, 2018, 2019, 2020, 2021
- IEEE Robotics and Automation Magazine (IEEE-RAM): 2013, 2014, 2015, 2016, 2019
- IEEE Transactions on Robotics (T-RO): 2015, 2018, 2019, 2020
- International Journal of Robotics Research (IJRR): 2016, 2017
- International Journal of Social Robotics (SORO): 2018, 2019

### **Grant Reviewing**

NSF Panelist: 2016(x2), 2018, 2019

## **University Service**

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### **College Level**

- Faculty Hiring Committee for Whole Communities Whole Health Cluster Hires: 2019–2020
- CNS Fall Lab Working Group in response to COVID restrictions: 2020

### **Department Level**

- Texas Robotics Machine Shop Committee: 2020–2021
- Texas Robotics Space Committee: 2020–2021
- UTCS Turing Scholars Admissions Committee: 2020–2021
- UTCS Diversity, Equity, and Inclusion Committee: 2020–2021
- UTCS Graduate Admissions Committee: 2019–2020

- UMass CICS Honors Program Director: 2018–2019
- UMass CICS Undergraduate Course Assistant Program Director: 2018–2019
- UMass CICS Graduate Admissions Committee: 2015–2016
- UMass CICS Student Activities Committee: 2015–2016
- UMass CICS Data Science Faculty Hiring Committee: 2016–2017
- UMass CICS Student Activities Committee: 2016–2017

## **Advising and Thesis Committees**

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### **PhD Supervisor**

- John Borer (Co-advised by Mitchell Pryor), UT Austin. 2021–present
- Amanda Adkins, UT Austin. 2020–present
- Joshua Hoffman (Co-advised by Swarat Chaudhuri), UT Austin. 2020–present
- Kavan Sikand, UT Austin. 2019–present
- Emily Pruc, UMass Amherst. 2018–present
- Sadeqh Rabiee, UT Austin. 2016–present
- Jarrett Holtz, UT Austin. 2015–present
- Samer Nashed (Changed advisors in 2019), UMass Amherst. 2015–2019
- Spencer Lane (Changed advisors in 2019), UMass Amherst. 2016–2019
- Alyxander Burns (Changed advisors in 2019), UMass Amherst. 2017–2019

### **Master’s Thesis Supervisor**

- David Balaban, UMass Amherst, 2016 – 2018  
*A Real-Time Solver For Time-Optimal Control Of Omnidirectional Robots with Bounded Acceleration*

### **Undergraduate Honors Thesis Supervisor**

- Edward Schneeweiss, UMass Amherst, 2015 – 2019  
*Joint Perception and Planning for Obstacle Avoidance over Non-Planar Terrain*
- Kyle Vedder, UMass Amherst, 2015 – 2019  
*X\*: Anytime Multiagent Path Planning With Bounded Search*
- George Larionov, UMass Amherst, 2015 – 2016  
*Human-robot Interaction: Integrating Speech Recognition with a Mobile Robot System*



## **PhD Committee Member**

- Minkyu Kim, UT Austin. Supervisor: Luis Sentis
- Abhinav Verma, UT Austin. Supervisor: Swarat Chaudhuri
- Kyle Hollins Wray, UMass Amherst. Supervisor: Shlomo Zilberstein
- Justin Svegliato, UMass Amherst. Supervisor: Shlomo Zilberstein
- Tiffany Liu, UMass Amherst. Supervisor: Roderic Grupen
- Takeshi Takahashi, UMass Amherst. Supervisor: Roderic Grupen
- Mike Lanighan, UMass Amherst. Supervisor: Roderic Grupen
- Keen Sung, UMass Amherst. Supervisor: Brian Levine
- (Thesis Opponent)<sup>1</sup>, Nils Bore, KTH. Supervisor: John Folkesson

## **Undergraduate Honors Thesis Committee Member**

- Stefan Kussmaul, UMass Amherst. Supervisor: Roderic Grupen
- Karl Schmeckpepper, UMass Amherst. Supervisor: Roderic Grupen

## **Publications**

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### **Conference Papers**

- [1] Jarrett Holtz, Simon Andrews, Arjun Guha, and Joydeep Biswas. “Iterative Program Synthesis for Adaptable Social Navigation.” In: *Intelligent Robots and Systems (IROS), IEEE/RSJ International Conference on*. 2021. URL: [https://joydeepb.com/Publications/axiv\\_idips.pdf](https://joydeepb.com/Publications/axiv_idips.pdf).
- [2] Kavan Singh Sikand, Logan Zartman, Sadeh Rabiee, and Joydeep Biswas. “Robofleet: Secure Open Source Communication and Management for Fleets of Autonomous Robots.” In: *Intelligent Robots and Systems (IROS), IEEE/RSJ International Conference on*. 2021. URL: [https://joydeepb.com/Publications/axiv\\_robofleet.pdf](https://joydeepb.com/Publications/axiv_robofleet.pdf).
- [3] Jiayi Wei, Tongrui Li, Swarat Chaudhuri, Isil Dillig, and Joydeep Biswas. “OneVision: Centralized to Distributed Controller Synthesis with Delay Compensation.” In: *Intelligent Robots and Systems (IROS), IEEE/RSJ International Conference on*. 2021. URL: [https://joydeepb.com/Publications/axiv\\_onevision.pdf](https://joydeepb.com/Publications/axiv_onevision.pdf).
- [4] Connor Basich, Justin Svegliato, Kyle Hollins Wray, Stefan Witwicki, Joydeep Biswas, and Shlomo Zilberstein. “Learning to Optimize Autonomy in Competence-Aware Systems.” In: *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*. International Foundation for Autonomous Agents and Multiagent Systems. 2020, pp. 123–131. DOI: 10.5555/3398761.3398781. URL: [https://joydeepb.com/Publications/aamas2020\\_cas.pdf](https://joydeepb.com/Publications/aamas2020_cas.pdf).

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<sup>1</sup>A PhD thesis dissertation in the Swedish doctoral system is formally presented by an external examiner, called the *thesis opponent*. A thesis opponent places the work of the PhD thesis in context with the state of the art, presents the findings of the thesis, and leads a discussion with questions.

- [5] Jarrett Holtz, Arjun Guha, and Joydeep Biswas. “Robot Action Selection Learning via Layered Dimension Informed Program Synthesis.” In: *Conference on Robot Learning (CORL)*. 2020. URL: [https://joydeepb.com/Publications/corl2020\\_ldips.pdf](https://joydeepb.com/Publications/corl2020_ldips.pdf).
- [6] Sadegh Rabiee and Joydeep Biswas. “TV-SLAM: Introspective Vision for Simultaneous Localization and Mapping.” In: *Conference on Robot Learning (CORL)*. 2020. URL: [https://joydeepb.com/Publications/corl2020\\_ivslam.pdf](https://joydeepb.com/Publications/corl2020_ivslam.pdf).
- [7] Joseph Spitzer, Joydeep Biswas, and Arjun Guha. “Making High-Performance Robots Safe and Easy to Use for an Introduction to Computing.” In: *Educational Advances in Artificial Intelligence (EAAI)*. 2020. URL: [https://joydeepb.com/Publications/eaai2020\\_jsbots.pdf](https://joydeepb.com/Publications/eaai2020_jsbots.pdf).
- [8] Joydeep Biswas. “The Quest For ”Always-On” Autonomous Mobile Robots.” In: *International Joint Conference on Artificial Intelligence (IJCAI)*. July 2019, pp. 6388–6392. DOI: 10.24963/ijcai.2019/893. URL: [https://joydeepb.com/Publications/ijcai2019\\_early\\_career\\_spotlight.pdf](https://joydeepb.com/Publications/ijcai2019_early_career_spotlight.pdf).
- [9] Sadegh Rabiee and Joydeep Biswas. “A Friction-Based Kinematic Model for Skid-Steer Wheeled Mobile Robots.” In: *IEEE International Conference on Robotics and Automation (ICRA)*. IEEE. 2019, pp. 8563–8569. DOI: 10.1109/ICRA.2019.8794216. URL: [https://joydeepb.com/Publications/icra2019\\_skid\\_steer.pdf](https://joydeepb.com/Publications/icra2019_skid_steer.pdf).
- [10] Sadegh Rabiee and Joydeep Biswas. “IVOA: Introspective Vision for Obstacle Avoidance.” In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. IEEE. 2019, pp. 1230–1235. URL: [https://joydeepb.com/Publications/iros2019\\_ivoa.pdf](https://joydeepb.com/Publications/iros2019_ivoa.pdf).
- [11] Justin Svegliato, Kyle Hollins Wray, Stefan J. Witwicki, Joydeep Biswas, and Shlomo Zilberstein. “Belief Space Metareasoning for Exception Recovery.” In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. IEEE. 2019, pp. 1224–1229. DOI: 10.1109/IROS40897.2019.8967676. URL: [https://joydeepb.com/Publications/iros2019\\_belief.pdf](https://joydeepb.com/Publications/iros2019_belief.pdf).
- [12] Kyle Vedder and Joydeep Biswas. “X\*: Anytime Multiagent Path Planning With Bounded Search.” In: *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*. 2019, pp. 2247–2249. ISBN: 9781450363099. URL: [https://joydeepb.com/Publications/aamas2019\\_xastar.pdf](https://joydeepb.com/Publications/aamas2019_xastar.pdf).
- [13] David Balaban, Alexander Fischer, and Joydeep Biswas. “A Real-Time Solver For Time-Optimal Control Of Omnidirectional Robots with Bounded Acceleration.” In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2018, pp. 8027–8032. DOI: 10.1109/IROS.2018.8594306. URL: [https://joydeepb.com/Publications/iros2018\\_tsocs.pdf](https://joydeepb.com/Publications/iros2018_tsocs.pdf).
- [14] Jarrett Holtz, Arjun Guha, and Joydeep Biswas. “Interactive Robot Transition Repair With SMT.” In: *International Joint Conference on Artificial Intelligence (IJCAI)*. 2018, pp. 4905–4911. DOI: 10.24963/ijcai.2018/681. URL: [https://joydeepb.com/Publications/ijcai2018\\_srtr.pdf](https://joydeepb.com/Publications/ijcai2018_srtr.pdf).
- [15] Samer Nashed and Joydeep Biswas. “Human-in-the-Loop SLAM.” In: *AAAI Conference on Artificial Intelligence (AAAI)*. 2018, pp. 1503–1510. URL: [https://joydeepb.com/Publications/aaai2018\\_hitl-slam.pdf](https://joydeepb.com/Publications/aaai2018_hitl-slam.pdf).
- [16] Samer Nashed, David Ilstrup, and Joydeep Biswas. “Localization under Topological Uncertainty for Lane Identification of Autonomous Vehicles.” In: *IEEE International Conference on Robotics and Automation (ICRA)*. 2018, pp. 6000–6005. URL: [https://joydeepb.com/Publications/icra2018\\_lutu.pdf](https://joydeepb.com/Publications/icra2018_lutu.pdf).
- [17] Sourish Ghosh and Joydeep Biswas. “Joint Perception And Planning For Efficient Obstacle Avoidance Using Stereo Vision.” In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. IEEE. 2017, pp. 1026–1031. URL: <https://joydeepb.com/Publications/jpp.pdf>.

- [18] Jarrett Holtz and Joydeep Biswas. “Automatic Extrinsic Calibration of Depth Sensors with Ambiguous Environments and Restricted Motion.” In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. IEEE. 2017, pp. 2235–2240. URL: [https://joydeepb.com/Publications/delta\\_calibration.pdf](https://joydeepb.com/Publications/delta_calibration.pdf).
- [19] Juan Pablo Mendoza, Joydeep Biswas, Philip Cooksey, Richard Wang, Steven Klee, Danny Zhu, and Manuela Veloso. “Selectively Reactive Coordination for a Team of Robot Soccer Champions.” In: *AAAI Conference on Artificial Intelligence (AAAI)*. 2016, pp. 3354–3360. URL: <https://joydeepb.com/Publications/aaai2016selectively.pdf>.
- [20] Samer Nashed and Joydeep Biswas. “Curating Long-Term Vector Maps.” In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. IEEE. 2016, pp. 4643–4648. DOI: 10.1109/IROS.2016.7759683. URL: [https://joydeepb.com/Publications/iros2016\\_ltvvm.pdf](https://joydeepb.com/Publications/iros2016_ltvvm.pdf).
- [21] Priyam Parashar, Robert Fisher, Reid Simmons, Manuela Veloso, and Joydeep Biswas. “Learning Context-Based Outcomes for Mobile Robots in Unstructured Indoor Environments.” In: *2015 IEEE 14th International Conference on Machine Learning and Applications (ICMLA)*. 2015, pp. 703–706. DOI: 10.1109/ICMLA.2015.222. URL: <https://joydeepb.com/Publications/icmla2015learning.pdf>.
- [22] Manuela Veloso, Joydeep Biswas, Brian Coltin, and Stephanie Rosenthal. “CoBots: Robust symbiotic autonomous mobile service robots.” In: *AAAI Conference on Artificial Intelligence (AAAI)*. AAAI Press. 2015, pp. 4423–4429. URL: [https://joydeepb.com/Publications/ijcai2015\\_cobots.pdf](https://joydeepb.com/Publications/ijcai2015_cobots.pdf).
- [23] Alfredo Weitzenfeld, Joydeep Biswas, Mehmet Akar, and Kanjanapan Sukvichai. “RoboCup Small-Size League: Past, Present and Future.” In: *RoboCup 2014: Robot World Cup XVIII*. Springer International Publishing, 2015, pp. 611–623. URL: [https://joydeepb.com/Publications/robocup2014\\_ssl.pdf](https://joydeepb.com/Publications/robocup2014_ssl.pdf).
- [24] Danny Zhu, Joydeep Biswas, and Manuela Veloso. “AutoRef: Towards Real-Robot Soccer Complete Automated Refereeing.” In: *RoboCup 2014: Robot World Cup XVIII*. Springer International Publishing, 2015, pp. 419–430. URL: [https://joydeepb.com/Publications/robocup2014\\_autoref.pdf](https://joydeepb.com/Publications/robocup2014_autoref.pdf).
- [25] Joydeep Biswas, Juan Pablo Mendoza, Danny Zhu, Benjamin Choi, Steven Klee, and Manuela Veloso. “Opponent-driven planning and execution for pass, attack, and defense in a multi-robot soccer team.” In: *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*. International Foundation for Autonomous Agents and Multiagent Systems. 2014, pp. 493–500. URL: [https://joydeepb.com/Publications/aamas2014\\_cmdragons.pdf](https://joydeepb.com/Publications/aamas2014_cmdragons.pdf).
- [26] Joydeep Biswas and Manuela Veloso. “Episodic Non-Markov localization: reasoning about short-term and long-term features.” In: *IEEE International Conference on Robotics and Automation (ICRA)*. IEEE. 2014, pp. 3969–3974. DOI: 10.1109/ICRA.2014.6907435. URL: [https://joydeepb.com/Publications/icra2014\\_enml.pdf](https://joydeepb.com/Publications/icra2014_enml.pdf).
- [27] Joydeep Biswas and Manuela Veloso. “Model-Instance Object Mapping.” In: *RoboCup 2014: Robot World Cup XVIII*. Springer International Publishing, 2014, pp. 525–536. URL: [https://joydeepb.com/Publications/robocup2014\\_object\\_maps.pdf](https://joydeepb.com/Publications/robocup2014_object_maps.pdf).
- [28] Joydeep Biswas and Manuela Veloso. “Multi-sensor mobile robot localization for diverse environments.” In: *RoboCup 2013: Robot World Cup XVII*. Springer Berlin Heidelberg, 2014, pp. 468–479. URL: [https://joydeepb.com/Publications/13robocup\\_multisensor.pdf](https://joydeepb.com/Publications/13robocup_multisensor.pdf).
- [29] Stefan Zickler, Tim Laue, José Angelo Gurzoni Jr, Oliver Birbach, Joydeep Biswas, and Manuela Veloso. “Five Years of SSL-Vision-Impact and Development.” In: *RoboCup 2013: Robot World Cup XVII*. Springer Berlin Heidelberg, 2014, pp. 656–663. URL: [https://joydeepb.com/Publications/robocup2013\\_ssl-vision.pdf](https://joydeepb.com/Publications/robocup2013_ssl-vision.pdf).

- [30] Benjamin Choi, Cetin Meriçli, Joydeep Biswas, and Manuela Veloso. “Fast human detection for indoor mobile robots using depth images.” In: *IEEE International Conference on Robotics and Automation (ICRA)*. IEEE. 2013, pp. 1108–1113. DOI: 10.1109/ICRA.2013.6630711. URL: [https://joydeepb.com/Publications/icra2013\\_human\\_detection.pdf](https://joydeepb.com/Publications/icra2013_human_detection.pdf).
- [31] Joydeep Biswas and Manuela Veloso. “Depth camera based indoor mobile robot localization and navigation.” In: *IEEE International Conference on Robotics and Automation (ICRA)*. IEEE. 2012, pp. 1697–1702. DOI: 10.1109/ICRA.2012.6224766. URL: [https://joydeepb.com/Publications/icra2012\\_kinectLocalization.pdf](https://joydeepb.com/Publications/icra2012_kinectLocalization.pdf).
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