Shivam Bajaj

Post-doctoral Research Associate, Purdue University

517-974-4826 / bajaj41@purdue.edu / https://shivambajaj08.github.io/

EDUCATION

***Ph.D.**, Electrical and Computer Engineering* AUGUST 2019 – AUGUST 2023
Michigan State University *East Lansing, MI, USA*
Advisor: Dr. Shaunak D. Bopardikar
Title: Online Pursuit Algorithms and Optimal Strategies for Heterogeneous Robots

***M.Sc.**, Electrical and Computer Engineering* AUGUST 2017 - AUGUST 2019
Michigan State University *East Lansing, MI, USA*
Advisor: Dr. Shaunak D. Bopardikar
Title: Dynamic boundary guarding against radially incoming targets

***B. Tech.**, Electrical and Electronics Engineering* AUGUST 2012 - AUGUST 2016
Indraprastha University *Delhi, India*

RESEARCH EXPERIENCE

- **Post-doctoral Researcher:** (September 2023 - present) **Purdue University**
  Advisor: Dr. Vijay Gupta

  I work on designing learning algorithms for resilient multi-agent reinforcement learning. My immediate research focuses on techniques from **controls and dynamcal systems, game-theory, and reinforcement learning**.

- **Research Assistant:** (December 2018- August 2023) **Michigan State University**
  Advisor: Dr. Shaunak D. Bopardikar

  I **designed and analyzed scalable online algorithms** with performance guarantees in the worst-case as well as average scenarios with application to pursuit of mobile agents. In this work, I also established fundamental guarantees for the problem based on the problem parameters. I also **facilitated active collaborations with** Air Force Research Laboratories (**AFRL**). In this role, I used techniques from online optimization and optimal control.

- **Research Assistant:** (August 2018 – December 2018) **Michigan State University**
  Advisor: Dr. Zhaojian Li

  I worked on synthesizing control optimization for skid steering vehicles based on model predictive control (MPC) to effectively track a given human by avoiding dynamic obstacles on the way.

WORK EXPERIENCE

Innovation Intern JUNE 2018 – AUGUST 2018
Lear Corporation *Southfield, MI, USA*

- Developed a proof of concept to increase the safety of the occupants in a vehicle during a collision.
- The proposed product was innovative, low-cost, light weight, and reusable.
- Skills like time management, leadership, problem solving, and decision making were effectively shown.

Systems Engineer AUGUST 2016 – JULY 2017

Infosys LTD. *Mysore, India*

- Responsible for creating and modifying the codes and scripts to allow data migration from one application to another in Oracle and Pl/SQL.
- Day to day responsibility included programming and writing reports on BI Publisher

---

PUBLICATIONS

JOURNAL PUBLICATIONS

Published

1. **S. Bajaj**, Pranoy Das, Yevgeniy Vorobeychik, Vijay Gupta, “Rationality of Learning Algorithms in Repeated Normal-Form Games”, IEEE Control Systems Letter (**IEEE-LCSS**), 2024, (To Appear), DOI: 10.1109/LCSYS.2024.3486631
2. **S. Bajaj,** E. Torng and S. D. Bopardikar, "Randomized Competitive Perimeter Defense on a Line," in IEEE Control Systems Letters (**IEEE-LCSS**), vol. 8, pp. 1000-1005, 2024, DOI: 10.1109/LCSYS.2024.3407634.
3. **S. Bajaj,** S. D. Bopardikar, E. Torng, A. Von Moll and D. W. Casbeer, "Multivehicle Perimeter Defense in Conical Environments," in IEEE Transactions on Robotics (**IEEE-TRO**), vol. 40, pp. 1439-1456, 2024, DOI: 10.1109/TRO.2024.3351556.
4. **S Bajaj,** S.D. Bopardikar, A. Von Moll, E. Torng and D.W. Casbeer “Competitive perimeter defense with a turret and a mobile vehicle” in **Frontiers in Control Engineering**, vol. 4, 2023 4:1128597. DOI: 10.3389/fcteg.2023.1128597. Guest edited by D. Shishika, M. Dorothy, P. Tsiotras, D. Macharet, and J. Marden.

Under Review

5. **S. Bajaj**, B. Jha, S.D. Bopardikar, A.V. Moll, D. Casbeer, “Shortest Trajectory of a Dubins Vehicle with a Controllable Laser”, in IEEE Transactions on Automatic Control (**IEEE-TAC**), 2024, (under revision), online available at: arXiv:2403.12346
6. **S. Bajaj**, E. Torng, S.D. Bopardikar, " Competitive Perimeter Defense of Linear Environments”, Theoretical Computer Science Journal (**TCS**), 2022 (under revision), online available at: http://dx.doi.org/10.2139/ssrn.4145446
7. **S. Bajaj**, Prateek Jaiswal, Vijay Gupta, “Leveraging Offline Data from Similar Systems for Online Linear Quadratic Control”,Joint submission to IEEE Control Systems Letter (**IEEE-LCSS**) and American Control Conference (**ACC**), 2024, (under review)

CONFERENCE PUBLICATIONS

1. **S. Bajaj**, S. D. Bopardikar, A.V. Moll, E. Torng, D. W. Casbeer “Perimeter Defense Using a Turret with Finite Range and Service Times,” 2023 American Control Conference (**ACC**), San Diego, CA, USA, June 2023, pp. 3350-3355.
2. **S. Bajaj**, S.D. Bopardikar "Optimal Pursuit of Surveilling Agents Near a High Value Target." In Decision and Game Theory for Security: 13th International Conference (**GameSec**), Pittsburgh, PA, USA, October 2022, Proceedings, pp. 168-187. Cham: Springer International Publishing, 2023.
3. **S. Bajaj**, E. Torng, S. D. Bopardikar, A.V. Moll, I. Weintraub, E. Garcia, and D. W. Casbeer “Competitive Perimeter Defense of Conical Environments,” 61st Conference on Decision and Control (**CDC**), Cancun, Mexico, December 2022, pp. 6586-6593
4. **S. Bajaj**, E. Torng and S. D. Bopardikar, “Competitive Perimeter Defense on a Line,” 2021 American Control Conference (**ACC**), New Orleans, LA, USA, June 2021, pp. 3196-3201.
5. **S. Bajaj**, E. Garcia and S. D. Bopardikar, “Cooperative Evasion by Translating Targets with Variable Speeds,” 2021 IEEE Conference on Control Technology and Applications (**CCTA**), San Diego, CA, USA, August 2021, pp. 374-379.

6. **S. Bajaj** and S.D. Bopardikar, “Dynamic Boundary Guarding Against Radially Incoming Targets”, 2019 IEEE 58th Conference on Decision and Control (**CDC**), Nice, France, December 2019, pp. 4804-4809.
7. A. Goel, V. Rajput, **S. Bajaj**, R. Mittal, and A. Dube. "Solar hybrid electric vehicle—A green vehicle for future impulse." In *2016 3rd International Conference on Computing for Sustainable Global Development (***INDIACom***)*, pp. 2794-2800. IEEE, 2016.

PRESENTATIONS AND WORKSHOPS

1. Presented a poster titled, “Rationality of Learning Algorithms in Normal-Form Games” at the 2024 CERIAS Annual Security Symposium Agenda at Purdue University, April 2024
2. Presented a poster titled, “Rationality of Learning Algorithms in Normal-Form Games” at the 10th Midwest Workshop on Control and Game Theory, April 2023
3. Presented a poster titled, “Competitive Perimeter Defense of Conical Environments “at the 9th Midwest Workshop on Control and Game Theory, April 2022

AWARDS AND ACHIEVEMENTS

1. Best poster award (Mobility) in Engineering Graduate Symposium, College of Engineering, Michigan State University, 2022.
2. Certificate in Mentoring, Leadership, and Teamwork, Graduate School, Michigan State University, 2022
3. Graduate from the Leadership Academy at Michigan State University, 2020
4. First prize in LEAR Open Innovation Challenge, 2018.

OUTREACH

1. **Journal Reviewer**: IEEE Transactions on Automatic Control (**IEEE-TAC**), **Automatica** , IEEE Control Systems Letters (**IEEE-LCSS**), IEEE Robotics and Automation Letters (**IEEE RA-L**),.
2. **Conference Reviewer**: IEEE Conference on Decision and Control (**CDC**), American Control Conference (**ACC**), IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**), IEEE Conference on Control Technology and Applications (**CCTA**), IEEE International Conference on Automation Science and Engineering (**CASE**), International Conference on Robotics and Automation (**ICRA**).

VOLUNTEERING ACTIVITIES

1. Student Member of ECE Graduate Studies Committee, 2022
2. Served as a poster evaluator for 2023 University Undergraduate Research and Arts Forum
3. Presenter at MSU Science Festival, 2022
4. Presenter at MSU Science Festival, 2021

MENTORING EXPERIENCE

Master’s Students

1. Ulugbek Abdullaev at Purdue University — October 2024-Present

Under-graduate Students

1. Fellipe Ramirez Franco at Purdue University — Fall 2024-Present
2. Krishna Das Artis-Mickens at Michigan State University — Summer 2023
3. Jayden Devaull at Michigan State University — Summer 2022