Shivam Bajaj

Postdoctoral Research Associate, Purdue University

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

RESEARCH INTERESTS

Topics: Control Systems, Game Theory, Reinforcement Learning, Theoretical Computer Science

Overview: I am broadly interested in developing principled frameworks for *large-scale systems*, i.e., systems that are of high degree of freedom or systems consisting of many decision makers, which are *robust* to real-world disturbances and adversarial attacks. On the theoretical front, my frameworks provide modeling, design, and analysis tools. On the practical front, my frameworks enable large-scale systems to operate capably and safely. While I enjoy establishing theoretical properties of my frameworks, I also strongly believe in demonstrating their validity on real hardware platforms.

ACADEMIC APPOINTMENTS

Postdoctoral Associate, Purdue University, West Lafayette   September 2023 - Present

Advisor: Dr. Vijay Gupta

School of Electrical and Computer Engineering

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*

PUBLICATIONS

JOURNAL PUBLICATIONS

1. **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**), 2025, (To Appear), online available at: arXiv:2403.12346

2. **S. Bajaj**, E. Torng, S.D. Bopardikar, " Competitive Perimeter Defense of Linear Environments", Theoretical Computer Science Journal (**TCS**), 2025 (To Appear), online available at: http://dx.doi.org/10.2139/ssrn.4145446

3. **S. Bajaj**, Pranoy Das, Yevgeniy Vorobeychik, Vijay Gupta, "Rationality of Learning Algorithms in Repeated Normal-Form Games", IEEE Control Systems Letter (**IEEE-LCSS**), 2024

4. **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

5. **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

6. **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. Guest edited by J. Marden, P. Tsiotras, D. Shishika, M. Dorothy, and D. Macharet.

7. **S. Bajaj**, Prateek Jaiswal, Vijay Gupta, "Leveraging Offline Data from Similar Systems for Online Linear Quadratic Control", in IEEE Transactions on Automatic Control (**IEEE-TAC**), 2025, (under review)

8. **S. Bajaj**, Carolyn L. Beck, Vijay Gupta, "Model Order Reduction via (γ, δ)-similarity", in IEEE Transactions on Automatic Control (**IEEE-TAC**), 2025, (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 at the 2025 CERIAS Annual CyberSecurity Symposium at Purdue University, April 2025
2. Presented a poster at the 2024 CERIAS Annual Security Symposium at Purdue University, April 2024
3. Presented a poster at the 10th Midwest Workshop on Control and Game Theory, April 2023
4. Presented a poster 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

<u>PhD Students</u>

1. Ujin Jeon at Purdue University   Spring 2025-Present

<u>Master's Students</u>

1. Ulugbek Abdullaev at Purdue University   October 2024-Present

<u>Under-graduate Students</u>

1. Fellipe Ramirez Franco at Purdue University   Fall 2024-Spring 2025
2. Krishna Das Artis-Mickens at Michigan State University   Summer 2023
3. Jayden Devaull at Michigan State University   Summer 2022