Shivam Bajaj

Postdoctoral Research Associate, Purdue University

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RESEARCH INTERESTS

Topics: Multi-Agent Reinforcement Learning, Control Systems, Theoretical Computer Science

Research Overview: I am interested in developing principled frameworks for ***complex 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 such as robotic systems.

ACADEMIC APPOINTMENTS

Postdoctoral Research Associate, September 2023 – Present
Purdue University, West Lafayette, IN Advisor: Dr. Vijay Gupta

EDUCATION

***Ph.D.**, Electrical and Computer Engineering* August 2019 – August 2023
Michigan State University, East Lansing Advisor: Dr. Shaunak D. Bopardikar

***M.Sc.**, Electrical and Computer Engineering* August 2017 – August 2019
Michigan State University, East Lansing Advisor: Dr. Shaunak D. Bopardikar

***B. Tech.**, Electrical and Electronics Engineering* August 2012 – August 2016
Indraprastha University, Delhi, India

PUBLICATIONS

JOURNAL PUBLICATIONS

J1. **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, 2025, (To Appear).

J2. **S. Bajaj**, Carolyn L. Beck, Vijay Gupta, “Online Model Order Reduction via (γ, δ)-similarity”, in IEEE Transactions on Automatic Control, 2025, (under review)

J3. **S. Bajaj**, Prateek Jaiswal, Vijay Gupta, “Leveraging Offline Data from Similar Systems for Online Linear Quadratic Control”, in IEEE Transactions on Automatic Control, 2025, (under review)

J4. **S. Bajaj**, E. Torng, S.D. Bopardikar, " Competitive Perimeter Defense of Linear Environments”, Theoretical Computer Science Journal, 2025, pp. 115262

J5. **S. Bajaj**, Pranoy Das, Yevgeniy Vorobeychik, Vijay Gupta, “Rationality of Learning Algorithms in Repeated Normal-Form Games”, IEEE Control Systems Letter, 2024

J6. **S. Bajaj,** E. Torng and S. D. Bopardikar, "Randomized Competitive Perimeter Defense on a Line," in IEEE Control Systems Letters, vol. 8, pp. 1000-1005, 2024

J7. **S. Bajaj,** S. D. Bopardikar, E. Torng, A. Von Moll, D. W. Casbeer, "Multivehicle Perimeter Defense in Conical Environments," in IEEE Transactions on Robotics, vol. 40, pp. 1439-1456, 2024

J8. **S Bajaj,** S.D. Bopardikar, A. Von Moll, E. Torng, 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, D. Macharet.

CONFERENCE PUBLICATIONS

C1. **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, San Diego, CA, USA, June 2023, pp. 3350-3355.

C2. **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.

C3. **S. Bajaj**, E. Torng, S. D. Bopardikar, A.V. Moll, I. Weintraub, E. Garcia, D. W. Casbeer "Competitive Perimeter Defense of Conical Environments," IEEE 61st Conference on Decision and Control, Cancun, Mexico, December 2022, pp. 6586-6593

C4. **S. Bajaj**, E. Torng, S. D. Bopardikar, "Competitive Perimeter Defense on a Line," 2021 American Control Conference, New Orleans, LA, USA, June 2021, pp. 3196-3201.

C5. **S. Bajaj**, E. Garcia, S. D. Bopardikar, "Cooperative Evasion by Translating Targets with Variable Speeds," 2021 IEEE Conference on Control Technology and Applications, San Diego, CA, USA, August 2021, pp. 374-379.

C6. **S. Bajaj,** S.D. Bopardikar, "Dynamic Boundary Guarding Against Radially Incoming Targets", 2019 IEEE 58th Conference on Decision and Control, Nice, France, December 2019, pp. 4804-4809.

C7. A. Goel, V. Rajput, **S. Bajaj**, R. Mittal, A. Dube. "Solar hybrid electric vehicle—A green vehicle for future impulse." In 3rd International Conference on Computing for Sustainable Global Development, pp. 2794-2800. IEEE, 2016.

PRESENTATIONS AND WORKSHOPS

1.	**Talk**, University of Maryland at College Park	June 2025
2.	**Poster**, Annual Security Symposium, Purdue University at West Lafayette	April 2025
3.	**Poster**, Annual Security Symposium, Purdue University at West Lafayette	April 2024
4.	**Poster**, Midwest Workshop on Control and Game Theory	April 2025
5.	**Poster**, Midwest Workshop on Control and Game Theory	April 2024
6.	**Poster**, Midwest Workshop on Control and Game Theory	April 2023
7.	**Oral Presentation**, American Control Conference	June 2023
8.	**Oral Presentation**, Decision and Game Theory for Security	October 2022
9.	**Oral Presentation**, IEEE Conference on Decision and Control	December 2022
10.	**Oral Presentation**, American Control Conference	June 2021
11.	**Oral Presentation,** IEEE Conference on Control Technology and Applications	August 2021
12.	**Oral Presentation,** IEEE Conference on Decision and Control	December 2019

AWARDS AND ACHIEVEMENTS

1. **Invited Workshop**: "New England Future Faculty Workshop" — August 2025
   Northeastern University, Boston, MA
2. **Best poster** award — May 2022
   Michigan State University, East Lansing, MI

3. **Certificate** in Mentoring, Leadership, and Teamwork — June 2022
   Graduate School, Michigan State University, East Lansing, MI
4. **Graduate** from the Leadership Academy — May 2020
   Michigan State University, East Lansing, MI
5. **First prize** in LEAR Open Innovation Challenge — March 2018
   LEAR Corporation, Detroit, MI

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), Open Journal of Control Systems (OJCSYS)

2. **Conference Reviewer**: IEEE Conference on Decision and Control (CDC), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), American Control Conference (ACC), 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. Poster Judge, Office of Interdisciplinary Graduate Programs — May 2025
   Purdue University, West Lafayette, IN
2. Poster Judge, University Undergraduate Research and Arts Forum — April 2023
   Michigan State University, East Lansing, MI
3. Student Member, ECE Graduate Studies Committee — Fall 2022-Fall 2023
   Michigan State University, East Lansing, MI
4. Presenter, Science Festival — April 2022
   Michigan State University, East Lansing, MI
5. Presenter, Science Festival — April 2021
   Michigan State University, East Lansing, MI

MENTORING EXPERIENCE

<u>PhD Students</u>

1. Ujin Jeon, Purdue University — January 2025-Present
2. Pranoy Das, Purdue University — October 2023 - March 2024

<u>Master's Students</u>

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

<u>Under-graduate Students</u>

1. Soham Samir Seksaria, Purdue University — May 2025-Present
2. Fellipe Ramirez Franco, Purdue University — August 2024 - June 2025
3. Krishna Das Artis-Mickens, Michigan State University — May 2023 - August 2023
4. Jayden Devaull, Michigan State University — May 2022 - August 2022