

# KSHITIJ JERATH

Assistant Professor, Mechanical and Industrial Engineering  
University of Massachusetts Lowell

## EDUCATION

**Ph.D., Mechanical Engineering, The Pennsylvania State University** 2014

Location: University Park, PA

Advisors: Dr. Sean Brennan and Dr. Asok Ray

Thesis title: Influential subspaces in self-organizing multi-agent systems

**M.S., Electrical Engineering, The Pennsylvania State University** 2014

Location: University Park, PA

Advisors: Dr. Constantino Lagoa

Paper title: Sensor noise modeling, characterization, and simulation

**M.S., Mechanical Engineering, The Pennsylvania State University** 2010

Location: University Park, PA

Advisor: Dr. Sean Brennan

Thesis title: Impact of adaptive cruise control on the formation of self-organized traffic jams on highways

**B.Tech., Mechanical and Automation Engineering, Amity School of Engineering and Technology** 2006

Location: New Delhi, India

Advisors: Dr. S B L Garg and Dr. Keshavendra Chaudhary

Thesis title: Unmanned aerial vehicle for terrain monitoring

## WORK EXPERIENCE

**Assistant Professor at University of Massachusetts, Lowell** 2018 – Present

- Conducted research on traffic flow and connected autonomous vehicles, swarm robotics, UAVs, multi-scale stream learning, and human-robot teams
- Taught graduate and undergraduate courses on robotics (MECH.5300), system dynamics and control (MECH.4510), control of automated systems (MECH.3230), and networked multi-agent systems (MECH.5550)
- Faculty coordinator for Robotics minor

**Assistant Professor at Washington State University** 2015 – 2018

- Conducted research on complex systems, connected autonomous vehicles, UAVs, and virtual reality interfaces for controlling robotic swarms
- Taught undergraduate courses on system dynamics (ME 348), mechatronics (ME 401), control systems (ME 481) and Fundamentals of Engineering Exam review course (ME 466)
- Faculty advisor for WSU Aerospace club

**Post-doctoral scholar at The Pennsylvania State University** 2014 – 2015

- Incorporated sensor systems into vehicle conceptual design and mission analysis for unmanned aerial systems as a post-doctoral scholar in the Department of Aerospace Engineering

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Instructor (Graduate Teaching Fellow) at The Pennsylvania State University	2013 – 2015
<ul style="list-style-type: none"> <li>• Primary instructor for senior-level course on Aerospace Control Systems (AERSP 460) and junior-level course on Vibration of Mechanical Systems (ME 370) in Fall 2013</li> <li>• Held classes and office hours, assigned homework, conducted exams and assessed student performance</li> </ul>	
Graduate Teaching Assistant at The Pennsylvania State University	2011 – 2013
<ul style="list-style-type: none"> <li>• Held recitation classes, and graded exams and homework assignments for: <ul style="list-style-type: none"> <li>– Graduate-level course on Digital Signal Processing (ACS 513)</li> <li>– Senior-level course on Modeling of Dynamic Systems (ME 450)</li> <li>– Junior-level course on Vibration of Mechanical Systems (ME 370)</li> </ul> </li> </ul>	
Graduate Research Assistant at The Pennsylvania State University	2007 – 2011
<ul style="list-style-type: none"> <li>• Developed theory and performed simulations to study effect of intelligent vehicles on traffic flow</li> <li>• Implemented and experimentally validated real-time vehicle tracking algorithm with low-cost sensors</li> <li>• Performed data analysis and generated failure models for transit buses and its components</li> <li>• Published papers at conferences and in peer-reviewed journals</li> </ul>	
Research Associate in Intellectual Property Group at Evalueserve	2006 – 2007
<ul style="list-style-type: none"> <li>• Drafted patents for inventions in the fields of navigation/mechanical devices, and web utilities</li> <li>• Performed invalidation searches for utility and design patents</li> <li>• Analyzed patent landscape of aircraft health monitoring systems for leading aircraft manufacturer</li> </ul>	

## GRANTS AND CONTRACTS

Total award amount raised @ UML: As PI or co-PI: **\$5.80 million**

Total award amount raised @ UML: As PI: **\$2.45 million**

Total award amount raised across all institutions and teams: **\$7.90 million**

<b>Office of Naval Research: Long-Term Underwater Autonomy for Surveillance and Manipulation</b>	<b>\$1.66 million</b>	<b>2023 – 2025</b>
<ul style="list-style-type: none"> <li>• PI: Holly Yanco; <b>co-PIs</b>: Reza Ahmadzadeh, <b>Kshitij Jerath</b>, Maru Cabrera, Adam Norton, and Paul Robinette</li> <li>• Develop new capabilities for long-term autonomy and supervisory control of underwater robots operating in highly complex environments that include poor or irregular communication, coordinating multiple agents performing surveillance, inspection, and maintenance tasks, and interacting with humans in multiple roles.</li> </ul>		
<b>Army Research Lab: Trust-NEARCHAT: Trust Network Emergence Amongst Resource-Constrained Human-Agent Teams</b>	<b>\$1.5 million</b>	<b>2021 – 2024</b>
<ul style="list-style-type: none"> <li>• <b>PI: Kshitij Jerath</b>; co-PIs: Paul Robinette, Reza Ahmadzadeh</li> <li>• Awarded through Army Research Lab's STRONG (Strengthening Teamwork for Robust Operations in Novel Groups) program</li> <li>• Examine impact of resource constraints applied to individual learning agents on the macroscopic level emergence of trust networks in teams</li> </ul>		
<b>Army Research Lab: CHATS: Computational HAT model of status sensitivity to facilitate team trust and performance under suboptimal conditions</b>	<b>\$1.5 million*</b> UML: \$177,665	<b>2021 – 2024</b>

- **PI: Kshitij Jerath;** co-PIs: Paul Robinette, Reza Ahmadzadeh
- \*Total award amount: \$1.5 million. Sub-award through University of Delaware
- Create and implement robots to assist human teammates in an escape room scenario.

<b>Army Research Lab: Individualized Adaptations to Calibrate Multi-Human Multi-Agent Team Trust</b>	\$99,507	2021 – 2022
<ul style="list-style-type: none"> <li>• PI: Paul Robinette; <b>co-PIs: Kshitij Jerath</b>, Reza Ahmadzadeh, Thanuka Wickramaratne</li> <li>• Enabling intelligent agents to reason about trust decisions made by human teammates and apply an appropriate future policy of actions to symbiotically improve overall team processes.</li> </ul>		
<b>NSF: MRI: Development of a Calibration System for Stereophotogrammetry to Enable Large-Scale Measurement and Monitoring</b>	\$455,096	2020 – 2023
<ul style="list-style-type: none"> <li>• PI: Alessandro Sabato; <b>co-PIs: Christopher Niezrecki, Kshitij Jerath</b>, and Yan Luo</li> <li>• Awarded through Major Research Instrumentation (MRI) program at NSF to develop multi-sensor system for real-time calibration of stereophotogrammetry and remotely paired digital cameras</li> </ul>		
<b>Army Research Lab: Emergence of Trust Clusters in Human-Agent Teams Operating under Resource Constraints</b>	\$99,861	2020 – 2021
<ul style="list-style-type: none"> <li>• <b>PI: Kshitij Jerath;</b> co-PIs: Paul Robinette, Reza Ahmadzadeh</li> <li>• Awarded through Army Research Lab’s STRONG (Strengthening Teamwork for Robust Operations in Novel Groups) program</li> <li>• Assess subsequent impacts on team performance and cohesion in soldier-robot teams conducting search and rescue operations</li> </ul>		
<b>DEVCOM Soldier Center: DECISIVE: Development and Execution of Comprehensive and Integrated Subterranean Intelligent Vehicle Evaluations</b>	\$1.1 million	2020 – 2021
<ul style="list-style-type: none"> <li>• PI: Holly Yanco; <b>co-PIs: Reza Ahmadzadeh, Kshitij Jerath</b>, Adam Norton, Paul Robinette, Jay Weitzen, Thanuka Wickramaratne</li> <li>• Design and evaluation of test methods for obstacle avoidance and navigation algorithms for small Unmanned Aerial Systems</li> </ul>		
<b>NSF: CPS: Medium: Collaborative Research: Automated Discovery of Data Validity for Safety-Critical Feedback Control in a Population of Connected Vehicles</b>	\$1.2 million* UML: \$501,150	2019 – 2023
<ul style="list-style-type: none"> <li>• <b>PI: Kshitij Jerath;</b> co-PI: Cindy Chen</li> <li>• *Total award amount: \$1.2 million. Awarded through cross-disciplinary Cyber Physical Systems (CPS) program at National Science Foundation (NSF).</li> <li>• Identify spatiotemporal scales over which information remains relevant in the context of friction measurements using connected vehicles on freeways</li> </ul>		
<b>NSF: Scale-dependent observability of emergent dynamics: Application to Traffic Flow with Connected Vehicles</b>	\$259,749	2017 – 2022
<ul style="list-style-type: none"> <li>• <b>PI: Kshitij Jerath</b></li> <li>• Awarded through CMMI Dynamics, Control and System Diagnostics (DCSD) program at NSF</li> <li>• Assess optimal scale to observe and predict complex traffic flow dynamics using connected vehicles</li> </ul>		

## RESEARCH AND ENGINEERING EXPERIENCE

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<b>Identifying influential subspaces of agents in self-organizing multi-agent systems</b>	<b>2013 – Present</b>
<ul style="list-style-type: none"> <li>• Developed framework for evaluating agent influence in networked multi-agent systems</li> <li>• Identified influential subspaces on highways where connected vehicles can impact self-organized jams</li> <li>• Performed observability analysis for reduced order models of complex nonlinear traffic dynamics</li> </ul>	
<b>Emergence of trust networks in multi-human, multi-agent teams</b>	<b>2019 – Present</b>
<ul style="list-style-type: none"> <li>• Implemented multi-agent reinforcement learning (MARL) in simulated robot navigation tasks</li> </ul>	
<b>Modeling and control of robotic swarms</b>	<b>2015 – Present</b>
<ul style="list-style-type: none"> <li>• Generated multi-scale models and state estimators for robotic swarms</li> <li>• Created efficient controllers and exploration-coverage algorithms for robotic swarms</li> <li>• Developed human gesture-based virtual reality control of robotic swarms using Unreal game engine</li> </ul>	
<b>Sensor-driven conceptual design for small unmanned aerial system (UAS)</b>	<b>2014 – 2018</b>
<ul style="list-style-type: none"> <li>• Developed simulation framework for photorealistic simulations of UAS waypoint navigation missions</li> <li>• Performed Monte Carlo simulations of navigation missions with on-board lidars and cameras</li> </ul>	
<b>Studying the effects of intelligent and connected vehicles on traffic flow dynamics</b>	<b>2008 – Present</b>
<ul style="list-style-type: none"> <li>• Generated and analyzed stochastic models of traffic jam dynamics</li> <li>• Analyzed the effect of variations in parametric driver models on the formation of traffic jams</li> <li>• Performed microscopic simulations of traffic flow using statistical mechanics-inspired models</li> </ul>	
<b>Human detection in complex construction environments</b>	<b>2012</b>
<ul style="list-style-type: none"> <li>• Conducted proof-of-concept study for major construction equipment manufacturer to detect humans at construction sites using LIDAR</li> </ul>	
<b>GPS-free terrain-based vehicle tracking</b>	<b>2009 – 2011</b>
<ul style="list-style-type: none"> <li>• Developed noise models for simulating low-cost sensors</li> <li>• Implemented real-time vehicle tracking with simulated low-cost sensors using Sigma Point Kalman filters in absence of GPS</li> <li>• Implemented vehicle tracking on large road networks using multiple model estimation schemes</li> </ul>	
<b>Reliability analysis of in-service transit buses</b>	<b>2007 – 2009</b>
<ul style="list-style-type: none"> <li>• Analyzed failure rate data from transit buses and Larson Transportation Institute bus testing program using regression and Hidden Markov models</li> <li>• Generated performance comparison scheme for bus models and agencies</li> </ul>	
<b>Design of unmanned aerial vehicle</b>	<b>2006</b>
<ul style="list-style-type: none"> <li>• Designed, built and flew an R/C Unmanned Aerial Vehicle (UAV)</li> <li>• Initiated project idea, formed and managed a group of 10 persons for 5 months</li> <li>• Performed feasibility studies for various design specifications</li> </ul>	
<b>Testing of Hydraulic Control Unit on Airbus A320</b>	<b>2005</b>
<ul style="list-style-type: none"> <li>• Observed assembly, disassembly and maintenance procedures for jet engines (IAE V2500 and Pratt and Whitney JT8D) at the Jet Engine Overhaul Complex (JEOC), New Delhi, India</li> <li>• Helped develop in-house testing setup for the Hydraulic Control Unit (HCU) of the Nose wheel steering system on the Airbus A320 at the Aircraft Accessory Overhaul Shop, Indian Airlines Ltd., New Delhi, India</li> </ul>	
<b>Anti-Lock Braking System (ABS)</b>	<b>2004</b>

- Designed and built an anti-lock braking system for hydraulic brakes of a compact car using 3-way solenoid valve and induction proximity sensor

## PUBLICATIONS

<sup>^</sup>IEEE Trans. on Intelligent Transportation Systems is the top-ranked journal in the field of transportation as per Google Scholar Metrics. It has an Impact Factor of 9.551

<sup>^</sup>Measurement Impact Factor: 5.131

<sup>^</sup>IEEE Sensors Impact Factor: 4.325

Springer Nature Computer Science Impact Factor: 3.78

<sup>^</sup>IEEE Control System Letters Impact Factor: 2.332

<sup>^</sup>IFAC-PapersOnLine Impact Factor: 1.132

### Journal Publications

1. K. Jerath, V. V. Gayah, and S. Brennan; *Mitigating Delay due to Capacity Drop near Freeway Bottlenecks: Zones of Influence of Connected Vehicles*, PLOS ONE, vol. 19, no. 6, 2024
2. L. Gao, J. Mitrovich, C. Beal, W. Bai, S. P. Maddipatla, C. Chen, K. Jerath, H. Haeri, L. Sinanaj, S. Brennan, *Boxes-based Representation and Data Sharing of Road Surface Friction for CAVs*, Data Science for Transportation, vol. 5, no. 9, 2023
3. F. Botalico, C. Niezrecki, K. Jerath, Y. Luo, and A. Sabato; *Sensor-Based Calibration of Camera's Extrinsic Parameters for Stereophotogrammetry*, IEEE Sensors, vol. 23, no. 7, pp. 7776-7785, 2023
4. L. Sinanaj, H. Haeri, S. S. P. Maddipatla, L. Gao, R. Pakala, N. Kathiriya, C. Beal, S. Brennan C. Chen, K. Jerath; *Granulation of Large Temporal Databases: An Allan Variance Approach*, Springer Nature Computer Science, vol. 4, no. 1, pp. 7, 2023
5. S. S. P. Maddipatla, H. Haeri, K. Jerath, S. Brennan; *Fast Allan Variance (FAVAR) and Dynamic Fast Allan Variance (D-FAVAR) Algorithms for both Regularly and Irregularly Sampled Data*, IFAC-PapersOnLine, vol. 54, no. 20, pp. 26-31, 2021
6. T. Kim, and K. Jerath; *Congestion-aware Cooperative Adaptive Cruise Control and Mitigation of Self-Organized Traffic Jams*, IEEE Transactions on Intelligent Transportation Systems, 2021.
7. H. Haeri, C. Beal, and K. Jerath, *Near-optimal Moving Average Estimation at Characteristic Timescales: An Allan Variance Approach*, IEEE Control Systems Letters, vol. 5, no. 5, pp. 1531-1536, 2020
8. H. Haeri, K. Jerath, and J. Leachman, *Thermodynamics-inspired Macroscopic States of Bounded Swarms*, ASME Letters in Dynamic Systems and Control, vol. 1, pp 011-015, 2020
9. K. Jerath, S. Brennan, and C. Lagoa, *Bridging the gap between sensor noise modeling and sensor characterization*, Measurement, vol. 116, pp 350-366, 2018
10. K. Jerath, A. Ray, S. Brennan, and V. V. Gayah, *Dynamic prediction of vehicle cluster distribution: A statistical mechanics-inspired approach*, IEEE Transactions on Intelligent Transportation Systems, vol. 16, no. 5, 2015
11. K. Jerath and S. Brennan; *Analytical Prediction of Self-Organized Traffic Jams as a Function of Increasing ACC Penetration*, IEEE Transactions on Intelligent Transportation Systems, vol. 13, no. 4, 2012
12. J. Yutko, K. Jerath, and S. Brennan; *A Failure Rate Analysis of Complex Vehicles*, International Journal of Heavy Vehicles and Systems, vol. 17, no. 1, 2010

### Journal Manuscripts (under review)

13. Z. Yang and K. Jerath; *Renormalization Group-theoretic Approach to Multi-scale Modeling of Traffic Flow*, under review, Journal of Computational Science
14. F. Botalico, N. A. Valente, C. Niezrecki, K. Jerath, Y. Luo, A. Sabato; *Validation of Sensor-Based Calibration for Expedited and Scale-Insensitive Stereophotogrammetry*, under review, Measurement

### Journal Manuscripts (in preparation)

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15. Z. Yang and K. Jerath; *Information-based Observability on Traffic Flow*, for submission to Journal of Computational Science
16. E. Meriaux and K. Jerath; *Evaluation of Collision Tolerance, and Trajectory-following Capabilities of Small Unmanned Aerial System*, Submission to Drones
17. H. Haeri, N. Kathiriya, and K. Jerath; *Stream Learning under Continual Concept Drift via Multi-Scale Model Stability Analysis*, for submission to IEEE Transactions on Knowledge and Data Engineering

### Full-length Conference Publications

18. A. Kolli, P. Robinette, S. Ahmadzadeh, and K. Jerath; *Learning graph topology in multi-agent systems: A graph-attention approach*, accepted Modeling, Estimation, and Control Conference, 2024
19. Z. Yang and K. Jerath; *Energy-guided Data Sampling for Traffic Prediction with Small Training Datasets*, accepted Modeling, Estimation, and Control Conference (MECC), 2024
20. M. R. Kotturu, S. V. Movahed, K. Jerath, P. Robinette, R. Ahmadzadeh; *Relational Weight Optimization for Enhancing Team Performance in Multi-Agent Multi-Armed Bandits*, accepted Modeling, Estimation, and Control Conference (MECC), 2024
21. Yasin Findik, Paul Robinette, Kshitij Jerath, S. Reza Ahmadzadeh, *Relational Q-Functionals: Multi-Agent Learning to Recover from Unforeseen Robot Malfunctions in Continuous Action Domains*, 21st International Conference on Ubiquitous Robots (UR), New York, USA, June 24-27, 2024
22. N. Kathiriya, H. Haeri, C. Chen, and K. Jerath; *Iterative Forgetting: Online Datastream Regression using Adaptive Granulation*, accepted, Databases and Machine Learning workshop at IEEE Conference on Data Engineering (ICDE) 2024
23. S.P. Maddipatla, R. Pakala, H. Haeri, C. Chen, K. Jerath, and S. Brennan; *Using Databases to Implement Algorithms: Estimation of Allan Variance Using B+-tree Data Structure*, 2024 American Control Conference, Toronto, Canada, Jul 8-12, 2024
24. Y. Findik, H. Osooli, P. Robinette, K. Jerath and R. Ahmadzadeh; *Influence of Team Interactions on Multi-Robot Cooperation: A Relational Network Perspective*, Multi-robot Systems Symposium, Boston, MA, USA, Dec 2023
25. Y. Findik, P. Robinette, K. Jerath, and S. Reza Ahmadzadeh, *Impact of Relational Networks in Multi-Agent Learning: A Value-Based Factorization View*, IEEE Conference on Decision and Control, Singapore, Dec 2023
26. H. Haeri, N. Kathiriya, C. Chen, K. Jerath, *Adaptive Granulation: Data Reduction at the Database Level*, 15<sup>th</sup> International Conference on Knowledge Management and Information Systems, Rome, Italy, 13-15 November, 2023 (**Acceptance rate: 15%**)
27. Y. Findik, P. Robinette, K. Jerath, and S. Reza Ahmadzadeh, *Collaborative Adaptation: Learning to Recover from Unforeseen Malfunctions in Multi-Robot Teams*, MADGames workshop at IEEE Intelligent Robots and Systems (IROS), Detroit, MI, USA, Oct 1-5, 2023
28. H. Osooli, P. Robinette, K. Jerath, S. R. Ahmadzadeh, *A Multi-Robot Task Assignment Framework for Search and Rescue with Heterogeneous Teams*, IROS 2023 Advances in Multi-Agent Learning - Coordination, Perception, and Control Workshop, in 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Detroit, MI, USA, Oct 1-5, 2023.
29. R. Pakala, N. Kathiriya, H. Haeri, S.P. Maddipatla, K. Jerath, C. Beal, S. Brennan, and C. Chen; *Distributed Edge computing system setup for vehicle communication*, DATA 2023: 12<sup>th</sup> International Conference on Data Science, Technology and Applications, Rome, Italy, July 11-13, 2023
30. F. Bottalico, C. Niezrecki, K. Jerath, Y. Luo, and A. Sabato; *Experimental Quantification of Sensor-Based Stereocameras' Extrinsic Parameters Calibration*. In Society for Experimental Mechanics Annual Conference and Exposition, June 2023 (pp. 49-55). Springer Nature Switzerland.

31. F. Bottalico, N. A. Valente, C. Niezrecki, K. Jerath, Y. Luo, and A. Sabato; *Sensor-aided camera calibration for three-dimensional digital image correlation measurements*. In Health Monitoring of Structural and Biological Systems XVII (Vol. 12488, pp. 233-242). SPIE, Long Beach, CA, USA, Apr 24-28, 2023
32. F. Mazzone and K. Jerath; *Understanding Agent Competency: Effects of Environment Complexity on Area Coverage Time*, Intelligent Agents (IA) at IEEE Symposium Series on Computational Intelligence 2022, Singapore, Dec 4-7, 2022
33. E. Meriaux and K. Jerath; *Evaluation of Navigation and Trajectory-following Capabilities of Small Unmanned Aerial Systems*, IEEE Symposium on Technologies for Homeland Security 2022, virtual
34. F. Bottalico, N. A. Valente, S. Dabetwar, K. Jerath, Y. Luo, C. Niezrecki, and A. Sabato; *A sensor-based calibration system for three-dimensional digital image correlation*, Proc. SPIE 12048, Health Monitoring of Structural and Biological Systems XVI, 120480Z, 19 April 2022, <https://doi.org/10.1117/12.2612106>
35. H. Haeri, B. Soleimani, and K. Jerath; *Optimal Moving Average Estimation of Noisy Random Walks using Allan Variance-informed Window Length*, Proceedings of the American Control Conference 2022, July 2022, Atlanta, GA
36. L. Gao, C. Beal, W. Bai, S. P. Maddipatla, C. Chen, K. Jerath, H. Haeri, L. Sinanaj, and S. Brennan; *Boxes-based Representation and Data Sharing of Road Surface Friction for CAVs*, 2021 Road Safety and Simulation International Conference (RSS), 08-10 June 2022, Athens, Greece.
37. S. S. P. Maddipatla, H. Haeri, K. Jerath, S. Brennan; *Fast Allan Variance (FAVAR) and Dynamic Fast Allan Variance (D-FAVAR) Algorithms for both Regularly and Irregularly Sampled Data*, presented at the Modeling, Estimation, and Control Conference (MECC) 2021, Austin, TX, USA (**Best paper award**)
38. Sinanaj, H. Haeri, L. Gao, S. S. P. Maddipatla, C. Chen, K. Jerath, C. Beal, S. Brennan; *Allan Variance-based Granulation Technique for Large Temporal Databases*, 13<sup>th</sup> International Conference on Knowledge Management and Information Systems, 25-27 Oct 2021 (virtual) (**Acceptance rate: 16%; Best student paper award**)
39. H. Haeri, R. Ahmadzadeh, and K. Jerath; *Reward-Sharing Relational Networks in Multi-Agent Reinforcement Learning as a Framework for Emergent Behavior*, Adaptive and Learning Agents Workshop 2021, London (virtual)
40. L. Gao, S. Maddipatla, C. Beal, K. Jerath, C. Chen, L. Sinanaj, H. Haeri, and S. Brennan; *A Micro-simulation Framework for Studying CAVs Behavior and Control Utilizing a Traffic Simulator, Chassis Simulation, and a Shared Roadway Friction Database*, American Control Conference, New Orleans, LA, USA, 2021
41. Z. Yang, H. Haeri, and K. Jerath, *Renormalization Group Approach to Cellular Automata-based Multi-scale Modeling of Traffic Flow*, Unifying Themes in Complex Systems X: Proceedings of the Tenth International Conference on Complex Systems (Springer Proceedings in Complexity), Nashua, NH, 2020
42. Z. Yang and K. Jerath, *Observability Variation in Emergent Dynamics: A Study using Krylov Subspace-based Model Order Reduction*, American Control Conference 2020, Denver, CO, USA
43. Z. Yang and K. Jerath, *Examining the Observability of Emergent Behavior as a Function of Reduced Model Order*, American Control Conference 2018, Milwaukee, WI, USA
44. M. Scott and K. Jerath, *Multi-robot Exploration and Coverage: Entropy-based Adaptive Maps with Adjacency Control Laws*, American Control Conference 2018, Milwaukee, WI, USA
45. M. Scott and K. Jerath; *Mission Performance Evaluation of Low-speed Small Unmanned Aerial Systems using Virtual Range and Stereo Camera Sensors*, AIAA Unmanned Systems Conference, 2018, Kissimmee, FL, USA
46. T. Kim, and K. Jerath; *Mitigation of self-organized traffic jams using cooperative adaptive cruise control*, 2016 International Conference on Connected Vehicles and Expo (ICCVE), 2016, Seattle, WA, USA
47. K. Jerath, and J. Langelaan; *Simulation Framework for UAS Conceptual Design*, AIAA Modeling and Simulation Technologies Conference, 2016, San Diego, CA, USA
48. K. Jerath and S. Brennan; *Identification of locally influential agents in self-organizing multi-agent systems*, American Control Conference 2015, Chicago, IL, USA
49. K. Jerath, V. V. Gayah, and S. Brennan; *Influential Subspaces of Connected Vehicles in Highway Traffic*, Symposium Celebrating 50 Years of Traffic Flow Theory, TRB Committee on Traffic Flow Theory and Characteristic, 2014, Portland, OR, USA

50. K. Jerath, A. Ray, S. Brennan, and V. Gayah; *Statistical Mechanics-inspired Framework for Studying the Effects of Mixed Traffic Flows on Highways*, Proc. of American Control Conference, 2014, Portland, OR, USA
51. K. Jerath and S. Brennan; *GPS-Free Terrain-based Vehicle Tracking on Road Networks*, Proceedings of American Control Conference, 2012, Montreal, Canada
52. K. Jerath and S. Brennan; *GPS-Free Terrain-based Vehicle Tracking Performance as a function of Inertial Sensor Noise Characteristics*, Proc. of Dynamic Systems and Control Conference, 2011, Arlington, VA, USA
53. K. Jerath and S. Brennan; *Adaptive Cruise Control: Towards higher traffic flows, at the cost of increased susceptibility to congestion*, Proceedings of AVEC10, 2010, Loughborough, UK
54. R. Deshpande, D. Johar, A. Kasyap, C. Feng, K. Jerath, and Z. Li; *Intellectual Property Monetization by R&D Organizations in India and China*, Proceedings of the International Symposium on the Management of Technology, 2007, Hangzhou, PRC.

### Conference Manuscripts (under review)

55. H. Haeri, N. Kathiriya, C. Chen, and K. Jerath; *Stream Learning under Continual Concept Drift via Multi-Scale Model Stability Analysis*, under review, ACM Knowledge and Data Discovery (KDD) Conference 2024
56. A. Daniels, P. Robinette, R. Ahmadzadeh, and K. Jerath; *Concurrent Learning of Network Topology and Coordination Policy in Multi-agent Systems using Graph Attention*, under review, IEEE Conference on Decision and Control, 2024

### Technical Reports

57. A. Norton, R. Ahmadzadeh, K. Jerath, P. Robinette, J. Weitzen, T. Wickramaratne, H. Yanco, M. Choi, R. Donald, B. Donoghue, C. Dumas, P. Gavriel, A. Giedraitis, B. Hertel, J. Houle, N. Letteri, E. Meriaux, Z. Rezaei, R. Singh, G. Willcox, N. Yoni, DECISIVE Benchmarking Data Report: sUAS Performance Results from Phase I, 2023.
58. A. Norton, R. Ahmadzadeh, K. Jerath, P. Robinette, J. Weitzen, T. Wickramaratne, H. Yanco, M. Choi, R. Donald, B. Donoghue, C. Dumas, P. Gavriel, A. Giedraitis, B. Hertel, J. Houle, N. Letteri, E. Meriaux, Z. Rezaei, R. Singh, G. Willcox, N. Yoni, *DECISIVE Test Methods Handbook: Test Methods for Evaluating sUAS in Subterranean and Constrained Indoor Environments, Version 1.1*, Technical Report, University of Massachusetts Lowell, 2022.
59. Auburn University, Stanford Research Institute, The Pennsylvania State University, and Kapsch TrafficCom Inc., *Next Generation Vehicle Positioning Techniques for GPS-Degraded Environments to Support Vehicle Safety and Automation Systems*, Technical Report, 2014
60. S. Brennan, P. Vemulapalli, K. Jerath, M. Robinson, M. Guo, *Human detection to increase safety in complex construction environments*, Technical report, Penn State/Volvo Construction Equipment, 2012
61. S. Brennan, K. Jerath, D. Klinikowski, S. Muthiah, and J. Yutko, *Study of the relationship between results of the Bus Testing Program and in-service performance of buses*, Technical Report, The Pennsylvania State University, 2008

### Abstracts, Posters, and Other Publications

62. S. Barclay and K. Jerath; *Human-guided Swarms: Impedance Control-inspired Influence in Virtual Reality Environments*, ArXiv preprint: arXiv:2402.04451
63. H. Haeri, R. Ahmadzadeh and K. Jerath, *Reward-Sharing Relational Networks in Multi-Agent Reinforcement Learning as a Framework for Emergent Behavior*, Northeastern Robotics Colloquium (NERC) 2022, Lowell, MA, 2022
64. A. Daniels, F. Mazzone and K. Jerath, *Understanding Agent Competency: Effects of Environment Complexity on Area Coverage Time*, Northeastern Robotics Colloquium (NERC) 2022, Lowell, MA, 2022
65. C. Pezeshki and K. Jerath, *Canonical Knowledge Structures and Complexity in the Design of Artificial Intelligence*, Collective Intelligence Conference, Brooklyn, NY, USA, 2017
66. K. Jerath; *Influential subspaces in self-organizing multi-agent systems*, Ph.D. dissertation, Department of Mechanical and Nuclear Engineering, The Pennsylvania State University, 2014
67. K. Jerath; *Cooperative Intelligent Vehicles: Are we there yet?*, Award-winning entry to the ITSA Student Essay Competition, 2012



68. K. Jerath; *Impact of Adaptive Cruise Control on the Formation of Self-Organized Traffic Jams on Highways*, M.S. Thesis, Department of Mechanical and Nuclear Engineering, The Pennsylvania State University, 2010

## TEACHING AND MENTORING EXPERIENCE

<b>University of Massachusetts Lowell</b>	2018 – Present
<ul style="list-style-type: none"> <li>• <b>MECH 3230:</b> Control of Mechanical Systems (<u>New undergraduate course</u> with integrated project-based learning)</li> <li>• <b>MECH 4510:</b> Dynamic Systems Analysis</li> <li>• <b>MECH 5300:</b> Autonomous Robotic Systems (<u>New graduate course</u> and new projects)</li> <li>• <b>MECH 5540:</b> Dynamic Systems and Control</li> <li>• <b>MECH 5550:</b> Networked Multi-agent Systems (<u>New graduate course</u> and projects)</li> <li>• <b>MECH 4230: Mechanical Engineering Capstone</b> (Advised team of two undergraduate students)</li> <li>• <b>ENGN.4019/4020: Industry Capstone with Brooks Automation</b> (Advised team of four undergraduate students from electrical, mechanical, and computer engineering across two semesters on project related to customizable design and vibration analysis of a robotic arm end-effector used for transporting semiconductor wafers)</li> </ul>	
<b>Washington State University</b>	2015 – 2018
<ul style="list-style-type: none"> <li>• <b>ME 348:</b> System Dynamics</li> <li>• <b>ME 401:</b> Mechatronics</li> <li>• <b>ME 481:</b> Control systems (introduced robotics-based projects to enhance learning outcomes)</li> </ul>	
<b>Penn State University</b>	2013 – 2014
<ul style="list-style-type: none"> <li>• <b>AERSP 460:</b> Aerospace Control Systems</li> <li>• <b>ME 370:</b> Vibrations of Mechanical Systems</li> </ul>	

### Graduate student advising

#### Primary advisor (Graduated 1 PhD and 3 MS students, as of Spring 2024)

1. Zhaohui Yang (Ph.D., 2021, Mechanical Engineering, UML): *Macroscopic Observability of Emergent Behaviors in Multi-scale Models of Traffic Flow*
2. Hossein Haeri (Ph.D., 2024 (expected), Mechanical Engineering; Concurrent degree)
3. Alden Daniels (Ph.D., 2025 (expected), Computer Science, UML)
4. Hossein Haeri (M.S., 2023, Computer Science, UML; Concurrent degree)
5. Niket Kathiriyia (M.S., 2023, Computer Science, UML): *Iterative Forgetting: A Novel Online Data Stream Regression Method*
6. Taehooie Kim (M.S., 2017, Mechanical Engineering, WSU): *Cooperative Adaptive Cruise Control: Impact on Self-organized Traffic Jams*
7. Mitchell Scott (M.S., 2018, Mechanical Engineering, WSU): *Information-based Multi-robot Navigation, Exploration and Coverage using Adaptive Occupancy Grids*
8. Michael Buckley (M.S., 2024 (expected), Mechanical Engineering, UML)
9. Akshay Kolli (M.S., 2024 (expected), Computer Science, UML)
10. Kshitij Srivastava (M.S. 2025 (expected), Computer Science, UML)

#### Co-advisor

1. Lorina Sinanaj (M.S., 2021, Computer Science, UML): *Allan Variance-based Granulation Technique for Large Temporal Databases*
2. Rinith Pakala (M.S., 2023, Computer Science, UML): *Distributed Edge Computing System for Vehicle Communication*

3. Hamid Osooli (M.S., 2024, Computer Science, UML)
4. Monish Reddy Kotturu (M.S., 2024, Computer Science, UML)
5. Yasin Findik (Ph.D., 2025 (expected), Computer Science, UML)

#### **Thesis committees**

1. Amir Iqbal (Ph.D., Mechanical Engineering, UML)
2. Yuan Gao (Ph.D., Mechanical Engineering, UML)
3. Satya Maddipatla (Ph.D., Mechanical Engineering, Penn State)
4. Wushuang Bai (Ph.D., Mechanical Engineering, Penn State)
5. Hamid Osooli (M.S., Computer Science, UML)
6. Debashis Saha (M.S., Civil Engineering, WSU)
7. Brian Laferriere (M.S., Mechanical Engineering, WSU)

## **SERVICE AND PROFESSIONAL ACTIVITIES**

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- **Member of**
  - Participating member of ASME Automotive and Transportation Systems (ATS) Technical Committee since 2018
  - IEEE Intelligent Transportation Systems Society (ITSS)
  - American Institute of Aeronautics and Astronautics (AIAA)
  - American Society for Engineering Education (ASEE)
- **Program Committee**, 17<sup>th</sup> International Symposium on Distributed Autonomous Robotic Systems (DARS 2024) at New York City, NY
  - **Associate Editor** for American Control Conference (ACC) 2023: Identified, solicited, and evaluated reviews provided for submissions to invited session on Resiliency and Privacy Throughout Networked Cyber-Physical Systems
- **Program Committee** for International Conference on Complex Systems (2020) at Nashua, NH
- **Organized** Tenth Northeast Robotics Colloquium (2022) at Lowell, MA
- Organized and chaired invited sessions at various conferences:
  - American Control Conference 2022 (titled (a) Traffic-Awareness Vehicle Controls; and (b) Automated Vehicle Controls)
  - Modeling, Estimation, and Control Conference (MECC) 2021 (titled (a) Modeling and Controls of Car Following and Driver Behaviors, and (b) Advanced Vehicle Safety Controls)
  - *Advanced Driver Assist Systems* at American Control Conference 2021 in New Orleans, LA
  - *Connected vehicle systems* at Dynamic Systems and Controls Conference 2020 in Pittsburgh, PA
  - *Influence in multi-agent systems* at the American Control Conference (ACC) 2015 in Chicago, IL
  - *Systems, Control and Communication* at College of Engineering Research Symposium 2014 at Penn State University, State College, PA
- Chaired/co-chaired regular sessions at various conferences:
  - *Observers for nonlinear systems* at American Control Conference 2020 in Denver, CO
  - *Large-scale systems* at American Control Conference 2018 in Milwaukee, WI
- **Reviewed proposals** as part of four (4) NSF review panels ((July 2016, April 2018, March 2022, January 2024), and for Canada Foundation for Innovation (CFI))
- **Served as judge for best paper award** for the Automotive and Transportation Systems Technical committee at American Control Conference 2021 and 2022
- **Invited talks at**
  - Washington State University (Mar 17, 2021): Renormalization Group Theory and Applications to Traffic Flow

- University of Massachusetts Amherst; Self-organization in traffic flow: Applications to modeling and mitigation of traffic jams, Sep 12, 2019
- University of New Hampshire; Collective behavior in robotic swarms: Modeling and control - A complex systems perspective, Oct 25, 2019
- **Reviewer for:**
  - IEEE Transactions on Intelligent Transportation Systems
  - IEEE Intelligent Transportation Systems Magazine
  - IEEE Transactions on Vehicular Technology
  - IEEE Transactions on Automatic Control
  - Transportation Research: Part B
  - Journal of Network and Computer Applications
  - Transportation Research Record
  - American Control Conference (ACC)
  - IEEE Conference on Decision and Control
  - Dynamic Systems and Control Conference (DSCC)
  - Distributed Autonomous Robotics Systems (DARS) Conference
  - International Conference on Intelligent Robots and Systems (IROS)
  - International Conference on Complex Systems
  - Northeastern Robotics Colloquium (NERC)
  - IEEE Vehicle Power and Propulsion Conference
- **Attended Conferences and Workshops:**
  - American Control Conference (2012, 2014, 2015, 2017, 2018, 2020, 2022)
  - NSF Cyber Physical Systems PI Meeting, Washington D.C. (2019, 2020, 2021, 2022)
  - Multi Robot Systems Symposium, Boston, MA (2023)
  - IEEE Symposium Series on Computational Intelligence (2022)
  - Northeast Robotics Colloquium, Lowell, MA (2022)
  - Modeling, Estimation and Control Conference (2021)
  - Adaptive and Learning Agents (ALA) workshop at International Conference on Autonomous Agents and Multiagent Systems (AAMAS) 2021
  - Northeast Regional Conference on Complex Systems (2021)
  - Dynamic Systems and Controls Conference (2011, 2019)
  - International Conference on Complex Systems (2018, 2020)
  - Annual Meeting of the Transportation Research Board, Washington D.C., Jan 11-13, 2019
  - Modeling, Prediction, and Design for Complex Networks: A Multi-Disciplinary Perspective Workshop (2018)
  - Collective Intelligence Conference, New York, NY (2017)
  - International Conference on Connected Vehicles and Expo, Seattle, WA (2016)
  - AIAA Modeling and Simulation Conference, San Diego, CA (2016)
  - TRB Symposium Celebrating 50 Years of Traffic Flow Theory, Portland, OR (2014)
  - 3rd Robotics Roadmapping Workshop, Lowell, MA – Nov 15-16, 2019
  - Presenting Data and Information with Edward Tufte, Cambridge, MA, June 3, 2019
  - Navigating NSF: Funding Opportunities, Proposal Preparation, and the Merit Review Process (Irina Dolinskaya) UML, Sep 2018
  - Joint Center for Aerospace Technology Innovation (JCATI) 2018 Symposium, Spokane, WA, Apr 2018
  - NSF Grants Conference, Alexandria, VA (2016)
  - WSU Office of Research Advancement and Partnership Grant writing course (2016)
  - Active Learning Workshop by National Effective Teaching Institute (NETI) at Pullman, WA (2016)
- **University and department committees at UMass Lowell:**

- Robotics Faculty search committee (chair (2019), member (2018, 2022, 2023)),
- Robotics Strategic Planning Working Group (Team Lead, 2019-21),
- Faculty Coordinator for Robotics Minor (2019-present)
- Course coordinator for MECH.3230 (Control of Automated Systems)
- Faculty senate (2021-22)
- **University and department committees at WSU:**
  - Member of UAS drone safety committee (WSU Department of Environmental and Health Safety, 2016-17),
  - Undergraduate Studies committee (MME department, 2016-17),
  - Website redesign committee (MME department, 2015-16)
  - Society of Women Engineers (SWE) undergraduate research mixer (Jan 2018): Presented overview of research activities in my lab, discussed potential research opportunities with undergraduate students
  - Featured in Dr. Universe article on swarm behavior in animal groups: ([Link](#))
- Advised WSU Aerospace club for the Intercollegiate Rocket Engineering Competition (IREC): 2015-17
- Member, Penn State Robotics Club and Intelligent Ground Vehicle Competition (IGVC) Team: 2007-2009
- Coordinator of Student Activities, SAE Student Chapter at Amity School of Engineering and Technology: 2005-2006

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## HONORS

- **Best paper award** at the 2021 Modeling, Estimation and Control Conference, MECC 2021
- **Best student paper award** at the 13<sup>th</sup> International Conference on Knowledge Management and Information Systems, 2021
- Awarded **Best Presentation in Session** at the American Control Conference, 2014
- Received the **Kulakowski Travel Award** by the Department of Mechanical and Nuclear Engineering at The Pennsylvania State University, 2014
- **Media coverage:** Research mentioned in **Society of Industrial and Applied Mathematics News** – “*Smells like a traffic jam*”, November 2013
- Awarded **Graduate Teaching Fellowship** by Department of Mechanical and Nuclear Engineering at The Pennsylvania State University, 2013
- Awarded **Best Presentation in Session** at the American Control Conference, 2012
- Awarded **2nd place** in Student Essay Competition organized by **Intelligent Transportation Society of America**, 2012 for essay titled “*Cooperative intelligent vehicles: are we there yet?*”