# KSHITIJ JERATH

*My overarching research goal is to advance the understanding of complex dynamics observed in large-scale multi-agent systems, and to develop bottom-up control algorithms that guide such systems to desired states via minimal intervention. My current work focuses on transportation networks with emphasis on the role of intelligent vehicles in controlling meso-scale traffic flow dynamics. In the future I intend to apply the developed mathematical tools to diverse networked systems such as robotic and social ensembles, system reliability, and neural systems.*

## 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: An Allan variance tutorial*

**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 the purpose of terrain monitoring*

## WORK EXPERIENCE

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

- 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

**Instructor** at **The Pennsylvania State University** 2013 – Present

- **Primary instructor** for:
  - Senior-level course on Aerospace Control Systems (AERSP 460) in Fall 2014
  - Junior-level course on Vibration of Mechanical Systems (ME 370) in Fall 2013
- Held classes and office hours, assigned homework, conducted exams and assessed student performance
- Received **70% approval rating** in university-mandated end-of-semester student feedback for ME 370

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**Graduate Teaching Assistant** at **The Pennsylvania State University** 2011 – 2013

- Held recitation classes, and graded exams and homework assignments for:
  - Graduate-level course on Digital Signal Processing (ACS 513)
  - Senior-level course on Modeling of Dynamic Systems (ME 450)
  - Junior-level course on Vibration of Mechanical Systems (ME 370)

**Graduate Research Assistant** at **The Pennsylvania State University** 2007 – 2011

- Performed data analysis and generated failure models for transit buses and its components
- Developed theory and performed simulations to study effect of intelligent vehicles on traffic flow
- Implemented and experimentally validated real-time vehicle tracking algorithms using low-cost sensors
- Published papers at conferences and in peer-reviewed journals

**Research Associate (Intellectual Property)** at **Evalueserve.com** 2006 – 2007

- Drafted patents for inventions in various domains including navigation/mechanical devices, and web utilities
- Performed invalidation searches for utility and design patents
- Performed patent landscape study of aircraft health monitoring systems for leading aircraft manufacturer

## PUBLICATIONS

### Journal Publications

1. **K. Jerath**, A. Ray, S. Brennan, and V. V. Gayah, *Dynamic prediction of vehicle cluster distribution: A statistical mechanics-inspired approach*, accepted for publication in IEEE Transactions on Intelligent Transportation Systems
2. **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
3. 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

### Submitted for Journal Publication / at Conference Venues

4. **K. Jerath**, V. V. Gayah, and S. Brennan; *Event Horizons and Influential Subspaces of Connected Vehicles*
5. **K. Jerath**, S. Brennan, and C. Lagoa; *Sensor Noise Modeling, Characterization and Simulation: An Allan Variance Tutorial*
6. T. Kim and **K. Jerath**; *Mitigation of self-organized traffic jams using Cooperative Adaptive Cruise Control*, Submitted to ICCVE 2016, Seattle

### In Refereed Conference Proceedings

7. **K. Jerath** and S. Brennan; *Identification of locally influential agents in self-organizing multi-agent systems*, accepted to American Control Conference 2015, Chicago, IL
8. **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
9. **K. Jerath**, A. Ray, S. Brennan, and V. Gayah; *Statistical Mechanics-inspired Framework for Studying the Effects of Mixed Traffic Flows on Highways*, Proceedings of American Control Conference, 2014, Portland, OR, USA

10. **K. Jerath** and S. Brennan; *GPS-Free Terrain-based Vehicle Tracking on Road Networks*, Proceedings of American Control Conference, 2012, Montreal, Canada
11. **K. Jerath** and S. Brennan; *GPS-Free Terrain-based Vehicle Tracking Performance as a function of Inertial Sensor Noise Characteristics*, Proceedings of Dynamic Systems and Control Conference, 2011, Arlington, VA, USA
12. **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
13. 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

### In Preparation

14. **K. Jerath** and S. Brennan; *GPS-Free terrain-based ground vehicle tracking on large road networks*
15. **K. Jerath** and S. Brennan; *Performance evaluation of GPS-free Terrain-based vehicle tracking algorithms using inertial sensors with varying noise characteristics*
16. **K. Jerath** and S. Brennan, *Spatial dependence of agent influence in self-organizing multi-agent systems*

### Technical Reports and Other Publications

17. **K. Jerath**; *Influential subspaces in self-organizing multi-agent systems*, Ph.D. dissertation, Department of Mechanical and Nuclear Engineering, The Pennsylvania State University, 2014
18. S. Brennan, P. Vemulapalli, **K. Jerath**, M. Robinson, M. Guo, *Human detection to increase safety in complex construction environments*, Technical report, The Pennsylvania State University, 2012
19. **K. Jerath**; *Cooperative Intelligent Vehicles: Are we there yet?*, Award-winning entry to the ITSA Student Essay Competition, 2012
20. **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
21. 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

## RESEARCH AND ENGINEERING EXPERIENCE

**Identifying influential subspaces of agents in self-organizing multi-agent systems** 2013 – Present

- Developed framework for evaluating agent influence in networked multi-agent systems
- Identified influential subspaces on highways where connected vehicles impact dynamics of self-organized jams

**Studying the effects of intelligent and connected vehicles on traffic flow dynamics** 2008 – Present

- Generated and analyzed stochastic models of traffic jam dynamics
- Analyzed the effect of variations in parametric driver models on the formation of traffic jams
- Performed microscopic simulations of traffic flow using statistical mechanics-inspired models

**Human detection in complex construction environments** 2012

- Conducted proof-of-concept study for major construction equipment manufacturer to detect humans at construction sites using LIDAR

**GPS-free terrain-based vehicle tracking** 2009 – 2011

- Developed noise models for simulating low-cost sensors
- Implemented real-time vehicle tracking with simulated low-cost sensors using Sigma Point Kalman filters in absence of GPS
- Implemented vehicle tracking on large road networks using multiple model estimation schemes

**Reliability analysis of in-service transit buses** 2007 – 2009

- Analyzed failure rate data from transit buses and Larson Transportation Institute bus testing program using regression and Hidden Markov models
- Generated performance comparison scheme for bus models and agencies

**Unmanned aerial vehicle** 2006

- Designed, built and flew an R/C Unmanned Aerial Vehicle (UAV)
- Initiated project idea, formed and managed a group of 10 persons for 5 months
- Performed feasibility studies for various design specifications

**Testing of Hydraulic Control Unit on Airbus A320 (Industrial Training)** Summer 2005

- 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
- 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

**Anti-Lock Braking System (ABS)** Summer 2004

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

## HONORS

- Awarded **Best Presentation in Session** at the American Control Conference, 2014
- Awarded the **Kulakowski Travel Award** by the Department of Mechanical and Nuclear Engineering at The Pennsylvania State University, 2014
- **Media article:** 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?*"
- Awarded **Scholar's Gold Medal** in 2000 for sustained academic excellence over a period of six years in high school.
- Awarded **National Merit-cum-Means Scholarship** under National Scholarship Scheme of the Govt. of India for 'outstanding performance in the Board's Secondary School Examination 2000'.
- Awarded **Certificate of Merit** by CBSE for being among the top 0.1 % of successful candidates in All India Secondary School Examination, 2000, in science.

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## ACTIVITIES

- **Organized invited session** titled "*Influence in multi-agent systems*" **at the American Control Conference (ACC)** 2015 in Chicago, IL
- **Session chair** at the College of Engineering Research Symposium, 2014 organized at Penn State for session titled "*Systems, Control and Communication*"
- **Reviewer** for
  - IEEE Transactions on Intelligent Transportation Systems
  - IEEE Intelligent Transportation Systems Magazine
  - IEEE Transactions on Vehicular Technology
- **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

## COMPUTER SKILLS

- Languages: C, C++, Python, Java, HTML and CSS, R, SQL
- Software handled: Matlab, Simulink, ROS, RePast Simphony, QuaRC, AutoCAD, MiniTab
- Proficient in MS Word, LaTex, MS PowerPoint, and MS Excel

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