Ragesh Kumar Ramachandran

Contact Information

Robotic Embedded Systems Lab (RESL)
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Research Interests

- Robotics:
  - Exploration and mapping in Swarm robotics
  - Resilience in multi-robot teams
- Control System:
  - Optimal control
  - Network control
- Topological data analysis
- Applied differential geometry
- Inverse problems

Education

Arizona State University, Tempe, Arizona USA

Ph.D. , Mechanical Engineering, *GPA* : 4.00/4.00, **August 2012 - August 2018**

- Dissertation Topic: "Exploration, Mapping and Scalar Field Estimation using a Swarm of Resource-Constrained Robots."
- Advisor: Spring M. Berman

National Institute of Technology Calicut, Calicut, Kerala India

Bachelor of Technology, Civil Engineering, *GPA* : 7.11/10.00, May, 2011

Academic Experience

University of Southern California, Los Angeles, California USA

Postdoctoral Scholar - Research Associate **August, 2018 - present**
Advisor: Gaurav Sukhatme

Massachusetts Institute of Technology, Boston, Massachusetts USA

Visiting Research Scholar **August, 2019**
Advisor: Sertac Karaman

Arizona State University, Tempe, Arizona USA

Graduate Student **August, 2012 - August, 2018**
Includes current Ph.D. research, Ph.D. and Masters level coursework, and research/consulting projects.

Teaching Experience

University of Southern California, Los Angeles, California USA

Introduced a course titled: "Applied Mathematics in Robotics" **Summer 2019**

Arizona State University

Teaching Assistant **January, 2013 - May, 2014**

Duties at various times have included office hours and leading weekly lab exercises.

- MAE 322 Structural Mechanics, Spring 2013.
- MAE 419 Experimental Mechanical Engineering, Fall 2013.
- MAE 318 System Dynamics and Control, Spring 2014.

Journal Publications

1. **Ragesh K. Ramachandran**, Nicole Fronda and Gaurav S. Sukhatme. Resilience in multi-robot multi-target tracking with unknown number of targets through reconfiguration. Conditionally accepted to *IEEE Transactions on Control of Network Systems* (TCNS), 2020.
2. **Ragesh K. Ramachandran**, Zahi Kakish and Spring Berman. In Information correlated Lévy walk exploration and distributed mapping using a swarm of robots. *IEEE Transactions on Robotics* (T-RO), 2020.
3. **Ragesh K. Ramachandran**, Sean. Wilson, and Spring. Berman. A probabilistic approach to automated construction of topological maps using a stochastic robotic swarm. In *IEEE Robotics and Automation Letters*, 2(2):616–623, April 2017.
4. Thomas G. Sugar, Andrew Bates, Matthew Holgate, Jason Kerestes, Marc. Mignolet, Philip. New, **Ragesh K. Ramachandran**, Sangram. Redkar, Chase. Wheeler, (2015). Limit cycles to enhance human performance based on phase oscillators. In *Journal of Mechanisms and Robotics*, 7, 011001.

Journal Papers in Submission

1. **Ragesh K. Ramachandran**, Pietro Pierpaoli, Magnus Egerstedt and Gaurav S. Sukhatme. Resilient Monitoring in Heterogeneous Multi-robot Systems through Network Reconfiguration. *IEEE Transactions on Robotics* (TRO), 2020.
2. Isabel M. Rayas Fernández, Peter Englert, **Ragesh K. Ramachandran** and Gaurav S. Sukhatme. Sampling-Based Motion Planning on Manifold Sequences. *IEEE Transactions on Robotics* (TRO), 2020.

Journal Papers in Preparation

1. **Ragesh K. Ramachandran**, Nicole Fronda and Gaurav S. Sukhatme. Resilience in multi-robot target tracking through reconfiguration under unknown exogenous inputs. *IEEE Transactions on Robotics* (TRO), 2020.

Peer Reviewed Conference Publications

1. **Ragesh K. Ramachandran**, Lifeng Zhou, James A. Preiss and Gaurav S. Sukhatme. Resilient Coverage: Exploring the Local-to-Global Trade-off. Accepted to appear in the Proceedings *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Las Vegas, USA, 2020 (Virtual conference).
2. Renato Fernando dos Santos, **Ragesh K. Ramachandran**, Marcos A. M. Vieira and Gaurav S. Sukhatme. Pac-Man is Overkill. Accepted to appear in the Proceedings *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Las Vegas, USA, 2020 (Virtual conference).
3. **Ragesh K. Ramachandran**, Nicole Fronda and Gaurav S. Sukhatme. Resilience in multi-robot target tracking through reconfiguration. In the Proceedings of *IEEE International Conference on Robotics and Automation (ICRA)*, Paris, France, 2020 (Virtual conference).
4. Eric Heiden, Ziang Liu, **Ragesh K. Ramachandran** and Gaurav S. Sukhatme. Physics-based Simulation of Continuous-Wave LIDAR for Localization, Calibration and Tracking. In

the Proceedings of *IEEE International Conference on Robotics and Automation (ICRA)*, Paris, France, 2020 (Virtual conference).

5. **Ragesh K. Ramachandran** and Spring Berman. Automated Construction of Metric Maps using a Stochastic Robotic Swarm Leveraging Received Signal Strength. In the Proceedings of *International Symposium on Swarm Behavior and Bio-Inspired Robotics (SWARM)* 2019, Okinawa, Japan, November 20–22, 2019.
6. **Ragesh K. Ramachandran**, James A. Preiss and Gaurav S. Sukhatme. Resilience by Reconfiguration: Exploiting Heterogeneity in Robot Teams. In the Proceedings of *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Macau, China, November 4–8, 2019.
7. **Ragesh K. Ramachandran** and Spring Berman. The effect of communication topology on scalar field estimation by large networks with partially accessible measurements. In Proceedings of the *American Control Conference (ACC)*, Seattle, WA, USA, May 24–26, 2017.
8. **Ragesh K. Ramachandran**, Sean Wilson and Spring Berman. A probabilistic topological approach to feature identification using a stochastic robotic swarm. In the Proceedings of *International Symposium on Distributed Autonomous Robotic Systems (DARS)*, London, UK, November 7-9, 2016 (Accepted for oral presentation - 25% acceptance rate).
9. **Ragesh K. Ramachandran**, Karthik Elamvazhuthi, and Spring Berman. An optimal control approach to mapping GPS-denied environments using a stochastic robotic swarm. In the Proceeding of the *International Symposium on Robotics Research (ISRR)*, Sestri Levante, Italy, September 12-15, 2015.
10. Jason Kerestes, Thomas G Sugar, Thierry Flaven, Matthew Holgate, and **Ragesh K Ramachandran**. A method to add energy to running gait: Pogosuit. In the Proceedings of the ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Volume 5A: 38th Mechanisms and Robotics Conference. Buffalo, New York, USA. August 17–20, 2014.
11. **Ragesh K. Ramachandran**, Vivek M Elayidom, A P Sudheer. (2009). Target Location algorithm for Automation Assistance in Weld Industries. In the proceedings of the *International Conference on Simulation Modeling and Analysis (COSMA*) , Calicut, India, December 2009: 194 - 198.

Submitted Conference Papers

1. Isabel M. Rayas Fernández, Giovanni Sutanto, Peter Englert, **Ragesh K. Ramachandran** and Gaurav S. Sukhatme. Learning Equality Constraints for Motion Planning on Manifolds. Submitted to *Conference on Robot Learning (CoRL)* 2020.

Refereed Abstracts

1. Isabel M. Rayas Fernández, Giovanni Sutanto, Peter Englert, **Ragesh K. Ramachandran** and Gaurav S. Sukhatme. "Learning Manifolds for Sequential Motion Planning". Workshop for Learning (in) Task and Motion Planning *Robotics: Science and Systems (RSS)* 2020.
2. **Ragesh Kumar Ramachandran**, and James A. Preiss and Gaurav S. Sukhatme. "Resilience by Reconfiguration: Exploiting Heterogeneity in Robot Teams". Workshop on Resilient Robot Teams: Composing, Acting, and Learning, ICRA 2019: International Conference on Robotics and Automation, Montreal, Canada, 2019.
3. **Ragesh Kumar Ramachandran**, and Spring Berman. "Post Processing of Occupancy Grid Maps using Persistent Homology". Workshop on Emerging Topological Techniques in Robotics, ICRA 2019: International Conference on Robotics and Automation, Montreal, Canada, 2019.
4. **Ragesh Kumar Ramachandran**, and Spring Berman. "Topological Mapping Using a Heterogeneous Robotic Swarm". Workshop on Emerging Topological Techniques in Robotics, ICRA 2016: International Conference on Robotics and Automation, Stockholm, Sweden, 2016.

Invited talks

- "Estimation and Mapping using a Swarm of Resource-Constrained Robots" School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, January 16, 2018.
- "Topological Mapping using a Stochastic Robotic Swarm" Mechanical & Aerospace Engineering department, Arizona State University, Tempe, Arizona USA, April 7, 2017.

Workshops organized

- "Heterogeneous Multi-Robot Task Allocation and Coordination" Harish Ravichandar, **Ragesh Kumar Ramachandran**, Sonia Chernova, Seth Hutchinson, Gaurav Sukhatme, and Vijay Kumar. Robotics: Science and Systems, 2020.

Professional Service

- **Mentoring :** Mentored a graduate student (Nicole Fronda) in implementing a resilient strategy for distributed target tracking. Nicole Fronda received the **best research award** from the department of computer science.
  Mentored a graduate student(Vaibhav Deshmukh) in implementing a decentralized Markov chain based strategy on a robotic platform Pheeno using ROS.
- **Journal Review :** IEEE Control Systems Letters 2020, Autonomous Robots 2020, IEEE Robotics and Automation Letters 2020, Computers & Graphics 2020, Robotica 2019, IEEE Robotics and Automation Letters 2019, Swarm Intelligence 2019, IEEE Control Systems Letters 2018, IEEE Transactions on Automation Science and Engineering 2018, Autonomous Robots 2017.
- **Conference Review :** IEEE International Conference on Robotics and Automation (ICRA) 2020, Robotics: Science and Systems(RSS) 2020, Robotics: Science and Systems(RSS) 2019, IEEE International Conference on Intelligent Robots and Systems (IROS) 2018, IEEE International Conference on Robotics and Automation (ICRA) 2016, International Symposium on Distributed Autonomous Robotic Systems (DARS) 2016 and IEEE International Conference on Intelligent Robots and Systems (IROS) 2015.

Peer-reviewed conference presentations

(P) = Presenter of a talk or poster

- **Ragesh K. Ramachandran***P*, Nicole Fronda and Gaurav S. Sukhatme. Resilience in multi-robot target tracking through reconfiguration. *IEEE International Conference on Robotics and Automation (ICRA)* 2020, Paris, France, May 2020. Virtual presentation.
- **Ragesh K. Ramachandran***P* and Spring Berman. Automated Construction of Metric Maps using a Stochastic Robotic Swarm Leveraging Received Signal Strength. *International Symposium on Swarm Behavior and Bio-Inspired Robotics (SWARM)* 2019, Okinawa, Japan, November 20–22, 2019. Oral presentation.
- **Ragesh K. Ramachandran***P*, James A. Preiss and Gaurav S. Sukhatme. Resilience by Reconfiguration: Exploiting Heterogeneity in Robot Teams. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Macau, China, November 4–8, 2019. Oral presentation.
- **Ragesh K. Ramachandran***P*, James A. Preiss and Gaurav S. Sukhatme. Resilience by Reconfiguration: Exploiting Heterogeneity in Robot Teams. Workshop on Resilient Robot Teams: Composing, Acting, and Learning, ICRA 2019: *IEEE International Conference on Robotics and Automation (ICRA)*, Montreal, Canada, May 20-24, 2019. Oral presentation.
- **Ragesh K. Ramachandran***P* and Spring Berman. The effect of communication topology on scalar field estimation by large networks with partially accessible measurements. *IEEE American Control Conference (ACC)*, Seattle, WA, USA, May 24–26, 2017. Oral presentation.
- **Ragesh K. Ramachandran***P*, Sean Wilson, and Spring Berman. A probabilistic topological approach to feature identification using a stochastic robotic swarm. *International Symposium on Distributed Autonomous Robotic Systems (DARS)*, London, UK, November 2016. Oral presentation.
- **Ragesh Kumar Ramachandran***P*, and Spring Berman. Topological Mapping Using a Heterogeneous Robotic Swarm. Workshop on Emerging Topological Techniques in Robotics, ICRA 2016: *IEEE International Conference on Robotics and Automation (ICRA)*, Stockholm, Sweden, May 16-21, 2016. Poster presentation.
- **Ragesh K. Ramachandran***P*, Karthik Elamvazhuthi, and Spring Berman. An optimal control

approach to mapping GPS-denied environments using a stochastic robotic swarm. *International Symposium on Robotics Research (ISRR)*, Sestri Levante, Italy, September 12-15 2015. Oral presentation.

Computer Skills

- **Languages/Software:** Matlab, C/C++, Python, Unix shell scripts, ROS, LaTeX, HTML, CSS, Javascript
- **Version control:** git, mercurial, svn

References

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