

Vidya Raju

Postdoctoral fellow, The Soft Math Lab
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Research Interests

Cognition and control of active matter including using geometric and optimal control theory, Evolutionary game theory and mathematical models of learning inspired from cognitive neuroscience.

Education

- University of Maryland(UMD), College Park** USA
Doctor of Philosophy in Electrical Engineering 2013 - 2019
· Advisor: Prof. P. S. Krishnaprasad
- The Swiss Federal Institute of Technology(ETH), Zürich** Switzerland
M.Sc Robotics, Systems and Control,
Department of Mechanical and Process Engineering (D - MAVT) 2010 - 2012
· Advisor: Prof. Robert Riener
- National Institute of Technology(NITT), Tiruchirappalli(Trichy)** India
B.Tech Instrumentation and Control Engineering 2006 - 2010
· First class with distinction

Research Experience

- Postdoctoral fellowship** School of Engineering and Applied Sciences, Harvard University, USA
Soft Math Lab Aug 2019 - present
· Advisor: Prof. L. Mahadevan
- Graduate Research** Intelligent Servosystems Lab & Institute for Systems Research, UMD
Advisor: Prof. P. S. Krishnaprasad Aug 2013 - May 2019
– Title: Cognitive Control, Evolutionary Games and Lie Algebras
– *Relevant coursework:* System Theory, Random Processes in Communication and Control, Adaptive Control, Estimation and Detection Theory, Information Theory, Nonlinear Control, Optimal Control, Stochastic Control, Fundamental Concepts of Differential Geometry, Real Analysis
- Internship** Real Time Optimization and Controls Lab, GE Global Research, New York
Advisors: Anup Menon and Olugbenga M. Anubi Jun - Aug 2016
– Projects: 1. Implemented signal processing routines for Gas Turbine performance optimization, and 2. Validated new models for control of freight trains.
- Masters' Thesis** Sensory Motor Systems Lab, ETH Zürich
Advisor: Prof. Robert Riener Apr - Nov 2012
– Title: Design and implementation of tools and techniques for real-time analysis of physiology during relaxation
- Internship** Supélec, Gif-sur-Yvette, France
Advisor: Prof. Jerome Juillard Sep 2011 - Jan 2012
– Title: Stability analysis of a CNEM inverter
- Internship** Autonomous Systems Lab, ETH Zürich
Advisors: Martin Rufli, Javier Alonso Mora and Prof. Roland Siegwart Jun - Aug 2011

- Title: Motion control of display swarm robots

Semester Thesis

Advisors: Stephan Huck and Prof. John Lygeros

- Title: Modeling and Control of a RC Helicopter

Automatic Control Lab, ETH Zürich

Feb - Jun 2011

Undergraduate Research

Advisor: Prof. V. Sankaranarayanan

- Title: Higher order sliding mode control of the cart on a beam system

National Institute of Technology, Trichy

Mar 2009 - May 2010

Work Experience

Alstom Switzerland Ltd., R & D, Gas Turbines Division

Process Control Application Engineer

Baden, Switzerland

Feb - Jun 2013

Academic Honors

- Future Faculty Fellowship, Spring '16 - Fall '17.
- Student Travel Support, 55th IEEE Conference on Decision and Control, 2016.
- ECE Teaching and Training Development mentor, Fall '16 - Spring '17.
- ECE Distinguished Teaching Assistant Award, Fall '15 - Spring '16.
- Clark School of Engineering Distinguished Graduate Fellowship, Fall '13- Spring '14.

Publications

1. *In preparation.* V. Raju, A. Krotov, L. Mahadevan and D. Sternad, ‘Rhythms of a whip,’ 2022.
2. *In preparation.* A. Dear, V. Raju and L. Mahadevan, ‘Online estimation and optimal mitigation of protein aggregation under model uncertainty,’ 2022.
3. *In preparation.* V. Raju and L. Mahadevan, ‘A neuro-sensory model for optimal tuning of head direction cells in fly navigation,’ 2022.
4. *To be submitted.* U. Halder, V. Raju, P. S. Krishnaprasad *et al.*, ‘Cognitive Cost of Flocking: A Geometric and Hamiltonian Perspective,’ 2022.
6. *Likely to be accepted at Proceedings of National Academy of Sciences.* S. Shankar, V. Raju and L. Mahadevan, ‘Optimal transport and control of active drops,’ 2022. [[arXiv](#)]
7. *Submitted.* Serra, M., S. al-Mosleh, S.G. Ganga Prasath, V. Raju, S. Mantena, J. Chandra, S. Iams, and L. Mahadevan, ‘Optimal policies for mitigating pandemic costs,’ 2021. [[arXiv](#)]
8. *Submitted.* V. Raju and P. S. Krishnaprasad, ‘Lie algebra structure of fitness and replicator control,’ 2020. [[arXiv](#)]
9. V. Raju, ‘Cognitive Control, Evolutionary Games, and Lie Algebras,’ Ph.D Thesis, 2019. [[PDF](#)]
10. V. Raju and P. S. Krishnaprasad, ‘A variational problem on the probability simplex,’ in *Proceedings of the 57th IEEE Conference on Decision and Control (CDC)*, pp. 3522 – 3528, 2018. [[PDF](#)]
11. V. Raju and P. S. Krishnaprasad, ‘Motion camouflage in the presence of sensory noise and delay,’ in *Proceedings of the 55th IEEE Conference on Decision and Control (CDC)*, pp. 2846 – 2852, 2016. [[PDF](#)]

Talks and Poster Presentations

1. **Simulating the target-reaching motion of a whip.** Talk at Kavli Seminar, Harvard University on February 15, 2021.

2. **Optimal transport of a drop II – externally actuated case.** Talk at APS Division of Fluid Dynamics (Virtual) meeting, November 23, 2020.
3. **Cognitive Control, Evolutionary Games and Lie Algebras.** Poster with P. S. Krishnaprasad at Meet the Faculty Candidate Poster Session, 57th IEEE Conference on Decision and Control (CDC) on December 17, 2018, at Northrop Grumman University Research Symposium on April 17, 2018 and April 26, 2017.
4. **Resilient-by-cognition Cyber-Physical Systems.** Poster and demonstration with P. S. Krishnaprasad, Yasser Shoukry and Xiaowu Sun at the National Science Foundation Cyber-Physical Systems Principal Investigators' meeting, Alexandria, Virginia, November 15, 2018.
5. **Replicator dynamics and controllability.** Talk at Information Engines Annual Review, MURI meeting, University of Maryland, October 11, 2018.
6. **Replicator control systems.** Talk at Conference on Distributed, Collective Computation in Biological and Artificial Systems, Janelia Research Campus, Virginia, March 20, 2018.
7. **Higher order sliding mode control of MIMO systems.** Talk at the Winter School for Control and Dynamical Systems 2010, Indian Institute of Technology, Bombay, January 30, 2010.

Teaching Experience

- Fall 2017: ENEE 460 Control Systems - Co-Instructor with Prof. S. Marcus
- Fall 2016: ENEE 408I Capstone Design Project: Autonomous Control of Interacting Robots - Teaching Assistant (TA)
- Spring 2016: ENEE 324 Engineering Probability - TA
- Fall 2015: ENEE 660 System Theory - TA
- Fall 2015: ENEE 460 Control Systems - TA
- Spring 2015: ENEE 222 Discrete Signal Analysis - TA
- Fall 2014: ENEE 440 Microprocessors - Grader

Software Skills

- Languages: C++, C, Python
- Packages: Matlab, CasADi, ROS, Vicon (Nexus and Tracker), Simulink, Microsoft Office, LaTeX, Keil uVision, DSpace Control Desk, PSpice, Winavr, Autocad 2007

Professional Activities

- Member of IEEE Control Systems Society (CSS), Society of Industrial and Applied Mathematics (SIAM), American Physical Society (APS).
- Board member of Women in ECE (WECE), University of Maryland, College Park (2015-2016).
- Board member of ECE Graduate Students' Association (ECEGSA), University of Maryland, College Park (2014-2015).
- Member, Robotics and Machine Intelligence Club of NITT (2009-2010).
 - Developed line follower based robots like Micromouse and Rube Goldberg Machines, conducted Robotics Workshops and Robotics events in Pragyan - a techno-management fest of NITT.

Professional Service

- Mentor for Women+ of Color Project (2020 - present). Responsibilities include advising women applying for graduate programs after completion of Bachelors.

- Mentor for Harvard Graduate Women in Science and Engineering (HGWISE, 2021 - present). Responsibilities include preparation of workshops to disseminate information about career paths in STEM in partnership with Learn With Leaders, India.
- Reviewer, IEEE 57th Conference on Decision and Control, 2018, and IEEE Transactions on Systems, Man and Cybernetics, Indian Control Conference, 2021.
- Lab co-manager, Intelligent Servosystems Lab, University of Maryland (Fall 2015 - Spring 2019).
 - With U. Halder, helped maintain a robotic testbed comprising Pioneer-3 robots, Vicon motion capture system and ROS framework, and presented demonstrations of robot collectives for visitors.