

Education

Georgia Institute of Technology	ATLANTA, GEORGIA, USA
Doctor of Philosophy in Mechanical Engineering	2013 – 2016
Thesis Title: Input to State Stabilizing Control Lyapunov Functions for Hybrid Systems	
Committee: Aaron D. Ames (advisor), Magnus Egerstedt, Patricio Vela, Jonathan Rogers, Jun Ueda	
Texas A&M University	COLLEGE STATION, TEXAS, USA
Master of Science in Electrical and Computer Engineering	2010 – 2012
National Institute of Technology Karnataka	SURATHKAL, KARNATAKA, INDIA
Bachelor of Technology in Electrical and Electronics Engineering	2004 – 2008

Experience

Indian Institute of Science	BENGALURU, KARNATAKA, INDIA
INSPIRE Faculty Fellow	Jan '18 – present
Working in the Robert Bosch Center for Cyber Physical Systems (RBCCPS), in IISc. I am currently working on real-time safety critical control for various robotic platforms like quadrotors, arms and legged robots. I am also exploring the confluence of learning and control via deep reinforcement learning (D-RL) based methods for legged robots.	
California Institute of Technology	PASADENA, CALIFORNIA, USA
Postdoctoral Scholar	Jan '17 – Dec '17
Worked with MisoRobotics on the 6-DOF arm project. The goal was to realize dynamic behaviors in a robotic arm platform; specifically, applied to flipping burgers as an example of nonprehensile object manipulation. Flipping of burgers involves a series of tasks—going to the burger location, scooping, picking up and flipping. We employed direct collocation based multi-segmented trajectory optimization for realizing these behaviors, which were successfully demonstrated in a 6-DOF robot experimentally.	
Tejas Networks Ltd.	BENGALURU, KARNATAKA, INDIA
R&D Engineer	Jun '08 – Jun '10
Designed and fabricated two stand alone switching power supplies. Each power supply used a standard buck converter topology with hot swappable, current-voltage monitoring features.	

Research Interests

I currently have following major activities:

- I am interested both in theoretical and practical aspects of hybrid robotic systems, especially in the domain of walking robots. My PhD dissertation was about bridging the gap between theory and experiment in these types of systems by using input-to-state stabilizing control Lyapunov functions (ISS-CLFs). I am currently looking to extend it for various other robotic platforms.
 - My interests in real-time safety critical control gradually grew as I worked more and more with industrial robot arms. As we see an increasing use of robots and robotic technology around us, safety will be of critical importance. We need guaranteed margins of safety in order to create a human-friendly environment. My focus currently has been to introduce robustness in safety-critical control via the notion of input-to-state safety. This was mainly motivated from my PhD work on input-to-state stability.
 - Deep learning is getting a lot of attention of late. I am currently in the phase of understanding deep reinforcement learning (D-RL) and see how it can be applied to legged robots. This is in collaboration with Dr. Bharadwaj Amrutur, Dr. Shalabh Bhatnagar and Dr. Ashitava Ghosal in the center. We were successfully able to realize walking in two custom quadruped robots, Stoch 1 and 2. More details are provided in my website (www.shishirny.com).
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Journal Publications

- [1] S. Kolathaya. “Local Stability of PD Controlled Bipedal Walking Robots”. In: *accepted to Automatica* (2019).
- [2] S. Kolathaya and A. D. Ames. “Input-to-State Safety With Control Barrier Functions”. In: *IEEE Control Systems Letters* 3.1 (Jan. 2019), pp. 108–113. ISSN: 2475-1456.
- [3] S. Kolathaya et al. “Direct Collocation for Dynamic Behaviors With Nonprehensile Contacts: Application to Flipping Burgers”. In: *IEEE Robotics and Automation Letters* 3.4 (Oct. 2018), pp. 3677–3684. ISSN: 2377-3766.
- [4] A. D. Ames et al. “First Steps Toward Formal Controller Synthesis for Bipedal Robots with Experimental Implementation”. In: *Nonlinear Analysis: Hybrid Systems* 25 (2017), pp. 155–173. ISSN: 1751-570X.
- [5] S. Kolathaya and A. D. Ames. “Parameter to State Stability of Control Lyapunov Functions for Hybrid System Models of Robots”. In: *Nonlinear Analysis: Hybrid Systems* (2016). ISSN: 1751-570X.

Publications (under review/preparation)

- [1] S. Kolathaya, J. P. Reher, and A. D. Ames. *Input-to-State Stability of Bipedal Walking Robots: Application to DURUS*. In: *Submitted to IEEE Transactions on Control Systems Technology* (2018).
- [2] S. Kolathaya. *PD Based Quadratic Programs for Robotic Systems*. In: *In preparation for IEEE Transactions on Robotics* (2019).

Peer Reviewed Book Chapters

- [1] S. N. Y. Kolathaya, M. Pasupuleti, and A. D. Ames. “From Formal Methods to Algorithmic Implementation of Human Inspired Control on Bipedal Robots”. In: *Algorithmic Foundations of Robotics X: Proceedings of the Tenth Workshop on the Algorithmic Foundations of Robotics*. Ed. by E. Frazzoli et al. Berlin, Heidelberg: Springer Berlin Heidelberg, 2013, pp. 511–526. ISBN: 978-3-642-36279-8.
- [2] S. Kolathaya, W. L. Ma, and A. D. Ames. “Composing Dynamical Systems to Realize Dynamic Robotic Dancing”. In: *Algorithmic Foundations of Robotics XI: Selected Contributions of the Eleventh International Workshop on the Algorithmic Foundations of Robotics*. Ed. by H. L. Akin et al. Cham: Springer International Publishing, 2015, pp. 425–442. ISBN: 978-3-319-16595-0.
- [3] J. P. Reher et al. “Algorithmic Foundations of Realizing Multi-Contact Locomotion on the Humanoid Robot DURUS”. In: *The International Workshop on the Algorithmic Foundations of Robotics (WAFR) XII*. San Francisco, Dec. 2016.

Conference Publications

- [1] S. Bhattacharya et al. “Learning Active Spine Behaviors for Dynamic and Efficient Locomotion in Quadruped Robots”. In: *28th IEEE International Conference on Robot & Human Interactive Communication (RO-MAN)*. Oct. 2019.
- [2] S. Kolathaya et al. “Trajectory based Deep Policy Search for Quadrupedal Walking”. In: *28th IEEE International Conference on Robot & Human Interactive Communication (RO-MAN)*. Oct. 2019.
- [3] S. Kolathaya and S. Veer. “PD based Robust Quadratic Programs for Robotic Systems”. In: *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Nov. 2019.
- [4] D. Dholakiya et al. “Design, Development and Experimental Realization of a Quadrupedal Research Platform: Stoch”. In: *2019 IEEE International Conference on Control Automation and Robotics (ICCAR)*. Apr. 2019.
- [5] A. Singla et al. “Realizing Learned Quadruped Locomotion Behaviors through Kinematic Motion Primitives”. In: *2019 IEEE International Conference on Robotics and Automation (ICRA)*. May 2019.
- [6] S. Kolathaya et al. “Direct Collocation for Dynamic Behaviors with Nonprehensile Contacts: Application to Flipping Burgers”. In: *2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Oct. 2018.
- [7] S. Kolathaya and A. D. Ames. “Input-to-State Safety With Control Barrier Functions”. In: *2018 IEEE 57th Conference on Decision and Control (CDC)*. Dec. 2018.
- [8] S. Kolathaya et al. “Input to State Stabilizing Control Lyapunov Functions for Robust Bipedal Robotic Locomotion”. In: *2018 Annual American Control Conference (ACC)*. June 2018, pp. 2224–2230.
- [9] W.-L. Ma et al. “Bipedal Robotic Running with DURUS-2D: Bridging the Gap Between Theory and Experiment”. In: *Proceedings of the 20th International Conference on Hybrid Systems: Computation and Control (HSCC)*. Pittsburgh, Pennsylvania, USA: ACM, 2017, pp. 265–274. ISBN: 978-1-4503-4590-3.

- [10] A. Hereid, S. Kolathaya, and A. D. Ames. “Online Optimal Gait Generation for Bipedal Walking Robots using Legendre Pseudospectral Optimization”. In: *2016 IEEE 55th Conference on Decision and Control (CDC)*. Dec. 2016, pp. 6173–6179.
- [11] S. Kolathaya, A. Hereid, and A. D. Ames. “Time Dependent Control Lyapunov Functions and Hybrid Zero Dynamics for Stable Robotic Locomotion”. In: *2016 American Control Conference (ACC)*. July 2016, pp. 3916–3921.
- [12] S. Kolathaya and A. D. Ames. “Parameter Sensitivity and Boundedness of Robotic Hybrid Periodic Orbits.” In: *2015 Analysis and Design of Hybrid Systems (ADHS)*. Vol. 48. 27. 2015, pp. 377–382.
- [13] A. D. Ames et al. “First Steps Toward Formal Controller Synthesis for Bipedal Robots”. In: *Proceedings of the 18th International Conference on Hybrid Systems: Computation and Control*. HSCC ’15. Seattle, Washington, 2015, pp. 209–218. ISBN: 978-1-4503-3433-4.
- [14] S. Kolathaya and A. D. Ames. “Exponential Convergence of a Unified CLF Controller for Robotic Systems under Parameter Uncertainty”. In: *2014 American Control Conference*. June 2014, pp. 3710–3715.
- [15] W. L. Ma et al. “Human-Inspired Walking via Unified PD and Impedance Control”. In: *2014 IEEE International Conference on Robotics and Automation (ICRA)*. May 2014, pp. 5088–5094.
- [16] A. Hereid et al. “Dynamic Multi-domain Bipedal Walking with Atrias Through SLIP Based Human-Inspired Control”. In: *Proceedings of the 17th International Conference on Hybrid Systems: Computation and Control*. HSCC ’14. Berlin, Germany, 2014, pp. 263–272. ISBN: 978-1-4503-2732-9.
- [17] H. Zhao, S. Kolathaya, and A. D. Ames. “Quadratic Programming and Impedance Control for Transfemoral Prosthesis”. In: *2014 IEEE International Conference on Robotics and Automation (ICRA)*. May 2014, pp. 1341–1347.
- [18] S. Kolathaya and A. D. Ames. “Achieving Bipedal Locomotion on Rough Terrain through Human-Inspired Control”. In: *10th IEEE International Symposium on Safety Security and Rescue Robotics*. College Station, Texas, USA, Oct. 2012.
- [19] S. N. Y. Kolathaya, M. Pasupuleti, and A. D. Ames. “Human-Inspired Underactuated Bipedal Robotic Walking With AMBER on Flat-ground, Up-slope and Uneven Terrain”. In: *2012 IEEE/RSJ International Conference on Intelligent Robots and Systems*. Oct. 2012, pp. 2478–2483.
- [20] Z. Huihua, S. N. Y. Kolathaya, and A. D. Ames. “Bipedal Robotic Running With Partial Hybrid Zero Dynamics and Human-Inspired Optimization”. In: *2012 IEEE/RSJ International Conference on Intelligent Robots and Systems*. Oct. 2012, pp. 1821–1827.
- [21] S. N. Y. Kolathaya, B. Kothapalli, and A. D. Ames. “Zeno Behavior in Electromechanical Hybrid Systems: From Theory to Experimental Validation”. In: *2012 American Control Conference (ACC)*. June 2012, pp. 2437–2442.

Miscellaneous

- [1] S. N. Y. Kolathaya. *Phase Uncertainty to State Stability of Continuous Periodic Orbits*, *arXiv preprint arXiv:1707.02258*. 2017.
- [2] S. Kolathaya et al. *System Identification and Control of Valkyrie through SVA-Based Regressor Computation*, *arXiv preprint arXiv:1608.02683*. 2016.
- [3] S. Kolathaya et al. *Human-Inspired Walking in AMBER 1.0 and AMBER 2.0, Dynamic Walking*. 2013.

Teaching Experience

Indian Institute of Science

Robot Dynamics and Control–Graduate Level–CPS312

Was the main instructor for this course.

BENGALURU, KARNATAKA, INDIA

Fall 2018

California Institute of Technology

Dynamics and Control of Walking Robots–Graduate Level–CDS270-2

Taught two lectures, set homeworks, mentored projects, held office hours and also graded exams.

PASADENA, CALIFORNIA, USA

Spring 2017

Georgia Institute of Technology

Nonlinear Systems–Graduate Level–ECE6552

Taught four lectures, set homeworks, mentored projects, held weekly office hours and also graded exams.

ATLANTA, GEORGIA, USA

Spring 2016

Achievements

- INSPIRE Faculty Fellowship - 2018, awarded by the Department of Science and Technology, INDIA.
 - Best paper award (second author) for a seminal work on *Dynamic multi-domain bipedal walking with ATRIAS through slip based human-inspired control*, In the *Proceedings of the 17th international conference on Hybrid systems: Computation and Control*, 2014.
 - Student travel award for the Workshop on Algorithmic Foundations in Robotics XI, 2014, Istanbul, Turkey.
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Mentorship

- Abhimanyu, Research Intern, RBCCPS, IISc.
- Aditya Sagi, Technical Associate, RBCCPS, IISc.
- Shounak Bhattacharya, Technical Associate, RBCCPS, IISc
- Dhaivat Dholakia, Technical Associate, RBCCPS, IISc
- Abhik Singla, Technical Associate, RBCCPS, IISc
- Arun Kumar, Technical Associate, RBCCPS, IISc
- Navneet Paul, Research Intern, RBCCPS, IISc
- Ajay Gunalan, Research Intern, RBCCPS, IISc

List of Seminars and Presentations

- *Realizing Learned Quadruped Locomotion Behaviors through Motion Primitives*, 2019, ICRA Learning Legged Locomotion Workshop, Montreal, Canada.
- *Realizing Learned Quadruped Locomotion Behaviors through Motion Primitives*, 2019, EECS Symposium, IISc, Bengaluru, India.
- *Legged Mechanisms as Farming Assistants*, 2018, CPCPRI, Kasaragodu, Kerala, India.
- *History of Walking Robots*, 2017, IIT Bombay, India.
- *Bipedal robots: Bridging the gap between theory and experiment*, 2017, IISc, Bengaluru, India.
- *Bipedal robots: Bridging the gap between theory and experiment*, 2017, IIT Bombay, India.
- *Time dependent control Lyapunov functions and hybrid zero dynamics for stable robotic locomotion*, American Control Conference 2016, Boston, Massachusetts, USA.
- *Parameter Sensitivity and Boundedness of Robotic Hybrid Periodic Orbits*, Analysis and Design of Hybrid Systems 2015, Atlanta, Georgia, USA.
- *Composing Dynamical Systems to Realize Dynamic Robotic Dancing*, Workshop on Algorithmic Foundations of Robotics XI, Istanbul, Turkey.
- *Exponential convergence of a unified CLF controller for robotic systems under parameter uncertainty*, American Control Conference 2014, Portland, Oregon, USA.
- *Dynamic Multi-domain Bipedal Walking with ATRIAS Through SLIP Based Human-inspired Control*, Cyber Physical Systems Week 2014, Berlin, Germany.
- *Achieving Human-Inspired Bipedal Robotic Walking*, Invited seminar 2013, National Institute of Technology Karnataka, Surathkal, Karnataka, India.
- *Human-Inspired Walking in AMBER 1.0 and AMBER 2.0*, Dynamic Walking 2013, Pittsburgh, USA.
- *Introduction to Human-Inspired Bipedal Walking*, Invited seminar 2012, National Institute of Technology Karnataka, Surathkal, Karnataka, India.
- *Achieving Bipedal Locomotion on Rough Terrain through Human-Inspired Control*, International Symposium on Safety Security and Rescue Robotics 2012, College Station, Texas, USA.

- *Bipedal robotic running with partial hybrid zero dynamics and human-inspired optimization*, International Conference on Intelligent Robots and Systems 2012, Vilamoura, Algarve, Portugal.
- *Human-inspired underactuated bipedal robotic walking with AMBER on flat-ground, up-slope and uneven terrain*, International Conference on Intelligent Robots and Systems 2012, Vilamoura, Algarve, Portugal.
- *From Formal Methods to Algorithmic Implementation of Human Inspired Control on Bipedal Robots*, Workshop on Algorithmic Foundations of Robotics X, Cambridge, Massachusetts, USA.
- *Zeno behavior in electromechanical hybrid systems: From theory to experimental validation*, American Control Conference 2012, Montreal, Quebec, Canada.

Reviewership

- Program committee member of Robots, Science and Systems (RSS 2017, 2018).
- Program committee member of Safety, Security and Rescue Robotics (SSRR 2012-2013).
- IEEE-TRO, IEEE-TAC, IEEE-LCSS, IEEE-RA-L, NAHS, IJRR.
- IROS, ICRA, CDC, ACC, ICC.

List of Referees

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| Dr. Aaron Ames | California Institute of Technology, Pasadena, California, USA |
| Bren Professor of Mechanical and Civil Engineering | <i>email: ames@caltech.edu</i> |
| Dr. Ryan Sinnet | Miso Robotics, Pasadena, California, USA |
| Chief Technology Officer, Miso Robotics | <i>email: rsinnet@misorobotics.com</i> |
| Dr. Ayonga Hereid | Ohio State University, Columbus, Ohio, USA |
| Assistant Professor of Mechanical Engineering | <i>email: hereid.1@osu.edu</i> |