

VENKATRAMAN NARAYANAN

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EDUCATION

Ph.D. in Robotics

Aug '13 - Jun '17 (expected)

Carnegie Mellon University, Pittsburgh, USA

Thesis: Deliberative Perception

Advisor: Dr. Maxim Likhachev

Committee: Drs. Martial Hebert, Siddhartha Srinivasa, Manuela Veloso, Dieter Fox

M.S. in Robotics

Aug '11 - Dec '12

Carnegie Mellon University, Pittsburgh, USA

Thesis: Anytime Safe Interval Path Planning for Dynamic Environments

Advisor: Dr. Maxim Likhachev

CQPA: 4.06/4.33

B.E. in Electronics and Communication Engineering (ECE)

Aug '07 - Apr '11

College of Engineering, Guindy (CEG), Anna University, India

CGPA: 9.72/10 (Class Rank: 1/160)

RESEARCH INTERESTS

- **3D Perception:** RGB-D perception, 3D object detection and localization, perception for manipulation
- **AI and Robotics:** heuristic graph search, robot motion planning, planning under uncertainty
- **Applications:** personal robotics, flexible automation and manufacturing, autonomous driving, UAVs

EXPERIENCE

Research Assistant, Robotics Institute, Carnegie Mellon University

Jan '12 - Present

Advisor: Dr. Maxim Likhachev

- Introduced and studied *deliberative* 3D perception algorithms for object instance detection and localization
- Developed heuristic search and motion planning algorithms for mobile manipulation planning, anytime navigation planning in dynamic environments, and manipulation planning under uncertainty
- Visiting researcher at University of Washington (Nov '16 - Dec '16); ongoing collaboration with Dr. Dieter Fox's group on real-time deliberative perception for 3D object recognition
- Devised and implemented algorithms for planning with topological constraints (such as finding optimal surveillance routes for UAVs) in collaboration with Dr. Steven LaValle at UIUC
- Perception and planning algorithms were demonstrated on real robots (PR2 robot, hexacopter UAV, UR5 mobile manipulator) and published in top-tier robotics and AI conferences (RSS, ICRA, IROS, and IJCAI)

Software Engineering Intern, Uber Advanced Technologies Center, Pittsburgh

May - Aug '15

Mentor: Dr. Andrew Bagnell. Undisclosed work with the perception team

Software Engineering Intern, Google X, Mountain View

Apr - Jul '13

Mentor: Dr. Nathaniel Fairfield. Undisclosed work with the self-driving car planning team

Intern, Combat Vehicles Research and Development Establishment, Defense Research and Development Organization (DRDO), India

Jan - May '11

- Modeled and analyzed the wireless link for robust teleoperation of full-scale Unmanned Ground Vehicles
- Won the **Best Project** award from the Department of ECE, CEG

HONORS AND AWARDS

- **AAAI-15 Robotics Fellowship** (one of the 10 winners chosen from 72 applicants worldwide) *Nov '14*
- **Best Poster Presentation Award** at the International Symposium on Combinatorial Search *Aug '14*
- **Travel Awards** to present at ICRA '15, SoCS '15, IROS '12
- **Gold Medalist** (Rank 1/160), Department of ECE, CEG, Anna University *Apr '11*
- **Best Undergraduate Project Award**, Department of ECE, CEG, Anna University *Apr '11*
- **Best Graduating Student**, Department of ECE, CEG, Anna University *Jan '11*
- **School Topper**, Higher Secondary State Examinations, D.A.V Matriculation HSS, Chennai *May '07*
- Indian Overseas Bank **Scholarship** for securing the 5th rank (among 560,000 candidates) in the Higher Secondary State Examinations, Tamilnadu, India *May '07*

JOURNAL ARTICLES

- Sandip Aine, Siddharth Swaminathan, **Venkatraman Narayanan**, Victor Hwang, and Maxim Likhachev, *Multi-Heuristic A**. International Journal of Robotics Research (IJRR), 2016

PEER-REVIEWED CONFERENCE PUBLICATIONS

- **Venkatraman Narayanan** and Maxim Likhachev, *Discriminatively-guided Deliberative Perception for Pose Estimation of Multiple 3D Object Instances*. Robotics: Science and Systems (RSS), 2016
- **Venkatraman Narayanan** and Maxim Likhachev, *PERCH: Perception via Search for Multi-Object Recognition and Localization*. IEEE International Conference on Robotics and Automation (ICRA), 2016
- Fahad Islam, **Venkatraman Narayanan**, and Maxim Likhachev, *A*-Connect: Bounded Suboptimal Bidirectional Heuristic Search*. IEEE International Conference on Robotics and Automation (ICRA), 2016
- **Venkatraman Narayanan**, Sandip Aine, and Maxim Likhachev, *Improved Multi-Heuristic A* for Searching with Uncalibrated Heuristics*. International Symposium on Combinatorial Search (SoCS), 2015
- Mike Phillips, **Venkatraman Narayanan**, Sandip Aine, and Maxim Likhachev, *Efficient Search with an Ensemble of Heuristics*. International Joint Conference on Artificial Intelligence (IJCAI), 2015
- **Venkatraman Narayanan** and Maxim Likhachev, *Task-Oriented Planning for Manipulating Articulated Mechanisms Under Model Uncertainty*. IEEE International Conference on Robotics and Automation (ICRA), 2015
- Fahad Islam, **Venkatraman Narayanan**, and Maxim Likhachev, *Dynamic Multi-Heuristic A**. IEEE International Conference on Robotics and Automation (ICRA), 2015
- Sandip Aine, Siddharth Swaminathan, **Venkatraman Narayanan**, Victor Hwang, and Maxim Likhachev, *Multi-Heuristic A**. Robotics: Science and Systems (RSS), 2014
[Invited Talk at AAAI 2015]
- Kalin Gochev, **Venkatraman Narayanan**, Benjamin Cohen, Alla Safonova, and Maxim Likhachev, *Motion Planning for Robotic Manipulators with Independent Wrist Joints*. IEEE International Conference on Robotics and Automation (ICRA), 2014
- **Venkatraman Narayanan**, Paul Vernaza, Maxim Likhachev, and Steven M. LaValle, *Planning Under Topological Constraints Using Beam Graphs*. IEEE International Conference on Robotics and Automation (ICRA), 2013
- **Venkatraman Narayanan**, Mike Phillips, and Maxim Likhachev, *Anytime Safe Interval Path Planning for Dynamic Environments*. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2012
- Paul Vernaza, **Venkatraman Narayanan**, and Maxim Likhachev, *Efficiently Finding Optimal Winding-Constrained Loops in the Plane*. Robotics: Science and Systems (RSS), 2012

ABSTRACTS/WORKSHOP PUBLICATIONS

- **Venkatraman Narayanan** and Maxim Likhachev, *PERCH: Perception via Search for Multi-Object Recognition and Localization*. Two-page abstract in Workshop on Object Understanding for Interaction, International Conference on Computer Vision (ICCV), 2015
- Sandip Aine, Siddharth Swaminathan, **Venkatraman Narayanan**, Victor Hwang, and Maxim Likhachev, *Multi-Heuristic A**. Two-page abstract in Proceedings of the International Symposium on Combinatorial Search (SoCS), 2014
[**Best Poster Presentation Award**]
- Paul Vernaza, **Venkatraman Narayanan**, and Maxim Likhachev, *Efficiently finding optimal winding-constrained loops in the plane*. Two-page abstract in Proceedings of the International Symposium on Combinatorial Search (SoCS), 2012

TEACHING EXPERIENCE

- Future Faculty Program, Carnegie Mellon University** *Fall '15 - Present*
- Participant in a multi-semester program on improving pedagogy and course design through seminars, workshops, and teaching feedback consultations
- Guest Lecturer, Indian Institute of Technology, Madras (IITM)** *Oct '16*
- Delivered a lecture on *Robot Motion Planning* in the Introduction to Robotics course at IITM
- Graduate Teaching Assistant, Carnegie Mellon University** *Fall '14*
Course Instructor: Dr. Andrew Bagnell
- Graduate Teaching Assistant for the course 'Statistical Techniques in Robotics'
 - Held weekly office hours, graded homeworks and exams, conducted review sessions and presented a class lecture on *Multi-Armed Bandits*
- Instructor, Robotics Club of CEG, Anna University** *'10 - '11*
- Taught fundamental electronics and programming for freshmen and sophomores

MENTORING

- **Master's Students:**
 - Karthik Vijayakumar, CMU '15
 - Sameer Bardapurkar, CMU '15
 - Fahad Islam, CMU '14 (now Ph.D. candidate in Robotics at CMU)
 - Siddharth Swaminathan, CMU '13
- **Undergraduate Students:**
 - Joseph Shepley, CMU Summer Scholars Program '16 (supported by NSF REU Grant)
 - Shivam Vats, CMU Intern '16
 - Kalyan Vasudev, CMU Intern '15 (now Master's student in Robotics at CMU)
- **High School Students:**
 - Trevor Russo, CMU Intern, '16
- **Committee Member:**
 - Richard Goldstein, PhD Research Qualifier Committee, CMU '16
 - Derek Mitchell, PhD Research Qualifier Committee, CMU '16
 - Ben Holden, Master's Thesis Committee, CMU '16

INVITED TALKS

- *Deliberative Perception for Multi-Object Recognition*, IIT Madras, Chennai Oct '16
- *Discriminatively-guided Deliberative Perception*, Personal Robotics Lab, CMU May '16
- *Task-Oriented Planning for Manipulating Articulated Mechanisms Under Model Uncertainty*, AAAI Jan '15
- *Anytime Safe Interval Path Planning for Dynamic Environments*, Google[x] Apr '13

PROFESSIONAL SERVICES

- Program committee member for
 - International Joint Conference on Artificial Intelligence (IJCAI), 2016
 - 10th International Cognitive Robotics (CogRob) Workshop, in conjunction with IROS 2016
- Reviewer for the following journals/conferences:
 - Workshop on Algorithmic Foundations of Robotics (WAFR), 2016, 2014
 - IEEE Transactions on Circuits and Systems I: Regular Papers, 2016
 - International Joint Conference on Artificial Intelligence (IJCAI), 2015
 - National Conference on Artificial Intelligence (AAAI), 2015, 2014
 - IEEE International Conference on Robotics and Automation (ICRA), 2017, 2015, 2014
 - IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2015, 2014
 - Autonomous Robots (AURO), 2015
 - International Conference on Automated Planning and Scheduling (ICAPS), 2015

NON-ACADEMIC SERVICES

- Board Member ('16 - Present), Treasurer ('13 - '16), Society for the Promotion of Indian Classical Music and Culture Amongst Youth (SPICMACAY), CMU
- Organized the inaugural speed chess tournament at the Robotics Institute, CMU, '16
- Member of the core team behind CEG's annual technical festival 'Kurukshetra', '11
- Organized an online puzzle-solving event which attracted over 5000 participants worldwide, '10
- Conceptualized and organized robotics competitions for a national level technical festival 'Vision', '10

UNDERGRADUATE AWARDS

- Winner, 'Fix the Android', robot debugging contest at NIT Trichy, 2011
- Runner Up, 'Takeshi's Castle', robotics competition at IIT Madras, 2010
- Winner, 'Crop Circles' and 'Park in Place', robotics competitions at NIT Trichy, 2010
- Winner, 'Time Machine', robotics competition at CEG, Anna University, 2010
- Best Design Award, 'Minimouse', robotics competition at NIT Calicut, 2009
- Finalist, 'Gold Rush', robotics competition at IIT Madras, 2009
- Winner, 'Cerebra', puzzle-solving competition at CEG, Anna University, 2010
- Winner, 'Dextera', puzzle-solving competition at MIT, Anna University, 2009
- Winner, 'Kryptyk', puzzle-solving competition at IIT Madras, 2008
- Won circuit debugging contests and math quizzes at CEG, Anna University, SVCE, Chennai and SSN College of Engineering, Chennai

INTERESTS

- Puzzles and Crosswords • Chess • Violin • Indian Classical (Carnatic) Music • Hiking • Short-film making
- Developed a web-application '<http://the-hindu-crossword.appspot.com/>' for interactively solving cryptic crosswords published in the leading Indian newspaper 'The Hindu'