Rohan Thakker

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Experience

Robotics Technologist at NASA's Jet Propulsion Laboratory, Caltech
March 2017 – Current

Autonomy Lead
EELS Snake Robot
October 2019 - Current
Collab with Howie Choset
& Matt Travers (CMU)
Michael Yip (UCSD)

- Building an adaptive autonomy stack for a 48-DoF large-scale (5m long, 400 N.m. peak torque) snake robot, deployed in unknown extreme environments like glaciers, snowy mountains, and Martian analogs. [1]
- Demonstrated the world's first autonomous controlled vertical descent in natural moulins along with surface mobility at the Athabasca Glacier, Canada [2]
- Leading a team of 20+ researchers and engineers. Introduced best practices such as bi-weekly sprints, test-driven-development, CI/CD based-performance tracking, etc [3]

Learning for Planning Lead
DARPA RACER
Oct 2021 – Sep 2022
Collab with Sergey Levine
& Peter Abbeel (UCB)
Sertac Karaman (MIT)

- Developed real-time motion planning algorithms for autonomous high-speed off-road driving on human-scale vehicles
- Exploring different research directions such as RL with zero-shot Sim2Real transfer, Imitation learning, and Value Function-based Planning [4, 5]
- Deployed robots in real-world dessert environments reaching speeds of up to 20 m/s (45 mile per hour) in extreme off-road conditions on steep slopes, sand, around cliffs, and through non-geometric hazards such as bushes

GNC Lead, Team COSTAR
DARPA SubT
June 2018 – Feb 2020
Collab with Boston Dynamics
Luca Carlone (MIT)
Joel Burdick (Caltech)
KAIST, LTU, GaTech

- Developed a unified Guidance, Navigation, and Controls stack for multi-robot teams consisting of drones, high-speed RC cars, tracked/wheeled rovers, and legged robots [6, 7]
- Deployed algorithms in real-world world subterranean environments including natural mines in California, West Virginia, and Pennsylvania [8]
- Developed energy-aware navigation of Rollocopter (hybrid ground-aerial robot) [9] including a robust state estimation framework that leverages heterogeneity/redundancy of sensors/odometry algorithms [10] and collisions with environment [11]

Autonomy Researcher
Verifiable Autonomy for Mars Helicopter & Rover
May 2017 – May 2018
Collab with Richard Murray
& Aaron Ames (Caltech)

- Developed a framework for multi-agent risk-aware planning under uncertainty for coordination of Mars Rover and Mars Helicopter by jointly solving task and motion planning problems.
- Designed the framework to provide safety guarantees by combining tools from Linear Temporal Logic (LTL), Belief space planning, and Control barrier functions. [12, 13, 5]

GNC Researcher
High-speed Quadrotor Flight
Mar 2017 – Feb 2018
Collab with Google Tango Team
& Army Research lab (ARL)

- Worked in collaboration with Google to implement a planner and controller based on differential flatness to perform aggressive maneuvers at high speeds on quadrotors using onboard Visual Inertial Odometry (VIO) from Google Tango [14, 15]
- Developed a stereo vision-based drone detection algorithm and demonstrated performance using a leader-follower behavior on two drones at Army Research Lab for the capstone of Micro Autonomous Systems Technology (MAST) Program [16]

Graduate Student Researcher, Carnegie Mellon University
with Dr. Siddhartha Srinivasa and Dr. Koushil Shreenath
November 2015 – Dec 2016

- Designed and simulated an Image Based Visual Servoing Robust Non-Linear Controller for a quadrotor to guarantee safety using Control Lyapunov and Control Barrier Functions (CLF-CBF)
- Worked on Asymptotically Optimal Kino-dynamic Planning to extend informed-RRT* to non-euclidean distance metrics/cost functions [17]

Research Engineer, Systemantics India Pvt. Ltd.
July 2014 – June 2015 — Bangalore, India

- Designed and implemented real-time controllers for a Novel Hybrid Serial and Parallel Manipulator. Also, derived closed-form solutions for forward/inverse kinematics and forward dynamics of the mechanism
- Extended control policy to suppress vibrations arising from compliance of Harmonic Drives

Education

- Carnegie Mellon University M.S. in Robotic Systems Development, Dec 2016. — GPA: 3.99
- NIT Nagpur, India B.Tech. in Mechanical Engineering, May 2014.

Mentorship and Teaching

Mentored/Advised several graduate students on their research at JPL:

- Fadhil Ginting (PhD, Stanford)
- Paul Nadan (PhD, CMU)
- Harshad Zade (MS, CMU)
- Jenny Zhang (MS, MIT)
- David Fan (PhD, GaTech)
- Jesús Tordesillas Torres (PhD, MIT)
- Abhishek Cauligi (PhD, Stanford)
- Tomoki Emmei (PhD, University of Tokyo)
- Thomas Lew (MS, ETHZ)
- Alatur Nikhilesh (MS, ETHZ)

Founder, Lecturer, and Mentor, IvLabs, NIT Nagpur, India
Jan 2014 – Present — www.ivlabs.in

- Co-founded the innovation lab at NIT to teach students the design cycle of going from requirements to product. The lab has successfully generated more than 75 robotics researchers and entrepreneurs who are creating an impact all over the world
- Mentored undergrad students to build the following robots: Ball collecting robot, Bipedal Robot, Blind Navigator, Maze-solving robot, Snake Robot, and Reconfigurable Bipedal Snake Robot [18, 19, 20]

Patents

- Assistive device for navigation in the dark or non-visibility ambiance (India 406/MUM/201)
- Humanoid robot (India 201721015920)
- Flying snake (Awaiting approval: India 201721020615)

Awards

- *07/2023* **IROS Best Paper Award Nomination** under search and rescue robots category.
- *07/2023* **JPL Voyager Award** for leading the EELS Autonomy Team to a series of highly successful field tests at Table Mountains, Big Bear, Pasadena Ice Rink, and in a walk-in freezer.
- *09/2022* **JPL Team Award** The team performed at high level in preparation and execution of the first DARPA RACER demonstration event.
- *05/2020* **First place in DARPA Subterranean Challenge Urban Circuit)**
- *09/2019* **Second place in DARPA Subterranean Challenge Tunnel Circuit)**
- *07/2019* **JPL Team Award** For tremendous dedication to achieving the final milestone of the Barn Owl project in successfully completing overnight autonomous flights in the dark at the Mars Yard.
- *05/2013* **Texas Instruments Analog Design Context** Device for Substitute Eyes for Blind

Selected Publications (*shared first author)

Total Publications: 35 h-index: 18 i-index: 19

[1] **Thakker, Rohan** and et. al. "EELS: Towards Autonomous Mobility in Extreme Terrain with a Versatile Snake Robot with Resilience to Exteroception Failures". In: *IEEE International Conference on Intelligent Robots and Systems (IROS)*. 2023.

[2] *T. S. Vaquero, *G. Daddi, ***R. Thakker**, *M. Paton, and et. al. "EELS: Autonomous snake-like robot with task and motion planning capabilities for ice world exploration". In: *Science Robotics* (2024).

[3] **Thakker, Rohan** and et. al. "NEO Autonomy for Robustly Exploring Unknown, Extreme Environments with Versatile Robots". In: *AIAA SciTech Forum*. 2024.

[4] John So, Amber Xie, Sunggoo Jung, Jeffrey Edlund, **Thakker, Rohan**, Ali-akbar Agha-mohammadi, Pieter Abbeel, and Stephen James. "Sim-to-Real via Sim-to-Seg: End-to-end Off-road Autonomous Driving Without Real Data". In: *Conference on Robot Learning*. PMLR. 2023.

[5] Sung-Kyun Kim, **Rohan Thakker**, and Ali Agha. "Bi-Directional Value Learning for Risk-Aware Planning Under Uncertainty". In: *IEEE Robotics and Automation Letters* (2019).

[6] Ali Agha, Kyohei Otsu, Benjamin Morrell, David D Fan, **Rohan Thakker**, Angel Santamaria-Navarro, Sung Kim, and Amanda Bouman et. al. "" In: *Journal of Field Robots* (2022).

[7] David D. Fan, Jennifer Nguyen, **Rohan Thakker**, Nikhilesh Alatur, Ali Agha, and Evangelos Theodorou. "Bayesian Learning-Based Adaptive Control for Safety Critical Systems". In: *IEEE International Conference on Robotics and Automation* (2020).

[8] **Rohan Thakker***, Nikhilesh Alatur*, David Fan*, Jesus Tordesillas*, Michael Paton, Kyohei Otsu, Olivier Toupet, and Ali Agha. "Autonomous Off-road Navigation over Extreme Terrains with Perceptually-challenging Conditions". In: *International Symposium on Experimental Robotics* (2021).

[9] David D. Fan, ***Rohan Thakker**, Tara Bartlett, Meriem Ben, Leon Kim, and Ali-Agha. "Autonomous Hybrid Ground/Aerial Mobility in Unknown Environments". In: *Proceedings of the International Symposium on Robotics Research* (2019).

[10] Angel Santamaria, ***Rohan Thakker**, David d. fan, Benjamin Morrell, and Ali Agha. "Towards Resilient Autonomous Navigation of Drones". In: *proceedings of the international symposium on robotics research* (2019).

[11] Thomas Lew, Tomoki Emmei, David D. Fan, Tara Bartlett, Angel Santamaria, **Rohan Thakker**, and Ali Agha. "Contact Inertial Odometry: Collisions are your Friend". In: *Proceedings of the International Symposium on Robotics Research* (2019).

[12] Petter Nilsson, Sofie Haesaert, **Rohan Thakker**, Kyohei Otsu, Cristian Vasile, Ali Agha, Richard Murray, and Aaron Ames. "Toward Specification-Guided Active Mars Exploration for Cooperative Robot Teams." In: *Robotics: Science and Systems* (2018).

[13] Sofie Haesaert, **Rohan Thakker**, Petter Nilsson, Ali Agha, and Richard Murray. "Temporal logic planning in uncertain environments with probabilistic roadmaps and belief spaces". In: *Conference on Decision and Control (CDC)* (2019).

[14] Benjamin Morrell, Marc Rigter, Gene Merewether, Robert Reid, **Rohan Thakker**, Theodore Tzanetos, Vinay Rajur, and Gregory Chamitoff. "Differential flatness transformations for aggressive quadrotor flight". In: *IEEE International Conference on Robotics and Automation* (2018).

[15] Benjamin Morrell, **Rohan Thakker**, Gene Merewether, Robert Reid, Marc Rigter, Theodore Tzanetos, and Gregory Chamitoff. "Comparison of trajectory optimization algorithms for high-speed quadrotor flight near obstacles". In: *IEEE Robotics and Automation Letters* (2018).

[16] Cevahir Cigla, ***Rohan Thakker**, and Larry Matthies. "Onboard stereo vision for drone pursuit or sense and avoid". In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops* (2018).

[17] Daqing Yi, ***Rohan Thakker**, Cole Gulino, Oren Salzman, and Siddhartha Srinivasa. "Generalizing informed sampling for asymptotically-optimal sampling-based kinodynamic planning via Markov chain monte carlo". In: *IEEE International Conference on Robotics and Automation* (2018).

[18] Sachin Bharambe, **Rohan Thakker**, Harsharanga Patil, and K.M. Bhurchandi. "Substitute eyes for blind with navigator using android". In: *2013 Texas Instruments India Educators' Conference* (2013).

[19] **Rohan Thakker**, Ajinkya Kamat, Sachin Bharambe, Shital Chiddarwar, and K. M. Bhurchandi. "Rebis-reconfigurable bipedal snake robot". In: *IEEE/RSJ International Conference on Intelligent Robots and Systems* (2014).

[20] Harshad Zade, Aadesh Varude, Karan Pandya, Ajinkya Kamat, Shital Chiddarwar, and **Rohan Thakker**. "ReQuBiS-Reconfigurable Quadrupedal-Bipedal Snake Robots". In: *International Conference on Automation Science and Engineering* (2021).