Prasanth Kotaru | Resume

4448 MacArthur Blvd, Oakland, CA

 (412) 726 3403 • ✉ prasanth.kotaru@berkeley.edu • 🌐 vkotaru.github.io

Education

o **Ph.D.**, Controls, in Mechanical Engineering, ... *2017-2022*[†]
  University of California, Berkeley (UCB), CA. *Advisor:* Koushil Sreenath

o **Master of Science** in Mechanical Engineering, ... *2015-2017*
  Carnegie Mellon University (CMU), Pittsburgh, PA. *Advisor:* Koushil Sreenath

o **Bachelor of Technology** in Mechanical Engineering, ... *2010-2014*
  Indian Institute of Technology Madras (IITM), Chennai, India. *Advisor:* Krishnan Balasubramanian

Relevant Courses: Nonlinear Controls, Predictive Control, Hybrid systems and Intelligent Controls, Engineering Optimization, Linear Systems, Stochastic Systems: Estimation and Control, Computer Vision, Deep Reinforcement Learning, Decision Making, and Control,

[†] - expected

Experience

o **Motion Planning Intern, Autopilot, Tesla**. .... *Sep'21-Dec'21*
  - Worked on designing optimization models for autonomous vehicle turning, factoring comfort and safety.
  - Designed various cost-function heuristics for generating smooth motion planning trajectories and validated them on the vehicle.

o **Autonomy Intern, Monarch Tractor.** .... *Jun'21-Aug'21*
  - Implemented and tested model predictive control (MPC) for autonomous navigation of electric tractor in the field.
  - Automated the process to convert custom CAN topics to ROS messages and publish the topics, which allowed for faster incremental development.

o **Graduate Student Researcher**, *Hybrid Robotics Group*, UCB. .... *Aug'17-Present*
  - Developed custom quadrotor flight control firmware to test various control strategies such as model predictive control (MPC), control Lyapunov and control barrier functions (CLF-CBF) based QP on the hardware.
  - Developed control (geometric, adaptive), estimation (on smooth manifolds) and planning (direct-collocation) algorithms for multi-aerial payload transportation.
  - Built hardware to test multiple quadrotor collaborative aerial manipulation tasks, such as carrying a hose/tether.
  - UCB *Graduate Division Block Grant* for summers of 2018 and 2019.

o **Graduate Research Assistant**, *Hybrid Robotics Group*, CMU. .... *Aug'15–July'17*
  - Modeled the dynamics for a load suspended from a quadrotor through flexible cable using coordinate-free representation.
  - Studied differential-flatness for such systems and developed trajectory tracking controllers.

o **Research Assistant**, *Centre for Non-destructive Evaluation (CNDE)*, IITM. .... *Aug'14–May'15*
  - Electronics lead for developing the field prototype of a pipe-defect detection sensor at high-temperatures.
  - Designed a portable signal acquisition system for the sensor and successfully tested it in the field at Reliance refinery, Jamnagar, India.

o Graduate Student Instructor, **Nonlinear Systems & Control** [ME C237], UCB *Spring 2019*

o Graduate Course Assistant, **Mechanical Systems & Experimentation** [ME 24-452], CMU *Fall 2016*

Skills

o Controls & Planning, Estimation and Perception, Computer Vision, Reinforcement Learning
o C/C++, Python, MATLAB, Scala
o Experience with developing custom flight control firmware (for quadrotors).
o ROS, Gazebo simulator, PyBullet, TensorFlow, OpenCV, Solidworks
o Embedded systems such as Raspberry Pi, Navio2, Pixhawk, Arduino, etc.

Projects

- **Trajectory planner for quadrotor with a cable-suspended payload**
  - Developed the trajectory planner by formulating a direction-collocation based optimization problem.
  - Exploited the differential-flatness nature of the system to reduce the computation time.
  - Implemented the planner on a Navio2 based quadrotor with custom firmware developed in C++.
- **L_1 adaptation scheme for a quadrotor with geometric-attitude control**
  - Developed an L_1 adaptation scheme for a quadrotor with geometric-attitude control in the presence of disturbances and model uncertainties.
  - Experimentally validated the control on a quadrotor with added weight in motion-capture.
- **Symbolic computation toolbox for generating Lagrange-Hamiltonian dynamics**
  - Developed a Python symbolic computation toolbox for generating dynamics of robotic systems.
  - The package generates dynamics for a system in $SO(3)$ and S^2 manifolds using the principle of least action.
- **Stair climbing using virtual model control for 2D bipedal locomotion**
  - Extended virtual model control techniques with addition models to achieve step climbing of biped robots.
  - Tested the controller in MATLAB SimMechanics environment on 5-link 2D walking robot.
- **Probabilistic control barrier functions for safety critical control**
  - Modified to CLF-CBF quadratic programming based controllers to an SOCP based controller to account for uncertainties in the barrier functions.
  - Resulting controller observes conservative approach to ensure safety with increased uncertainty in the perception.
- **Reinforcement Learning for Legged Robots balancing**
  - Explored reinforcement learning techniques to find robust control policies for a bipedal robot Cassie.
  - Learned a robust balancing control policy for the robot in the Mujoco environment.

Publications

Preprint...

[P1] Karan P. Jain*, **Prasanth Kotaru***, Massimiliano de Sa, Mark W. Mueller†, and Koushil Sreenath†, *"Tethered Power Supply for Quadcopters: Architecture, Analysis and Experiments"*, [pdf]

Journals...

[J1] **Prasanth Kotaru**, Ryan Edmonson, and Koushil Sreenath, *"Geometric L_1 Adaptive Attitude Control for a Quadrotor UAV"*, ASME, Journal of Dynamic Systems, Measurement, and Control, March 2020; 142(3): 031003. [doi], [pdf]

[J2] Jun Zeng, **Prasanth Kotaru**, Mark W. Mueller, and Koushil Sreenath. *"Differential Flatness Based Path Planning With Direct Collocation on Hybrid Modes for a Quadrotor With a Cable-Suspended Payload"*, IEEE Robotics and Automation Letters 5, no. 2 (2020): 3074-3081. [doi], [pdf]

Conferences...

[C1] **Prasanth Kotaru** and Koushil Sreenath. *"Multiple Quadrotors Carrying a Flexible Hose: Dynamics, Differential Flatness and Control"*, IFAC World Congress, 2020, [pdf]

[C2] Katherine L. Poggensee*, Albert H. Li*, Daniel Sotsaikich*, Bike Zhang, **Prasanth Kotaru**, Mark Mueller, and Koushil Sreenath. *"Ball Juggling on the Bipedal Robot Cassie"*, European Control Conference (ECC), 2020, [pdf]

[C3] **Prasanth Kotaru** and Koushil Sreenath. *"Variation Based Extended Kalman Filter on S^2"*, In 2019 18th European Control Conference (ECC), pp. 875-882. IEEE, 2019, [pdf]

[C4] Jun Zeng, **Prasanth Kotaru**, and Koushil Sreenath. *"Geometric control and differential flatness of a quadrotor UAV with load suspended from a pulley"*, In 2019 American Control Conference (ACC), pp. 2420-2427. IEEE, 2019, [pdf]

[C5] **Prasanth Kotaru**, Guofan Wu, and Koushil Sreenath. *"Differential-flatness and control of quadrotor (s) with a payload suspended through flexible cable (s)"*, In 2018 Indian Control Conference (ICC), pp. 352-357. IEEE, 2018, [pdf]

[C6] **Prasanth Kotaru**, Guofan Wu, and Koushil Sreenath. *"Dynamics and control of a quadrotor with a payload suspended through an elastic cable"*, In 2017 American Control Conference (ACC), pp. 3906-3913. IEEE, 2017, [pdf]

Reviewer...

ICRA (2022, 2021, 2020), IROS(2022, 2020), RAL(2022, 2021), ECC(2021), ACC(2021), CDC(2020), ICC(2019),

_____