

# Pranav Thakkar

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## RESEARCH INTERESTS

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Robust Perception, Safe Learning for Robotics, Pose Graph Optimization

## EDUCATION

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### Indian Institute of Technology, Bombay

B.Tech. & M.Tech., Aerospace Engineering (GPA: 9.02/10 | Rank 2)  
*Minor in Systems & Controls Engineering*

Mumbai, India  
Jul 2015 - Jun 2020

**Thesis:** Bearing-Only Localization in Uncertain Environments

*Guides: Prof. Leena Vachhani & Prof. Hemendra Arya*

## RESEARCH EXPERIENCE

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### Honda R&D Co. Ltd.

Research Engineer, Robot Vision

Wako, Japan  
Dec 2020 - Present

Have worked towards:

- Real-time **semantic elevation mapping** for off-road robot navigation
- Robust **lidar-inertial mapping** and subsequent localization in semi-static environments
- **Global point cloud registration** to initialize a factor graph from arbitrary poses

### ARMS Laboratory, IIT Bombay

Graduate Student Researcher

Mumbai, India  
Aug 2018 - Sep 2020

Collaborated with *Prof. Leena Vachhani*

- Designed tunable robust estimators for bearing-only navigation in semi-static environments [4]
- Discussed **nonlinear observability**; showed natural extension to similar estimation problems [1, 3]
- Compared algorithms for landmark selection for localization tasks in a visual homing setting [5]

### COVID-19 Research Group

Student Researcher

Mumbai, India  
Mar 2020 - Sep 2020

Collaborated with *Prof. Sai Vinjanampathy & Prof. Mithun Mitra*

- Extended the SIR model for infectious diseases to forecast COVID-19 cases under lockdown [2]
- Converted the epidemiological model to a tractable **constrained state estimation** problem

### Aerospace Systems Laboratory, UT Arlington

Summer Research Intern

Arlington, TX, USA  
May 2018 - Jul 2018

Collaborated with *Prof. Kamesh Subbarao*

- Worked on calibration and modelling of a limited FOV LiDAR on a low frequency servo motor
- Implemented ROS-based nonlinear Kalman filter to update occupancy grid after each sweep

### Supervised Learning, Thermoacoustics

Student Researcher

Mumbai, India  
Aug 2017 - Nov 2017

Collaborated with *Prof. Aniruddha Sinha*

- Studied thermoacoustic instability in aircraft engines & control through fuel flow rate variation
- Employed model order reduction; gauged closed-loop frequency response of approximated system

## PUBLICATIONS & PREPRINTS

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- [1] **Pranav N. Thakkar**, Prashant V. Patil, and Leena Vachhani. “Unobservable Spaces for Bearing-Only Localization”. In: *2021 American Control Conference (ACC)*. 2021, pp. 92–97.
- [2] Sanit Gupta, Sahil Shah, Sumit Chaturvedi, **Pranav Thakkar**, Parvinder Solanki, Soham Dibyachintan, Sandeepan Roy, M. B. Sushma, Adwait Godbole, Noufal Jaseem, Pradumn Kumar, Sucheta Ravikanti, Aritra Das, Giridhara R. Babu, Tarun Bhatnagar, Avijit Maji, Mithun K. Mitra, and Sai Vinjanampathy. “An India-specific Compartmental Model for Covid-19: Projections and Intervention Strategies by Incorporating Geographical, Infrastructural and Response Heterogeneity”. In: arXiv, 2020.
- [3] **Pranav Thakkar**. “Bearing-Only Localization in Uncertain Environments”. MA thesis. Indian Institute of Technology, Bombay, 2020.
- [4] Prashant V. Patil\*, **Pranav Thakkar**\*, and Leena Vachhani. “State Estimation for Vision-based Localization under Uncertain Conditions”. In: arXiv, 2019.
- [5] **Pranav Thakkar** and Leena Vachhani. “Optimal Landmark Selection for Bearing-Only Navigation”. In: *Proceedings of the Advances in Robotics 2019*. AIR 2019. Chennai, India: Association for Computing Machinery, 2019.

\* work involved equal contribution from authors

## AWARDS

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<b>IIT Bombay Undergraduate Research Award</b>	May 2019
<b>Bronze, PlutoX Drone Hackathon</b> , Inter IIT Technical Meet	Dec 2018
<b>ICSE Governor’s Gold Medal</b>	Aug 2013
<b>Pace Junior Science Scholarship</b>	Jun 2013

## INVITED TALKS

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<b>Landmark Selection Algorithms for Robot Navigation</b>	Dec 2018
Autonomous Systems Session, Inter IIT Student Academic Conference	Mumbai, India
<b>Introduction to Dynamics &amp; Control</b>	Mar 2019
Department of Aerospace Engineering, IIT Bombay	Mumbai, India

## TEACHING ASSISTANTSHIPS

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<b>AE 240 : Spaceflight Mechanics</b>	Instructor: Prof. Ashok Joshi
Indian Institute of Technology, Bombay	Jan 2020 - Apr 2020
<b>AE 333 : Aerodynamics</b>	Instructor: Prof. Vineeth Nair
Indian Institute of Technology, Bombay	Aug 2019 - Nov 2019

## COURSEWORK

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Math	Calculus, Linear Algebra, Partial Differential Equations, Numerical Analysis
Aerodynamics	Aerodynamics, Rotary Wing Aerodynamics
Systems & Control	Linear & Nonlinear Control, Adaptive Control, Differential Geometric Methods in Control, Navigation & Guidance, State Space Methods for Flight Vehicles
Dynamics	Analytical & Geometric Dynamics, Vibrational Dynamics for Structures
Robotics	State Estimation, Robotics, Advanced Topics in Mobile Robotics

## SKILLS

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Programming C++, Python  
Software ROS & ROS2, Gazebo, MATLAB, Simulink  
Libraries OpenCV, PCL, PyTorch, Eigen, GTSAM, Ceres  
Miscellaneous CMake, Git, Docker, L<sup>A</sup>T<sub>E</sub>X

## PROFESSIONAL SERVICE

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Reviewer for American Control Conference (ACC) and IEEE Control System Letters (L-CSS) in 2021

## POSITIONS OF RESPONSIBILITY

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<b>Mentor</b> , Institute Student Mentorship Programme Assisted freshmen with settling into college life, balancing academics with extracurriculars and planning curriculum roadmap	Jul 2019 - May 2020
<b>Student Host</b> , International Relations Office Helped exchange students from foreign universities with the academic system, registration and general queries about campus life	Jul 2018 - May 2020
<b>Mentor</b> , Academic Rehabilitation Programme Guided students with academic backlog in managing course load and charting out plan towards graduation	Jul 2018 - May 2020
<b>Institute Music Secretary</b> , Culturals@IITB Head of social media, publicity, logistics and execution of all musical performances, workshops and informal jam sessions on campus	Apr 2017 - Mar 2018

## REFERENCES

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Available on request.