

# Akshay Shetty

## Curriculum Vitae

🌐 [\[Personal website\]](#)

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📍 Stanford, CA

## Education

<b>Ph.D. Aerospace Engineering</b> <a href="#">[thesis]</a> University of Illinois at Urbana-Champaign	Champaign, Illinois <b>2017–2021</b>
<b>M.S. Aerospace Engineering</b> <a href="#">[thesis]</a> University of Illinois at Urbana-Champaign	Champaign, Illinois <b>2014–2017</b>
<b>B.Tech. Aerospace Engineering</b> Indian Institute of Technology Bombay	Mumbai, India <b>2010–2014</b>

## Research and Work Experience

**Postdoctoral Researcher** Stanford, California  
NAV Lab [\[website\]](#), Stanford University **2021–2022**

- Initiated and supervised research projects related to robust state estimation and safe navigation of autonomous systems. Key projects include:
  - o improving GNSS localization using a Set Transformer-based neural network; evaluating our algorithm on large-scale real-world Android raw measurements [\[pdf\]](#)[\[video\]](#)[\[code\]](#)
  - o GPS-IMU filtering using Chimera authentication for spoofing-mitigation; evaluating our algorithm for different grades of IMU and under varying spoofing attacks [\[pdf\]](#)[\[video\]](#)

**Graduate Research Assistant** Champaign, Illinois  
Grace Gao Research Group [\[website\]](#), UIUC **2014–2021**

- Led projects related to multi-sensor fusion (GPS, IMU, etc.), state estimation and trajectory planning of autonomous systems. Key projects include:
  - o planning under state uncertainty for multiple UAVs using reachability analysis [\[pdf\]](#)[\[video\]](#)
  - o adaptively estimating covariance of LiDAR-based positioning errors for GPS-LiDAR sensor fusion with the aid of 3D city models [\[pdf\]](#)[\[video\]](#)
  - o estimating global pose between a UAV image and satellite imagery using ConvNets; integrating pose output with feature-based visual odometry using a Kalman filter [\[pdf\]](#)[\[video\]](#)
  - o robustly estimating UAV position and heading using 2 GPS receivers, an IMU and a camera; resolving GPS carrier phase ambiguities with the aid of feature-based visual odometry [\[pdf\]](#)

**Research Intern** Mountain View, California  
NASA Ames Research Center **Summers 2016 & 2017**

- Setup the experimental testbed for NASA's SAFE50 project: developed software for visual SLAM-based autonomous UAV navigation and implemented on-board learning-based object detection for daily household items [\[video\]](#)[\[code\]](#)
- Mentored and led a team of 3 student interns to develop visual-tag-based autonomous UAV navigation with obstacle avoidance using time-of-flight proximity sensors [\[video\]](#)[\[slides\]](#)[\[code\]](#)

**Visiting Research Student** Shrivenham, UK  
Defence Academy, Cranfield University **Summer 2013**

- Improved Virtual Battle Space (VBS) training experience for defence personnel by developing and importing high-fidelity vehicle models from IPG Carmaker

**Research Intern** Bangalore, India  
Indian Space Research Organization (ISRO) **Summer 2012**

- Evaluated the performance of various existing GPS localization algorithms for the then upcoming Indian Regional Navigation Satellite System

# Publications










State Estimation, Sensor Fusion

Deep Learning



Motion and Trajectory Planning

Perception













## Journal Papers

-  1. Tara Mina, Ashwin V. Kanhere, **Akshay Shetty**, and Grace Gao, “GPS Spoofing-Resilient Filtering with Chimera and Self-Contained Odometry,” *NAVIGATION: Journal of the Institute of Navigation*, Submitted. [\[pdf\]](#)
-   2. **Akshay Shetty**, Timmy Hussain and Grace Gao, “Decentralized Connectivity Maintenance for Multi-robot Systems Under Motion and Sensing Uncertainties,” *NAVIGATION: Journal of the Institute of Navigation*, Accepted. [\[pdf\]](#)[\[video\]](#)
-   3. Ashwin V. Kanhere\*, Shubh Gupta\*, **Akshay Shetty**, and Grace Gao, “Improving GNSS Positioning using Iterative Deep Corrections,” *NAVIGATION: Journal of the Institute of Navigation*, DOI: 10.33012/navi.548, December 2022. [\[pdf\]](#)[\[video\]](#)[\[code\]](#)
-   4. **Akshay Shetty** and Grace Gao, “Predicting State Uncertainty Bounds Using Non-linear Stochastic Reachability Analysis for Urban GNSS-based UAS Navigation,” *IEEE Intelligent Transportation Systems*, DOI: 10.1109/TITS.2020.3040517, November 2020. [\[pdf\]](#)
-   5. **Akshay Shetty** and Grace Gao, “Adaptive Covariance Estimation of LiDAR-based Positioning Errors for UAVs,” *NAVIGATION: Journal of the Institute of Navigation*, DOI: 10.1002/navi.307, May 2019. [\[pdf\]](#)

## Magazine Articles

-   1. **Akshay Shetty** and Grace Gao, “GPS-LiDAR Fusion with 3D City Models,” *GPS World Magazine*, Cover Story, September 2017. [\[pdf\]](#)[\[video\]](#)

## Conference Papers

-   1. **Akshay Shetty**, Adam Dai, Alexandros Tzikas and Grace Gao, “Safeguarding Learning-Based Planners Under Motion and Sensing Uncertainties Using Reachability Analysis,” *International Conference on Robotics and Automation (ICRA) 2023*, Accepted. [\[pdf\]](#)[\[video\]](#)
-   2. Shubh Gupta\*, Ashwin V. Kanhere\*, **Akshay Shetty**, and Grace Gao, “Designing Deep Neural Networks for Sequential GNSS Positioning,” *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2022)*, Denver, CO, Sep. 2022. **Best Presentation of the Session Award.** [\[pdf\]](#)[\[slides\]](#)[\[video\]](#)
-  3. Tara Mina, Ashwin V. Kanhere, **Akshay Shetty**, and Grace Gao, “GPS Spoofing-Resilient Filtering with Chimera and Self-Contained Odometry,” *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2022)*, Denver, CO, Sep. 2022. [\[pdf\]](#)[\[slides\]](#)[\[video\]](#)
-  4. Ashwin V. Kanhere, Tara Mina, **Akshay Shetty**, and Grace Gao, “Factor Graph-based Spoofing Mitigation using the Chimera Signal Enhancement,” *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2022)*, Denver, CO, Sep. 2022. [\[pdf\]](#)[\[slides\]](#)[\[video\]](#)
-   5. **Akshay Shetty**, Timmy Hussain and Grace Gao, “Decentralized Connectivity Maintenance for Multi-robot Systems Under Motion and Sensing Uncertainties,” *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2021)*, St. Louis MO, Sep. 2021. **Best Presentation of the Session Award.** [\[pdf\]](#)[\[slides\]](#)[\[video\]](#)
-   6. Ashwin V. Kanhere\*, Shubh Gupta\*, **Akshay Shetty**, and Grace Gao, “Improving GNSS Positioning using Iterative Deep Corrections,” *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2021)*, St. Louis MO, Sep. 2021. [\[pdf\]](#)[\[slides\]](#)[\[video\]](#)[\[code\]](#)
-   7. **Akshay Shetty** and Grace Gao, “Trajectory Planning Under Stochastic and Bounded Sensing Uncertainties Using Stochastic Reachability,” *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2020)*, St. Louis MO, Sep. 2020. [\[pdf\]](#)[\[slides\]](#)[\[video\]](#)

- 8. **Akshay Shetty** and Grace Gao, "Predicting State Uncertainty for GNSS-based UAV Path Planning Using Stochastic Reachability," *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2019)*, Miami FL, Sep. 2019. [[pdf](#)][[slides](#)]
- 9. **Akshay Shetty** and Grace Gao, "UAV Pose Estimation using Cross-view Geolocalization with Satellite Imagery," *International Conference on Robotics and Automation (ICRA)*, Montreal, Canada, May 2019. [[pdf](#)][[video](#)][[data](#)]
- 10. **Akshay Shetty** and Grace Gao, "Covariance Estimation for GPS-LiDAR Sensor Fusion for UAVs," *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2017)*, Portland OR, Sep. 2017. [[pdf](#)]
- 11. **Akshay Shetty** and Grace Gao, "Vision-Aided Measurement Level Integration of Multiple GPS Receivers for UAVs," *Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2015)*, Tampa FL, Sep. 2015. [[pdf](#)]
- 12. **Akshay Shetty** and Grace Gao, "Measurement Level Integration of Multiple Low-Cost GPS Receivers for UAVs," *Proceedings of the International Technical Meeting of the Institute of Navigation (ION ITM 2015)*, Dana Point, CA, Jan. 2015. [[pdf](#)]

## Relevant Projects

### Autonomous Multi-robot Exploration

DARPA Subterranean (SubT) Challenge - Virtual

Summer 2019

- Developed autonomous navigation solutions for multiple robots exploring underground environments; adapted existing learning-based object detectors to detect a pre-specified list of artifacts; qualified as a preliminary finalist while participating as a one-member team [[announcement](#)]

### Active Sensing for Robot Localization

Course project [[presentation](#)]

Fall 2018

- Applied Reinforcement Learning to actively point limited field-of-view sensors at feature-rich areas

### Deep Learning for LiDAR Odometry

Course project [[report](#)]

Fall 2017

- Designed ConvNets to estimate LiDAR odometry; set up simulator in Unity game engine to generate training, validation and test data [[video](#)]

### Parallel Point Cloud Feature Extraction

Course project [[report](#)]

Spring 2017

- Developed parallel CUDA-accelerated algorithms for feature extraction from 3D point clouds; evaluated algorithms on a NVIDIA Jetson TX2 connected to a Velodyne LiDAR

## Skills

<b>Sensors</b>	GPS, IMU, Cameras, LiDAR, proximity sensors
<b>Programming</b>	Python, C++, MATLAB/Simulink, Git
<b>Learning and Robotics</b>	ROS, Arduino, PyTorch, AirSim, Unity, Gazebo, Pixhawk

## Honors and Awards

- 2022 Best Presentation of the Session Award [[video](#)], *ION GNSS+ 2022*
- 2021 Best Presentation of the Session Award [[video](#)], *ION GNSS+ 2021*
- 2019 Video of the Month [[video](#)], *Coordinated Science Lab, University of Illinois*
- 2016 Google Special Mention, *HackIllinois*
- 2015 Most Creative Team, *Smart Bar Hackathon*
- 2014 Institute Silver Medal, *Indian Institute of Technology Bombay*

## Academic Community Service

Session Chair, *ION ITM Conference* [[website](#)]

Jan 2022

Session: Navigation of Unmanned Aerial Vehicles and other Autonomous Systems

### **Paper Reviewer**

*IEEE Transactions on Robotics (T-RO); International Conference on Robotics and Automation (ICRA); NAVIGATION: Journal of The Institute of Navigation; IEEE Transactions on Aerospace and Electronic Systems (T-AES); AIAA Journal of Guidance, Control, and Dynamics (JGCD).*

## **Teaching**

**Collaborator, AA173: *Flight Mechanics and Controls*** **Spring 2021**  
Stanford University

**Lab and Teaching Assistant, AE483: *UAV Navigation and Control*** **Fall 2015 & Fall 2016**  
University of Illinois at Urbana-Champaign

**Teaching Assistant, AE353: *Aerospace Control Systems*** **Spring 2016 & Spring 2015**  
University of Illinois at Urbana-Champaign

**Teaching Assistant, *Dynamics and Control in State-Space*** **Summer 2014**  
Indian Institute of Technology Bombay

**Teaching Assistant, MA214 *Numerical Analysis*** **Summer 2014 & Fall 2013**  
Indian Institute of Technology Bombay