

Kshitij Goel

Ph.D. Student, [The Robotics Institute](#), Carnegie Mellon University

[website](#) • [google scholar](#) • kshitij@cmu.edu

EDUCATION

Ph.D. in Robotics 2021 - 2024 (expected)
The Robotics Institute, Carnegie Mellon University, Pittsburgh, USA

Master of Science in Robotics 2019 - 2021
The Robotics Institute, Carnegie Mellon University, Pittsburgh, USA

Bachelor of Technology (Honours), Aerospace Engineering 2013 - 2017
Indian Institute of Technology Kharagpur, Kharagpur, India

SELECTED PUBLICATIONS

[1] **K. Goel**, W. Tabib, and N. Michael, *Rapid and High-Fidelity Subsurface Exploration with Multiple Aerial Robots*, International Symposium on Experimental Robotics (ISER), Malta, November 2021.

[2] W. Tabib, **K. Goel**, J. Yao, C. Boirum, and N. Michael, *Autonomous Cave Surveying with an Aerial Robot*, IEEE Transactions on Robotics (T-RO), August 2021.

[3] **K. Goel**, M. Corah, C. Boirum, and N. Michael, *Fast Exploration with Multirotors: Analysis, Planning, and Experimentation*, Field and Service Robotics (FSR), Japan, August 2019.

[4] W. Tabib, **K. Goel**, J. Yao, M. Dabhi, C. Boirum, and N. Michael, *Real-time Information-Theoretic Exploration with Gaussian Mixture Model Maps*, Robotics: Science and Systems (RSS), Germany, June 2019.

[5] M. Corah, C. O'Meadhra, **K. Goel**, and N. Michael, *Communication-Efficient Planning and Mapping for Multi-Robot Exploration in Large Environments*, IEEE Robotics and Automation Letters (RA-L) (ICRA track), 4(2):1715-1721, April 2019.

RESEARCH EXPERIENCE

Graduate Student AUG, 2019 - PRESENT
[Resilient Intelligent Systems Lab](#), The Robotics Institute at Carnegie Mellon University.
Mentors: [Prof. Nathan Michael](#), [Prof. Wennie Tabib](#)

- **Exploration of subsurface environments using aerial robots.** Designed and implemented an anytime motion planning strategy that is capable of finding informative actions with different field-of-view range sensors. Real-world results with an aerial robot exploring a natural cave with a high perceptual detail [1, 2]. [VIDEO 1](#), [VIDEO 2](#), [VIDEO 3](#)
- **Rapid multi-robot exploration using aerial robots.** Extended the single-robot work in [3] to multiple robots. Result is a system that is capable of exploring subterranean voids at a high rate and fidelity [1]. [VIDEO 1](#), [VIDEO 2](#)

Research Assistant AUG, 2017 - AUG, 2019
[Resilient Intelligent Systems Lab](#), The Robotics Institute at Carnegie Mellon University.
Mentors: [Prof. Nathan Michael](#), Dr. Micah Corah

- **Fast exploration using multirotors.** Developed a planning algorithm that allows for **motion primitive-based informative action selection** under platform constraints. Achieved exploration at speeds up to **2.6 m/s**. [VIDEO 1](#), [VIDEO 2](#)
- **Multi-robot exploration using multirotors.** Helped address challenges due to limited inter-robot communication via Gaussian Mixture Model (GMM) based mapping and an information-

theoretic planning technique. Achieved **nearly 10x decrease in required communication bandwidth** amongst robots in simulated experiments [5]. [VIDEO](#)

- **High-speed assistive teleoperation of multirotors.** Developed a **maximum likelihood-based parameter estimator** and **high-fidelity simulation tools using Unreal Engine** to test high-speed visual navigation and enable accurate tracking performance for agile flight.

Undergraduate Researcher

AUG, 2016 - APR, 2017

Intelligent Systems Lab, Aerospace Engineering at Indian Institute of Technology Kharagpur.

Mentors: [Prof. Manoranjan Sinha](#), Prof. Bijoy Mukherjee

- **Reconfigurable controller for a damaged fighter jet aircraft.** Designed a controller which adapts to severe wing damage and enables performing high angle-of-attack supermaneuvers using sliding mode control augmented with a multi-layer neural network.
- Conducted stability analysis for the asymmetric damaged aircraft and the proposed control strategy using **Bifurcation theory** and **Lyapunov stability theory**.

HONORS

- 2017 **FICCI Fellow, Robotics Institute Summer Scholars (RISS) program (5/800).** [LINK](#)
- 2015-17 **Boeing-IIT Kharagpur University Relations Fellow** for best all-round performance in Aerospace Engineering, IIT Kharagpur (**2/50**). [MORE INFO](#)
- 2015 Represented IIT Kharagpur at the **Boeing Innovation Summit** organized by The Boeing Company, USA (**5/200**). [EVENT WEBPAGE](#)

SERVICE

- 2021 Reviewer for RA-L.
- 2021 Reviewer for IROS and ICRA.
- 2017 Peer Reviewer, Robotics Institute Summer Scholars Working Papers Journal.

LEADERSHIP EXPERIENCE

Boeing Student Team Lead

AUG, 2015 - MAR, 2016

Boeing Student Project, Aerospace Engineering at Indian Institute of Technology Kharagpur.

Mentor: Boeing India

- Led a team of 4 students to develop a grant proposal to design, fabricate, and reliably fly a fixed-wing vertical-takeoff and landing (VTOL) aircraft capable of achieving the required endurance and payload benchmarks. Demonstrated successful teleoperation performance. [VIDEO](#)

Undergraduate Research Team Lead

MAR, 2015 - MAR, 2017

[Autonomous Underwater Vehicle \(AUV\) Group](#), Indian Institute of Technology (IIT), Kharagpur.

Mentor: [Prof. Vishwanath Nagarajan](#)

- Led a group of 15 that developed and integrated control, motion planning, and computer vision [software systems](#) for an AUV.
- Developed an **open-source high-fidelity AUV simulator** to test various control algorithms for the vehicle and a long duration navigation system using a error-state kalman filter.