

# Harsh Sinha

• SENIOR UNDERGRADUATE STUDENT • INDIAN INSTITUTE OF TECHNOLOGY, KANPUR •

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## Education

Indian Institute of Technology, Kanpur (IIT Kanpur)

July 2014—Present

B.TECH IN AEROSPACE ENGINEERING, WITH A SECOND MAJOR IN ELECTRICAL ENGINEERING

GRSS Vidya Mandir, Bhagalpur, Bihar

April 2007—July 2013

CENTRAL BOARD OF SECONDARY EDUCATION

## Publications

### PUBLISHED

**Convolutional Neural Network based Sensors for Mobile Robot Relocalization** | [📄 PDF] [📄 IEEE]

ACCEPTED AT IEEE MMAR 2018, MIĘDZYDROJE, POLAND

Harsh Sinha, Jay Patrikar, Eeshan Dhekane, Gaurav Pandey, Mangal Kothari

**Autonomous Detection & Tracking of High-Speed Ground Vehicle using a Quadrotor** | [📄 PDF] [📄 IEEE]

ACCEPTED AT AIAA SciTech Forum and Exposition 2019

Animesh Kumar Shastri, Harsh Sinha, Mangal Kothari

### SUBMITTED

**Vision based Autonomous Tracking and Landing of a Fully Actuated Rotorcraft** | [📄 PDF] [📄 VIDEO]

SUBMITTED TO CONTROL ENGINEERING PRACTICE, AN ELSEVIER JOURNAL

Mahathi T Bhargavapuri, Animesh Kumar Shastri, Harsh Sinha, Soumya Ranjan Sahoo, Mangal Kothari

## Experience & Relevant Projects

**Drone Swarm Development for Humanitarian Assistance and Disaster Relief**

Oct 2018—Present

WITH DR. M. KOTHARI, DR. ABHISHEK, DR. V. P. NAMBOODIRI, DR. K. RAJAWAT, DR. S. R. SAHOO, AND DR. S. GOEL

IIT Kanpur

- Working on development of a **drone swarm** as the first response for **Humanitarian Assistance and Disaster Relief operations**.
- The primary objective is to showcase a VTOL swarm of **50 UAVs** that can travel **50 km** and collaboratively scan a 1 km by 1 km region.

**Intelligent Ground Vehicle** | [📄 REPORT] | [📄 CODE] | [📄 WEBSITE]

Nov 2016—Present

TEAM LEADER UNDER MENTORSHIP OF PROF. GAURAV PANDEY AND PROF. MANGAL KOTHARI

AUVSI IGVC, IIT Kanpur

COURSE PROJECT PROBABILISTIC MOBILE ROBOTICS | [📄 REPORT]

- Developed a **fully autonomous vehicle** for **waypoint navigaiton, obstacle avoidance and lane driving** on challenging terrain.
- Created the stack for **Computer Vision, Sensor Fusion, SLAM, Motion Planning and Control** and now mentor a team of 20 students.

**Deep Reinforcement Learning for Optimal Navigation of a Visually Guided UAV**

May 2018—Present

ONGOING PROJECT WITH PROF. FARSHAD KHORRAMI, DR. PRASHANT KRISHNAMURTHY AND NAMAN PATEL

CRR Lab, NYU Tandon

- Developed a modular framework for Deep RL for UAVs using **ROS, Gazebo Sim, Visual SLAM** and a custom RL training module.

**CNN-based Sensors for Mobile Robot Relocalization** | [📄 REPORT] | [📄 SLIDES]

May 2017—Sep 2017

WITH PROF. GAURAV PANDEY, PROF. MANGAL KOTHARI, JAY PATRIKAR AND EESHAN DHEKANE

IIT Kanpur

- Proposed a novel, robust and real-time **Convolutional Neural Network** based algorithm for **Mobile Robot Relocalization**.
- Integrated **Pose Estimation from RGB Images** with **Extended Kalman Filter** using the **ROS-Caffe** Platform.

**Vision based Autonomous Tracking and Landing on Moving Platforms** | [📄 PAPER]

March 2018—Sep 2018

WITH PROF. MANGAL KOTHARI, PROF. SOUMYA RANJAN SAHOO, MAHATHI T.B. AND ANIMESH K. SHASTRY

IIT Kanpur

- Developed a novel method to tracking of and landing on vehicles moving at high speeds using only vision based relative positioning.
- Proposed a novel high performance **Adaptive Controller** for motion estimation and showed performance in real-world upto 20 kmph.

## Human Tracking and Following Quadrotor | [REPORT] | [CODE]

Jan 2018—April 2018

COURSE PROJECT WITH PROF. MANGAL KOTHARI AND SHUBH GUPTA

IIT Kanpur

- Developed a pipeline for Human Tracking and Following Quadrotor using **Tensorflow API's implementation of SSD Mobilenet**.
- Used **Kernelized Correlation Filter**, **Stereo Image Disparity maps** and **Extended Kalman Filter** for better tracking performance.

## Low cost Tracking and Landing system for Quads | [REPORT] | [SLIDES] | [CODE]

Aug 2017—Nov 2017

UNDERGRADUATE PROJECT UNDER PROF. MANGAL KOTHARI

IIT Kanpur

- Developed a solution for tracking a ball of known size on a **low-cost low-power processor (Odroid XU4)** for light quadrotors.
- Implemented a **velocity field-based method** for landing and created a custom low-cost Gimbal using Arduino Nano.

## Single Image Super Resolution through Sparse Representation | [REPORT]

Jan 2018—April 2018

COURSE PROJECT UNDER PROF. TANAYA GUHA

IIT Kanpur

- Implemented and Compared various papers for Single Image Super Resolution with **Dictionary Learning in Wavelet domain**.
- Proposed a simple Convolutional Neural Network based method for Single Image Super Resolution in Wavelet Domain.

## Warehouse Inventory Check using Quadrotors | [SLIDES] | [CODE]

Oct 2017—Dec 2017

WITH PROF. MANGAL KOTHARI, KRISHNARAJ GAUR AND JAY PATRIKAR

IIT Kanpur

- Developed a solution for tracking a ball of known size on a **low-cost low-power processor (Odroid XU4)** for light quadrotors.
- Implemented a **velocity field-based method** for landing and created a custom low-cost Gimbal using Arduino Nano.

## Quazar Oscillation Control Card for Scanning Tunnelling and Atomic Force Microscopy

May 2016—July 2016

SUMMER INTERNSHIP AT QUAZAR TECHNOLOGIES, UNDER JOSHUA MATTHEWS, UNIT HEAD, PROBE MICROSCOPY

Quazar, Delhi

- Designed oscillation control electronics, **Hardware PID Controller and Phase Locked Loop** system for scanning probe of an AFM.
- Designed the PCB, Implemented the drivers and tested the functioning with an AFM on Carbon Nano Tubes and Gold deposit.

## Wind Propelled Navigation and Pole-climbing Robots | [POSTER] | [WEB] | [VIDEO]

Sep 2015—March 2016

PROJECT UNDER PROF. BHASKAR DAS GUPTA AND DR. ANJALI KULKARNI

ABU Robocon'16, IIT Kanpur

- Developed the Electronics for a pair of **Semi-Autonomous Robots for Collaborative Line, Wall-following and Pole Climbing**.
- Designed and Coded systems for Wall-following, Propeller Speed Control and implemented a Kalman Filter for Odometry estimation.

## Artificial Intelligence for Factories of Future | [SLIDES] | [VIDEO]

Aug 2017—Jan 2018

WITH ANIMESH SHASTRY AND EESHAN DHEKANE

IIT Kanpur

- Proposed Solutions for Challenges proposed by HUL, with focus on **Human/Vehicle Tracking and Warehouse Management**.
- Winner of IIT Kanpur round with a **funding of INR 50,000** for deployment of proposed solutions in HUL factories.

## Satellite Image Segmentation using Deep Learning | [SLIDES]

Dec 2018

WITH APURV GUPTA AND HARISH RAJAGOPAL

IIT Kanpur

- Developed a **per-class UNet** based solution for multi-class segmentation of Satellite Images and achieved accuracy around 90%.

## Autonomous Underwater Vehicle | [WEBSITE]

Dec 2014—Aug 2015

PROJECT UNDER PROF. K S VENKATESH

IIT Kanpur

- Developed **Motherboard and Drive-system PCB** design and Localization using Inertial Measurement Unit (IMU).

## Technical Skills

<b>Programming</b>	C/C++ • Python • Bash • Matlab / GNU Octave • $\LaTeX$
<b>Computer Vision</b>	OpenCV • Pillow • Pytorch • Sklearn
<b>Electronics</b>	gEDA • pcb • Altium • Eagle • Arduino • PixHawk • SPICE Simulator • MicroCap
<b>Software Packages</b>	ROS • Gazebo • Microsoft AirSim • Solidworks • AutoCAD
<b>Manufacturing</b>	Welding, Brazing, Casting, Water Jet Cutting, Laser cutting, Sheet metal processing, Lathe, Milling

## Achievements & Honors

2018	<b>Silver Medal, National</b> , Satellite Image Segmentation, InterIIT TechMeet	IIT Bombay, India
2018	<b>5th, International</b> , Robot Design Competition, Intelligent Ground Vehicle Challenge	Michigan, U.S.A
2018	<b>12th, International</b> , Overall, Intelligent Ground Vehicle Challenge	Michigan, U.S.A
2018	<b>2nd, National</b> , Hindustan Unilever Limited, TechSpark Competition	Mumbai, India
2017	<b>Bronze Medal, National</b> , Warehouse Inventory Check, InterIIT TechMeet	IIT Madras, India
2016	<b>3rd, National</b> , Asia Broadcasting Union, Robocon 2016	Pune, India