Harsh Sinha

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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, Międzyzdroje, 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 Shastry, **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 Shastry, **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 Aruino 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 Aruino 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

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

Achievements & Honors

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