Abhinav Gupta

Email | Website | GitHub
Undergraduate Researcher at IIIT Hyderabad
Computer Vision | Robotics | Machine Learning

Education

International Institute of Information Technology (IIIT), Hyderabad — Hyderabad, India
Bachelor of Technology (Honors) in Computer Science and Engineering — *Aug. 2017 – May 2021*

- Honors in Robotic Vision
- Awarded the Undergraduate Research Award, 2019-'20
- Dean's Merit List - Top 20% of the class, 2019-'20

Publications

- *DeepMPCVS: Deep Model Predictive Control for Visual Servoing*
  P Katara, Y V S Harish, H Pandya, **A Gupta**, A Sanchawala, G Kumar, B Bhowmick and KM Krishna.
  4th Annual Conference on Robot Learning (CoRL), 2020, Cambridge, MA, USA
- *Get There Faster with LiteVS: A Differentiable MPC Framework for Deep Visual Servoing.*
  A Gupta*, MN Qureshi*, P Katara*, H Pandya, Y V S Harish, A Sanchawala, G Kumar, B Bhowmick and KM Krishna. Under Review at the IEEE International Conference on Robotics and Automation (ICRA), 2021
  **indicates equal contribution*

Experience

Robotics Research Center — May 2019 – Present
Research in Robotics and Vision, IIIT Hyderabad — *Hyderabad, India*

- Working with **Prof. Madhava Krishna** at the intersection of computer vision, deep learning and robotics, primarily in advancing vision-based robot control techniques.
- Formulated a novel model predictive control framework for visual servoing in six degrees of freedom, conducted extensive experimentation of our approach in Habitat simulation and trained an unsupervised network for flow estimation. **Our work was accepted and published in CoRL '20**, a premier conference in robotics and machine learning.
- Proposed a novel and lightweight visual servoing technique for fast navigation which is 5 times faster than existing state-of-the-art approaches. Utilised an effective sampling strategy for optimal control generation, resulting in a 78% decrease in the servoing time. **Currently under review at ICRA '21**, the premier robotics conference.

Siemens Corporate Research — May 2020 – July 2020
Machine Learning and Applied Research Intern, Visual Perception Lab — *Bangalore, India*

- Worked extensively in human pose estimation and action recognition in the 'digitalisation and automation' division at Siemens. Carried out an exhaustive qualitative and quantitative analysis of various state-of-the-art pose estimation networks for real-time applications.
- Implemented a heuristic-based fall detection system using OpenPose and benchmarked such action recognition approaches against deep learning based methods.

Centre for Visual Information Technology — January 2020 – Present
Computer Vision Researcher, IIIT Hyderabad — *Hyderabad, India*

- Worked with **Prof. P J Narayanan** on the applications of vision and AI for society, and implemented a real-time object detection system for detecting unhygienic face touches to stay safe from the coronavirus. Manually curated and augmented the dataset and efficiently trained YOLOv3 using transfer learning, achieving an accuracy of 74%.
- Currently working with **Prof. Avinash Sharma** on 3D human motion detection and capture from event cameras. Implemented an event trajectory generation system in ROS which sharpens and detects features from neuromorphic data and simulates event streams from high fps conventional data. Trained a deep self-supervised convolutional network for estimating flow from asynchronous events.

Technical Skills

Languages: Python, C/C++, JavaScript, MATLAB, SQL, HTML/CSS, Elm/Racket, Golang, Bluespec
Machine Learning: TensorFlow, PyTorch, ROS, OpenCV, Caffe, keras, pandas
Frameworks and Tools: ReactJS, Node.js, Flask, Git, Docker, Linux, Bash, OpenGL, LaTeX

Academic Projects

3DMV: 3D Semantic Segmentation | *Computer Vision*
- Implemented the popular ECCV Paper "3DMV: 3D Semantic Segmentation", by combining 2D feature maps with 3D voxel data from the ScanNet dataset. Coded up the 2D and 3D deep networks to learn the semantics of the scene and obtained optimal results across the benchmark.

EKF-SLAM | *Mobile Robotics*
- Estimated the 2D pose and trajectory of a robot using sensor measurements from a wheel odometer and laser rangefinder, by applying an Extended Kalman Filter.

Stereo Reconstruction | *Robotic Vision*
- Generated a dense 3D point cloud reconstruction of a scene from stereo images by generating disparity maps for each stereo pair and implemented an iterative PnP algorithm to recover the pose.

Visual Odometry | *Robotic Vision*
- Implemented a monocular visual odometry algorithm from scratch, to recover the trajectory of the drone using a sequence of images and implemented the 8-point algorithm within a RANSAC scheme.

Face Classification | *Machine Learning*
- Trained various learning models on a dataset of real and animated face images by applying different feature transformations and quantitatively analysed the classification results.

Blue Skies: Interactive gaming | *Computer Graphics*
- Built a 2D arcade game and a 3D flight simulator game in OpenGL 3.0 using graphics concepts such as texture mappings, rasterisation and lighting, with support for multiple camera views for a great gameplay.

Metamorphose Compiler | *Compilers*
- Implemented a compiler and interpreter for a toy programming language, which supports basic mathematical operations and functions, performs lexical and semantic analysis and generates machine-understandable code.

Noughts and Crosses: AI Bot | *Artificial Intelligence*
- Built a bot for 3*3 Tic-Tac-Toe board, further divided into more 3*3 blocks using Minimax algorithm with alpha-beta pruning, using an optimal heuristic function.

Linux Shell | *Operating Systems*
- Implemented a Linux Bash shell, a command line interpreter in C. Supports numerous bash commands along with piping, redirection, foreground and background processing.

Relevant Coursework

Artificial Intelligence: Computer Vision, Statistical Methods in AI, Mobile Robotics
Systems: Advanced Computer Networks, Operating Systems, Compilers
Algorithms: Data Structures, C Programming, Principles of Programming Languages
Mathematics: Probability and Statistics, Linear Algebra, Discrete Structures

Other Experience

IIIT Hyderabad August 2019 – Present
Teaching Assistant *Hyderabad, India*
- Taught the principles of digital logic and the architecture of a processor to 300 students, as part of the Digital Logic and Processors course offered in Monsoon 2019
- Taught software engineering principles and coding techniques in Python and JavaScript, as part of the Design and Analysis of Software Systems course offered in Spring 2020

The Virtual Labs August 2018 - December 2018
Software Engineering and Research Intern *Hyderabad, India*
- Developed full-fledged experiments and interactive artefacts for various data structures and algorithms at The Virtual Labs, a social initiative of the Government of India, presented at the RnD Showcase 2019 at IIIT.

Miscellaneous

The Music Club: President of the music society at IIIT Hyderabad, responsible for conducting big music events. A skilled drummer and guitar player.
Ashakiran: Teaching underprivileged high school students for school exams.
Swimming: A skilled freestyle swimmer, represented my high school at inter-school competitions.