Akash Kumar **Singh**

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Education

2021 **Indian Institute of Technology Kanpur,** BT-MT, Electrical Engineering | MT CPI: 6, BT CPI: 8/10 — *Kanpur, India*

2016 **D.A.V. Public School, NTS Barkakana, C.C.L.,** CBSE, class 12th | Result: 93.4% — *Ramgarh, India*

2014 **D.A.V. Public School, Urimari,** CBSE, class 10th | Result: 10 CGPA — *Hazaribagh, India*

Work Experience

Google Summer of Code, RoboComp — *IITK, Kanpur, India*

Software Developer | Mentors: Luis J. Manso, Esteban Martinena and Ramon Cintas — *June - Aug 2020*

- The project aimed to port the code base of a C++ library, **innermodel** (used to represent virtual environments for a simulator), to Python to make it easy for the developers to use.
- Used **PyBullet** as the rendering engine and **Numpy** to create a customized math library for the calculations in simulation.
- Added **ROS2 middleware** support to **robocompdsl**, a tool to generate boiler plate code for robotic component having different interfaces (sensor, actuators, etc.).

Google Summer of Code, RoboComp — *IITK, Kanpur, India*

Software Developer | Mentors: Marco A Gutiérrez and Ramon Cintas — *May - Aug 2018*

- The project aimed to integrate **RoboComp**, a robotic framework, with a 3D robotic simulator, **Gazebo**, using **zeroc-ice** as a communication middleware.
- Used **Gazebo plugins** for robotics interfaces, corresponding to different sensors and actuators, to communicate with the Gazebo simulator.
- The integration is expected to allow developers more options from the framework and provide a better simulation with a more realistic physics engine.

Reseach and Technology Center (RTC), Robert Bosch — *Bangalore, India*

Research Intern | Mentor: Guruprasad M. Hegde — *May - July 2019*

- The project aimed to improve the performance of semantic segmentation on 2D RGB images using data from **LiDAR point clouds** for an **autonomous driving car**.
- Used CARLA to generate labelled point clouds, for training 3D semantic segmentation networks, using 3D reprojection algorithms.
- Trained **Pointnet++** network on **CARLA** and **Apolloscape** datasets. Compared performance of models initialised from pretrained models on synthetic CARLA data with models trained on real data.
- Developed a framework to combine the results of a model trained on 2D RGB images and a model trained on 3D point clouds to perform semantic segmentation on a 2D RGB image.
- Implemented a **Fast LiDAR point cloud segmentation algorithm**, to get clusters in LiDAR point clouds for an autonomous driving car to infer accurate pose of objects in a scene.

NYU-IITK, Research Track — *IITK, Kanpur, India*

Research Assistant | Mentor: Prof. Yi Fang (New York University) — *May - July 2018*

- The project aims to explore the possibilities of developing a **lightweight traffic light detection model** based on Deep Learning, using various model compression techniques.
- Explored various techniques of reducing the size of neural networks without any significant decrease in accuracy.
- Implemented a **RFCN** network using tensorflow object detection APIs.

New York Office, IIT Kanpur — *IITK, Kanpur, India*

Front End Developer | Team Lead: Prof. Manindra Agarwal — *May - July 2018*

- Worked as a front end developer to develop new features and improve **UI/UX** of a scalable web application.
- Used latest technology stacks like TypeScript in Angular 6 as well as HTML and SCSS for styling.

Projects Undertaken

Bellman optimals vs human optimals — *IIT Kanpur*

Guide: Prof. Nisheeth Srivastava — *Aug - Nov 2018*

- The central idea was to **compare human path-finding** with the **Bellman-optimal solution** found via value iteration, across various factors, in a stochastic two-dimensional grid world.
- Developed a **Graphical User Interface** to collect data via experiment on how humans choose an ideal path based on intuition and, analyzed the data collected to calculate the cognitive bias people have, along with different measures.
- Analyzed the data collected to calculate the cognitive bias people have, along with different measures.

AUV-IITK, IIT KANPUR — *IIT Kanpur*

Autonomous Underwater Vehicle | Mentor: Prof. Mangal Kothari — *Feb – July 2019*

- Implemented an Image Processing Algorithm (**Image Fusion**) to enhance the degraded underwater images in real time before feeding it to the perception module of the vehicle.
- Integrated **UUV Simulator**, an open source underwater simulator, to work with AUV-IITK code base.
- Designed and developed the software architecture for AUV consisting of dedicated layers for hardware integration, controls & navigation, motion planning, and perception using libraries such as **ROS, OpenCV & Gazebo**.

Publications

Multi-Modal Semantic Segmentation using Synthetic Data — *Robert Bosch, RTC, Bangalore*

Kartik Srivastava, Akash Kumar Singh, Guruprasad M. Hegde — *May 2019 - July 2019*

- Presented in a workshop on Deep Learning for Automated Driving: Beyond Perception (DLAD-BP 2019), IEEE International Conference on Intelligent Transportation Systems 2019 (ITSC '19). [arxiv]

MTECH Thesis

Surveillance System Using Multiple Quadcopters — *IIT Kanpur, Kanpur*

Mentor: Prof. Indranil Saha — *Aug 2020 - Present*

- **AIM:** To develop a surveillance system using multi quadcopters.
- **APPROACH:** Developing a framework to describe a mission plan as LTL (Linear Temporal Logic) specifications and solve it by using a SMT solver (Z3-solver) to get an optimal solution. Using px4 flight along with Gazebo-SITL to simulate the framework.
- **END RESULT:** A working demonstration of the above idea using 4 quadcopters in a real world scenario.

Skills

Languages C, C++, JavaScript, Python, HTML, CSS, BASH, AWK, Verilog, Matlab/Octave, TypeScript

Utilities ROS, OpenCV, Git, SolidWorks, Arduino, Gazebo, PyTorch, Angular, Tensorflow, Keras, GNU octave, Matlab, PyBullet , LaTeX

Interests Image Processing, Computer Vision, Linux Command Line, Robotics, 3D simulation, Machine Learning

Relevant Coursework

Representation and Analysis of Random Signals (A*), Introduction to Machine Learning (A), Convex Optimization, Probability & Statistics (A), Data Structures & Algorithms, Essentials of Scientific Computing, Cyber Security of critical infrastructure, Principles of Communication System, Robot Manipulators: Dynamics and Controls, Formal Methods for Robotics and Automation

Extracurricular Activity

AUV-IITK, IIT Kanpur — *Kanpur, India*

Software lead — *July 2018 - Mar 2019*

- Mentored juniors towards learning software structure of the vehicle
- Managed workflow and development of software system
- Runner up at the **Final Round** of NIOT SAVe 2019, **Indian National Competition** on **Student Autonomous Underwater Vehicle Challenge** held in Chennai

Robotics Club, IIT Kanpur — *Kanpur, India*

Secretary — *July 2017 - Mar 2018*

- Promoting Robotics in campus community by organizing workshops and lectures
- Assisted the Coordinators in organizing competitions in Major technical events

Arts Club, IIT Kanpur — *Kanpur, India*

Secretary — *July 2017 - Mar 2018*

- Promoting Fine Arts in campus community by organizing various competitions and exhibitions
- Assisted in development of various art pieces around the campus