# MAYANK MITTAL

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## Education

2014–present **Bachelor of Technology**, *Indian Institute of Technology*, Kanpur, *CGPA- 9.3/10*
Major: Electrical Engineering

2014 **Grade XII**, *Amity International School*, Noida, *Result- 97%*

2012 **Grade X**, *Amity International School*, Noida, *CGPA- 10/10*

## Research Experiences

May–July 2017 **Predicting Landing Sites from Aerial Images of Disaster Scenes — DAAD**

*Supervisors:* Prof. Wolfram Burgard, and Abhinav Valada

The project aims to use Deep Convolutional Neural Networks to detect landing sites for a drone in a hostile environment by only using the input from a ground facing camera mounted on it.

- **Created large dataset**, using Mircrosoft drone **simulator AirSim**, comprising of scene, normals and depth views of a self- designed map of a disaster affected region
- Trained DCNN model 'MarrRevisisted' proposed by Aayush B. *et.al.* on the created dataset and performed a qualitative and quantitative analysis of the results
- Proposed a **pipeline to extract candidate landing sites**, using the trained model and input RGB-D data, based on histogram based segmentation **in real-time**

June-December 2016 **Bomb Disposal using Multi-Robot System — Boeing-IIT Kanpur Joint Venture**

project page github

*Supervisors:* Prof. Shantanu Bhattacharya, and Prof. S. Kamle

In order to perform bomb- disposal operations in unstructured environment, the project aims to leverage the advantages of a multi- robot system comprising of an aerial and ground robot. My contributions, as a member of the ground robot sub- team, was on the navigation and map building using the ground robot, and are listed as follows:

- Built a two-wheeled differential drive robot, *Alpha*, with skid steering and on-board powering
- Performed simulation of *Alpha* in gazebo environment for creating maps and navigation
- Applied Kalman Filter based **sensor data fusion** algorithm for combining RGB-D data, 2D laser scan data and wheel odometry to create RTAB-Map of an indoor environment
- Implemented and compared **RRT* and D*-Lite algorithms** for navigating to goal points

November 2014-present **Autonomous Underwater Vehicle (AUV) — Research and Development Project**

project page github

*Supervisors:* Prof. Sachin Y. Shinde, and Prof. K.S. Venkatesh

The severity of challenges in robotics increases for an underwater system due to attenuation of communication and GPS signals. In this students' initiated project, we look at some of these problems in order to improve the autonomy of an AUV. As a prime member of this team, I have worked in various divisions of the project; of which a few of my contributions are listed below:

- Designed and developed **Institute's first AUV**, *Varun*, which uses computer vision and dead- reckoning sensors for navigation and is capable of shooting torpedo and drop markers
  - Optimized robot's structure and assemblies using **SolidWorks and Ansys Workbench**
  - Fabricated **waterproof casings** using in-house manufacturing facilities like lathe, milling
  - Designed **power distribution board** for the vehicle to ensure isolation between processor and motors, and provide circuit protection
- Currently developing a **state machine based mission planner** for our next vehicle, *Triton*

May- June 2016 **Recent Approaches to SLAM — NYU-IIT Kanpur Research Track**

*Supervisor:* Prof. Farshad Khorrami

- Reviewed recent **back-end implementation techniques** for SLAM based on Monte- Carlo methods, bundle adjustment, and kalman filter
- Implemented **EKF SLAM** in a virtual environment created on **V-REP** using MATLAB

December 2015 **Finite Element Analysis in Electromagnetism — NPDE-TCA Winter Internship**

*Supervisor:* Dr. B.V. Rathish Kumar

- Studied the Ritz-vibrational and Glarenkin's finite element analysis in 1- and 2- dimensions
- Solved 2-D boundary valued problems on electrostatics and time harmonics on MATLAB

## Selected Projects

February–April 2017 — **Visual Odometry using careful Feature Selection and Tracking**
Course Project for Probabilistic Robotics (EE698G), under Prof. Gaurav Pandey
github
- Implemented the algorithm for stereo odometry, adapted from the works of I. Cvišić and I. Petrović in 'Stereo odometry based on careful feature selection and tracking'
- Evaluated the implemented algorithm on KITTI Dataset City 01 and Residential 07 sequences

March–April 2017 — **MATLAB based GUI for Motion Planning**
Course Project for Robot Motion Planning (ME766A), under Prof. Ashish Dutta
github
- Created an interactive user interface on MATLAB to run a number of motion planning algorithms such as Rapidly exploring Random Tree (RRT) and its variants, and potential field method, in a user defined 2-D environment at specified start and goal points

October–November 2016 — **Failure Handling in Swarm of Quadrotors**
Course Project for Embedded and Cyber-Physical Systems (CS637A), under Prof. I. Saha
- Proposed an **extended state machine design for communication in a swarm**, with ability to handle failures, while ensuring redundancy, decentralization and anonymity
- Used gazebo to simulate swarm behavior in quadrotors using the `'hector-quad'`
- Tested communication network on hardware using X-Bees(Series 2) in broadcasting mode

October–November 2016 — **Applying $\mathscr{H}_\infty$ Control to Reduce Risks of Diabetes Mellitus in Patients**
Course Project for Robust Control Systems (EE654A), under Prof. Ramprasad Potluri
- Proposed an alternate design to the original controller, given in 'Reducing Risks in Type 1 Diabetes Using $\mathscr{H}_\infty$ Control' by P. Colmegna *et.al.*, and showed that it ensured a better performance for the considered nominal model of adult patient than the one suggested

February–March 2016 — **Adjustable Medical Chair**
Course Project for course Manufacturing Processes-II (TA202A), under Prof. Neeraj Sinha
- Designed and fabricated a scaled-down model of **dental chair** with independent controls for various motion, using operations like welding, turning, milling, drilling and fitting

## Academic Achievements

2017 — Recipient of DAAD-WISE Scholarship to pursue a summer internship in Germany

2016 — Received Academic Excellence Award at IIT Kanpur for performance in 2015-16

2016 — Secured $2^{nd}$ place in Student Underwater Vehicle (SAVe) competition at NIOT, Chennai

2014 — Secured 656 rank in JEE Advanced among 150,000 students

2014 — Secured 324 rank in JEE Mains among 1.2 million students

2012 — Awarded the Kishore Vaigyanik Protsahan Yogna (KVPY) Fellowship

2010 — Awarded the National Talent Search Examination (NTSE) Scholarship

## Technical skills

**Software:** Autodesk Inventor, SolidWorks, Ansys Workbench, PSpice, KiCAD, UnrealEngine Editor

**Languages:** C++, C, Python, Shell(bash), MATLAB, HTML, CSS

**Frameworks:** Caffe, ROS, OpenCV, PCL, AirSim, Gazebo, V-REP, Arduino IDE

**Other:** Git, Octave, LaTeX

## Relevant Coursework

**Robotics:** Robot Manipulators: Dynamics and Control, Robot Motion Planning, Probabilistic Robotics, Embedded and Cyber-Physical Systems, Robust Control Systems

**Mathematics:** Advanced Matrix Theory and Linear Estimation*, Probability and Statistics, Linear Algebra, Ordinary/Partial Differential Equations, Complex Analysis, Signals and Systems

**Algorithms:** Data Structures and Algorithms*, Fundamentals of Programming

**Electronics:** Power Electronics, Digital Electronics, Microelectronics- I, Power Systems Analysis*

** to be completed this semester*

## Positions of Responsibility

January 2016–present **Team Lead**, *AUV Team*, IIT Kanpur
- Overseeing the work in various divisions of the project, such as computer vision, navigation using dead- reckoning sensors, battery management system, and designing of the vehicle
- Managing a team of 18 members from various programs to develop our next vehicle *Triton*
- Interacting with technical companies and researchers to acquire sponsorships for the project
- Managed a seed funding of Rs.769,000 for the development of the first vehicle *Varun*

April 2016–2017 **Coordinator**, *Robotics Club*, IIT Kanpur
- Led a team of 18 secretaries and handled a budget of Rs.125,000 to organize various events, workshops, and competitions for robotics enthusiasts in the campus community
- Mentored and ensured completion of summer projects on wheeled humanoid using speech and facial recognition, 3-DOF robot manipulator, and gesture based gaming console
- Conducted a week-long lecture series in collaboration with the Institute's Center of Mechatronics; presented talks on sensing and actuation, micro-controllers and CAD designing
- Organized a two-weeks long winter camp for introduction to Arduino based embedded systems such as pinball machine, solar tracker, and club automation

August 2015–2016 **Student Guide & Academic Mentor**, *Counseling Service*, IIT Kanpur
- Assisted 6 freshmen students in adjusting to the college environment
- Provided personal tutoring to academically weak students for their courses

## Extra- Curricular Activities

2017 Presented a talk on 'Applications of Deep Learning in Robotics' on Machine Learning Research Day (MLRD) organized by SIGML, IIT Kanpur

2015 Secured $2^{nd}$ place in inter- college lawn tennis tournament at SNU, Greater Noida

2015 Secured $3^{rd}$ place at inter- college lawn tennis tournament at IIT, Roorkee