# SIDDHARTH SAHA

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## Education

| Examination | University | Institute | Year | GPA |
|---|---|---|---|---|
| Graduation | IIT Bombay | Indian Institute of Technology Bombay | 2017 - 2021 | 9.43/10.00 |

Undergraduate Degrees: B.Tech. with Honors in Mechanical Engineering, IIT Bombay
Minor in Computer Science and Engineering, IIT Bombay

## Conference Talks

- Siddharth Saha, Leena Vachhani, **Dynamic OctoMap: Mapping Regions of Dynamic Activity & Building Dynamic-free 3D Occupancy Maps**, *Lightning Talk at ROS Conference 2021* Video
- Siddharth Saha, P. Vanjani, S. Gokhale, **Google Summer of Code 2021: ROS2 RADI & pick-and-delivery warehouse exercise in web-based template**, *Lightning Talk at ROS Conference 2021* Video

## Scholastic Achievements

- Ranked **top 5** in batch of 150 students on merit of GPA | Secured **perfect 10.0** GPA in $7^{th}$ & $8^{th}$ semesters ['21]
- Bagged the **Technical Citation**, $2^{nd}$ highest award for excellence in technical activities at IIT Bombay ['21]
- Conferred **AP grade** (3/188 students) in Statistical Machine Learning course for exceptional performance ['20]
- Endowed with the **Economic Times Campus Star Award** from over 49,000 candidates across India ['20]
- Awarded the SSP scholarship (among 15 students from India) by **Japan Science & Technology** Agency ['19]

## Research Experience

**Equilibrium states of Rotary Ultra-flexible Inverted Pendulum** | IIT Bombay Jul 2021 - Present

*Guide: Prasanna Gandhi*

- Understood the assumed modes method to mathematically model equations of motion for the flexible beam
- Conducted lab experimentation | Comparing experimentally observed shapes against predictions from simulation

**Mapping Regions of Dynamic Activity & Building Dynamic-free 3D Occupancy Maps** | Demo

*Bachelor's Thesis — Guides: Prof. Leena Vacchani, Prof. Abhishek Gupta* Jun 2020 - Jul 2021

- Proved the occupancy & dynamic activity probabilities in an octree map to **form a field** in the range (0,1)
- Designed & implemented novel clustering algorithm in **ROS OctoMap** to reject nodes with high dynamic activity

## Professional Experience & International Exchange

**Goldman Sachs**, Structuring Analyst | Bengaluru Jul 2021 - Present

- Deriving critical insights into the upsides & downsides of structuring ideas vis-a-vis rating agency methodologies

**Google Summer of Code – JdeRobot**, Student Developer | Final Report Jun 2021 - Aug 2021

*JdeRobot develops framework based on ROS, Docker & Django to simplify learning robotics & computer vision*

- Built the RADI-4.0 (Robotics Academy Docker Image) for **ROS2 Foxy**, and VNC-based RViz2 web template
- Implemented BT (**Behavior Tree**) Navigator | Extended pick-and-delivery exercise to ROS2 web-based template

**Goldman Sachs**, Quantitative Summer Analyst | Bengaluru May 2020 - Jun 2020

- Innovated and implemented **payment structuring** ideas for mortgage-backed securities to **maximize arbitrage**
- Achieved **sharp improvement** of 1.62% profits by optimizing cash-flows through different derivative instruments

**Hiroshima University**, Special Auditing Student | Japan Jun 2019

- Assimilated ongoing research in the **Cybernetics Laboratory** under the *Sakura Research Exchange Programme*

## Key Technical Projects

**Quadruped Robot** | RoboCup Rescue League Challenge Dec 2019 - May 2021

*Founding member & Team Lead of two-tiered team with 15 members, overseeing technical budget of ~14K USD*

- Explored **impedance control** to create virtual leg compliance | Simulated **gait trajectories** inside Gazebo
- Generated foot trajectory by modulating length and height of control points for a 11-order **Bézier curve**
- Implemented **sensor fusion** of *MPU6050* with *Intel RealSense D435* PointCloud2 data to demonstrate SLAM

**Robot Vision Scene Understanding Challenge** | CVPR '21, Report & Source — Mar 2021 - Apr 2021

*Robot traversing environment to build an object-based semantic map using RGBD sensor & odometry measurements*

- Trained & compared 3D object detection techniques using VoteNet, Group Free 3D, Votenet ensemble learning
- Executed YOLOv4 in parallel with 3D detection techniques to achieve higher confidence through consensus
- Applied **3D NMS** algorithm to obtain semantic map of environment with bounding boxes around detected objects

**F1/10$^{th}$ – Autonomous Grand Prix** | IROS '20, Las Vegas, Source — Oct 2020

*International autonomous racing contest with standardized hardware simulated in ROS/Gazebo*

- Used **Bernstein polynomial** based local trajectory planner & MPC for Ackermann steering in 4-membered team
- Acquired global optimal path using **OSQP solver** | Implemented obstacle detection | Composed Docker submission

**Hilti SLAM Challenge** | IROS '21, Prague — Sep 2021

*Estimation of position from ROS bag files utilizing sensor combinations among images, IMU, and LIDAR*

- Understood **visual inertial odometry** and explored *VINS-Fusion* using monocular camera + IMU
- Calibrated Kannala-brandt camera model using datasheet & IMU noise parameters using *imu_utils* on bag files

**Multi-robot Capture of Non-adversarial Target** | Documentation & Source — Mar 2021 - Apr 2021

*Paper implementation of 'MILP Models for Multi-Robot Non-Adversarial Search' from scratch*

- Implemented graph-represented environment using *networkx* | Modeled the optimization problem using *gurobipy*

**Two-wheeled Self-Balancing Bot** | Documentation & Demo — Aug 2020 - Nov 2020

- Stabilized Arduino bot using PD control and applied **complementary filter** on gyroscope & accelerometer output

More projects...

## Competition Achievements

**Winner** | **International Micromouse Challenge** | Source & Demo — Dec 2020

*Team Leader in Maze-solving challenge to program an autonomous bot simulated in ROS/Gazebo*

- Implemented *online breadth-first planner* for optimal path & **omni-wheel** based drive to reduce steering latency

**Winner** | **Off-Track Bot** | Innerve '20, Delhi — Nov 2020

*Autonomous bot simulated in Webots to produce given pattern on ground, minimizing number of blocks kept as cues*

- Innovated vision-based **object detection in C** to sharply prune number of cues required by navigation algorithm

**Winner** | **Operations GC** | General Championship '21, IIT Bombay, Source — Feb 2021

- Devised optimization solutions in MathProg using the **GLPK Optimizer** | Solved machine learning challenges

**Vision Based Obstacle Avoidance Drone** | $9^{th}$ Inter IIT Tech Meet, Source — Mar 2021

*Team Leader of IIT Bombay in Autonomous Navigation challenge across complex, static environments in ROS/Gazebo*

- **Ranked 6$^{th}$** across India | Designed & implemented navigation pipeline with three-layered intelligence algorithms

**RoboCon, Team IIT Bombay** | ABU RoboCon '19 Ulaanbaatar, Mongolia — Oct 2018 - Apr 2019

*Competition to construct a manual bot with throwing capability & an autonomous walking bot*

- Bagged **9$^{th}$ position** among 50+ national teams in stage-1 | Designed Solidworks model of **robotic gripper arm**

## Positions Of Responsibility

**Teaching Assistant** | Student Mentorship Program, IIT Bombay — Apr-May 2018 / Jan-Apr 2019

- *Physical Chemistry*: **Only student from freshmen year** appointed to guide class of **15 students** in tutorials
- *Electricity & Magnetism*: Conducted tutorial sessions for **52 students** focusing on the academically weak students

**Summer of Science Mentor** | Maths and Physics Club, IIT Bombay — Apr 2020 - Jun 2020

- Guided **4 mentees** to proficiency in *Data Structures & Algorithms* with **conceptual aid** and meticulous roadmap

**Convener** | Electronics and Robotics Club, IIT Bombay — Apr 2018 - Mar 2019

*Part of a two-tiered team of 70 members constituting the Institute Technical Council of IIT Bombay*

- Guided over **600 freshmen** participants of XLR8 2018 to make their first remote-controlled wheeled robots
- Organized bootcamps and **delivered talks** on Arduino and Image Processing, attended by **200+ enthusiasts**

## Community Service & Volunteering

- **Open-source contributor** at JdeRobot, a toolkit for developing robotics applications — Mar 2021 - Present
- Mentoring 4 female undergraduates from low-income backgrounds under iWE (**Indian Women in Engineering**), an initiative by Goldman Sachs — Sep 2021 - Present
- Tutored a high-school junior under **Abhyasika**, a student initiative at IIT Bombay for upliftment of economically disadvantaged children — Nov 2018 - May 2019
- Facilitated **Juhu Beach Cleanup Drive** under IIT Bombay E-Cell's Swacch initiative — Oct 2017

## Technical Skills

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|---|---|
| **Programming & Scripting** | Python, C, C++, Java, R, x10, Bash, Sed, Awk, Perl, RegEx, CMake, SQLite |
| **Frameworks** | Git, Vim, Docker, OpenCV, PyTorch, TensorFlow, Tesseract-OCR, LaTeX |
| **Optimization** | GNU MathProg, GLPK, Gurobi, PuLP, Ipopt, OSQP |
| **Robotics tools** | ROS1, ROS2, Gazebo, Webots, MRPT, Pinochhio, TSID, Crocoddyl |
| **Controllers & Modules** | Arduino, Raspberry Pi, Tiva C, NodeMCU, MPU6050, Intel RealSense D435 |

## Key Courses

| | |
|---|---|
| **Computer Science** | Computer Vision, Reinforcement Learning, Data Structures and Algorithms, Design and Analysis of Algorithms, Digital Image Processing, Statistical Machine Learning |
| **Robotics** | Advanced Topics in Mobile Robotics, Design of Mechatronic Systems, Microprocessors & Automatic Control, Kinematics & Dynamics of Machines, Machine Design, Robotics |
| **Optimization** | Optimization from Fundamentals, Optimization for Engineering Design, Operations Research |
| **Certifications** | Advanced Methods for Planning & Control of Legged Robots, ROS: Localization, Navigation & SLAM, Using GPUs to Scale & Speed-up Deep Learning |

## Extra Curricular Activities

| | | |
|---|---|---|
| **Competition** | • First runners-up in Aerial Path Planning GC, IIT Bombay (Source) | ['21] |
| **Public Speaking** | • Participated in **Model United Nations** by WeSpeak, IIT Bombay | ['17] |
| | • Received **Special Mention** among **35 participants** in English Debate, IIT Bombay | ['17] |
| **Journalism** | • **Curated article** in Mechanical Media Newsletter with a **reach of 700**+ students | ['17] |
| **Sports** | • Completed inter-hostel Crossy General Championship and the Cyclothon by TechFest | ['17] |
| **Leadership** | • Headed **150**+ **students** as **House Captain** in $10^{th}$ & Vice-Captain in $9^{th}$ grade | ['14,'15] |