

# SIDDHARTH SAHA

Mumbai, India

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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 & WORKING PAPERS

- Ravit Anand, Siddharth Saha, Prasanna Gandhi, **Equilibrium states of Rotary Ultra-flexible Inverted Pendulum**, *Working Paper*
- 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 '21: 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<sup>th</sup> & 8<sup>th</sup> semesters [’21]
- Bagged the **Technical Citation**, 2<sup>nd</sup> 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’21 - Present  
*Guide: Prof. Prasanna Gandhi*

- Applied the **assumed modes method** to mathematically model equations of motion for the flexible beam
- Assembled **lab setup** and captured static equilibrium shapes of Be-Cu beam for varied fixed angles & tip masses
- Compared observed shapes against simulation predictions & validated with potential energy vs initial state q plots

**Mapping Regions of Dynamic Activity & Building Dynamic-free 3D Occupancy Maps** | [Demo](#)  
*Bachelor’s Thesis — Guides: Prof. Leena Vacchani, Prof. Abhishek Gupta* Jun’20 - Jul’21

- 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

**Hiroshima University, Japan** | Special Auditing Student Jun’19

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

## WORK EXPERIENCE

**Goldman Sachs**, Structuring Analyst | Bengaluru May-Jun’20 / Jul’21 - Present

- Ideated 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

**Google Summer of Code – JdeRobot**, Student Developer | [Final Report](#) Jun’21 - Aug’21

*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

## TECHNICAL PROJECTS

**Quadruped Robot** | RoboCup Rescue League Challenge Dec'19 - May'21

*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'21 - Apr'21

*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<sup>th</sup> – Autonomous Grand Prix** | IROS '20, Las Vegas, [Source](#) Oct'20

*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'21

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

- Understood **visual inertial odometry** and applied *VINS-Fusion* on monocular camera and IMU sensor feed
- 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'21 - Apr'21

*Paper implementation of 'MILP Models for Multi-Robot Non-Adversarial Search' from the ground up*

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

**Two-wheeled Self-Balancing Bot** | [Documentation](#) & [Demo](#) Aug'20 - Nov'20

- 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'20

*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** | Innervive '20, Delhi Nov'20

*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'21

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

**Vision Based Obstacle Avoidance Drone** | 9<sup>th</sup> Inter IIT Tech Meet, [Source](#) Mar'21

*Team Leader of IIT Bombay in autonomous drone challenge inside ROS/Gazebo with **Ardupilot SITL***

- **Ranked 6<sup>th</sup>** across India | Designed and implemented resilient navigation pipeline to recover from dead ends

**RoboCon, Team IIT Bombay** | ABU RoboCon '19 Ulaanbaatar, Mongolia Oct'18 - Apr'19

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

- Bagged **9<sup>th</sup> position** among 50+ national teams in stage-1 | Designed Solidworks model of **robotic gripper arm**

## POSITIONS OF RESPONSIBILITY

**Summer of Science Mentor** | Maths and Physics Club, IIT Bombay Apr'20 - Jun'20

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

**Teaching Assistant** | Student Mentorship Program, IIT Bombay

Apr-May'18 / Jan-Apr'19

- *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

**Convener** | Electronics and Robotics Club, IIT Bombay

Apr'18 - Mar'19

*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

- Heading JdeRobot's ROS2 Working Group as an **open-source contributor** Mar'21 - Present
- Mentoring 4 female undergraduates from low-income backgrounds under iWE (Indian Women in Engineering), an initiative by Goldman Sachs Sep'21 - Present
- Tutored a high-school junior under **Abhyasika**, a student initiative at IIT Bombay for upliftment of economically disadvantaged children Nov'18 - May'19
- Facilitated **Juhu Beach Cleanup Drive** under IIT Bombay E-Cell's Swacch initiative Oct'17

## TECHNICAL SKILLS

<b>Programming &amp; Scripting</b>	Python, C, C++, Java, R, x10, Bash, Sed, Awk, Perl, RegEx, CMake, SQLite
<b>Frameworks</b>	Git, Vim, Docker, OpenCV, PyTorch, TensorFlow, Tesseract-OCR, L <sup>A</sup> T <sub>E</sub> X
<b>Optimization</b>	GNU MathProg, GLPK, Gurobi, PuLP, Ipopt, OSQP
<b>Robotics tools</b>	ROS1, ROS2, Gazebo, Webots, MRPT, Pinocchio, TSID, Crocoddyl
<b>Controllers &amp; Modules</b>	Arduino, Raspberry Pi, Tiva C, NodeMCU, MPU6050, Intel RealSense D435

## RELEVANT COURSES

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

## EXTRA CURRICULAR ACTIVITIES

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