# Bhaskar Biswas

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## Education

- Bachelor of Technology (B.Tech) in Engineering Physics, IIT Bombay, 2022 – 2026
- Pursuing Minor Degree in Robotics

## Scholastic Achievements

- Attained **International Rank 58** in the **International Olympiad of Science** among 30,000+ candidates
- Distinguished as one of the top-performing teams in Makerspace, earning a coveted spot among the **top 24 teams out of 120**, for the opportunity to showcase our project in front of esteemed faculty members and deans
- Achieved **AA (10/10) in 5** courses including Computer programming & Utilization and Makerspace courses

## Internship and Research Experience

**EV-Powertrain Software Intern**
Jaguar Land Rover [May '25 - Jul '25]

- Developed a Python–MATLAB integrated application for AUTOSAR architecture workflows, enabling automated extraction and parsing of ARXML (AUTOSAR XML) files
- Automated version-to-version comparison reports, reducing manual verification time by 300% and improving consistency in ECU software validation
- Built a custom MATLAB environment to interface with Python scripts for seamless analysis, and visualization of AUTOSAR metadata
- Engineered a Battery Health Platform for JLR Global Hackathon, developing ECM model in MATLAB and leveraging ML for precise State-of-Health (SOH) and State-of-Charge (SOC) estimation

**Distributed Optimization for Uncertain Rotational Rigid Body Systems** | BTP
Guide: Prof(s). Ravi N Banavar [Jan '25 - Present]

- Designed and implemented a **nonlinear torque-based controller** integrating gradient descent, consensus coupling, and integral compensation for orientation alignment of agents with local and relative measurements
- Applied **Lie theory** to formulate the total objective function and ensure convergence on the **SO(3) manifold**
- Simulated system and controller dynamics in **Python** to validate performance of the proposed controller

## Technical Experience

**Design Engineer** | Autonomous Integration and Simulation Development | IIT Bombay Racing Team
Guide : Prof. Sandeep Anand [Aug '23 - Present]

*Actively contributing as a key member of **70+** student team engaged in design and fabrication of Formula-type electric race cars for competing in Formula student international engineering competition held by IMechE in the UK*

- **Published on arXiv**, "IIT Bombay Racing Driverless: Autonomous Driving Stack for Formula Student AI", for research and development of the self driving vehicles in Computer vision, SLAM, Motion Planning and Controls
- Secured overall **4th** place among 25 teams in the 2025 competition acheiving a **7-place** jump over last year
- Built a 1/5th scale prototype of a driverless racecar with **STM32 microncroller** and **CAN communication**
- Increased obstacle detection and depth prediction accuracy in simulations by more than **90%** by retraining it with around **1000+** image data collected from the simulator, improving the overall efficiency of the autonomous stack
- Implemented the complete tech stack migration from **ROS1** to **ROS2** leading to **25% increase** in performance
- Responsible for the development on a **custom PCB** used on prototype bot, increasing the efficiency by integrating **Arduino-Nano**, **LM-2596** DC-DC converter module, **BTS7960** motor driver and **HC-05** Bluetooth module
- Implemented an efficient development pipeline for the race car using **MRPT, ROS2, PyTorch, TensorFlow, ZED-2i packages** within a **Docker container**, ensuring seamless testing and validation of the autonomous stack
- Implemented **Virtual CAN** interface in **Linux** using test DBC files and **Cantools** with other Python libraries

**Electrical Division Trainee** | IIT Bombay Racing Team [Dec '22 - Aug '23]

- Utilized **Eagle** software to design a **printed circuit board(PCB)** produced specifically for the current sensor

- Successfully engineered a non-destructive method of current measurement using a **Hall effect sensor** and building a device capable of measuring currents of up to **50 Amps**, developing knowledge in circuit building
- Gained expertise in circuit design and simulation, utilizing **LTSpice** to create and validate electronic circuits for various applications, learning the ability to design complex analog circuits for real-world implementations

## Key Projects

**Introduction to Competitive Programming** | Project ID: 181 | Summer of Code 2024 [Jun '24]

- Accquired knowledge consisting of concepts like DFS, BFS, Rescursion, Binary search, and Greedy Algorithms
- Gained comprehensive knowledge of various data structures (arrays, linked lists, stacks, heaps, queues, BSTs, AVL Trees, graphs, hash tables, etc.) and their applications in solving and optimizing different types of problems

**Preserving Noether symmetries** | SC 651 | Estimation on Lie Groups | Course Project [Apr '24]
Guide: Prof(s). Ravi N Banavar

- Performed a detailed analysis of the paper **Lie Groups and Quantum Mechanics** by P.G.L. Leach and Nucci
- Examined the use of Lie groups and Jacobi's last multiplier preserving Noether symmetries during quantization

**Star tracker** | ME 604 | Robotics | Course Project [Apr '25]
Guide: Prof. A. Gupta

- Built Arduino-based star tracker with gyroscope, RTC and servo motors for real-time tracking of celestial objects
- Developed a self-leveling platform mechanism for more robust star tracking using magnetometer feedback

**YOLOv1 Implementation** | Self Project [Jun '24]

- Implemented and executed an object detection model architecture based on the **YOLOv1 Research paper**
- Gained in-depth knowledge of CNNs, including how they are built and trained to perform object detection tasks

**Review of Lie Groups and Quantum Mechanics** | SC 651 | Estimation on Lie Groups | Course Project [Apr '24]
Guide: Prof(s). Ravi N Banavar

- Performed a detailed analysis of the paper "Lie Groups and Quantum Mechanics" by Leach and Nucci, highlighting the integration of Lie groups with quantum mechanics and assessing quantization methods proposed by authors

**Smart Appliance IR Controller** | PH 222 | Digital Electronics and Microprocessor | Course Project [Apr '24]
Guide: Prof(s). Maniraj Mahalingam

- Developed the Smart Appliance Infrared-Remote Controller, an advanced system designed to manage household appliances such as air conditioners, televisions, fans, and air coolers using infrared (IR) signals
- Integrated Bluetooth functionality enables remote control via a smartphone application, combining traditional IR remote capabilities with smart device compatibility for both line-of-sight functionality and remote operations

**Compensator Design** | AE 308 | Control Theory | Course Project [Nov '23]
Guide: Prof(s). Arnab Maity

- Successfully designed and implemented a compensator for a system with a given open-loop transfer function achieving a phase margin greater than 45° to ensure system stability using softwares like MATLAB
- Met stringent performance criteria by designing a compensator that ensured a static error constant of 100

**Patent Pivot Promotional Video** | DE 109 | Introduction to Design | Course Project [Jun '23]
Guide: Prof(s). Avinash Shende and Bharat Parmar

- Led the direction, video production, and editing of the promotional advertisement for our 6-member team on **Da Vinci Resolve** software for the fictitious company "Patent Pivot" developing basic skills in Video editing

**Obstacle Removing Line Follower robot** | MS 101 | Makerspace | Course Project [Feb '23]
Guide: Prof(s). D.K. Sharma and Joseph John

- Designed and developed line follower bot using **Arduino**, implementing a simple, effective and robust algorithm
- Used **Fusion 360** for 3D modeling, **LaserCAD** for developing laser-cutting templates and Fractory to 3D print various mechanical components, which were coupled with circuit designing to make a more reliable bot

## Other Projects

**Flappy-bird Clone** | Self Project [Oct '23]

- Successfully designed and developed a Flappy Bird clone as a personal project using **Unity** and **C# language**

**Tic-Tac-Toe Game** | Self Project [Aug '23]

- Successfully designed and implemented a classic Tic Tac Toe game in both terminal-based and GUI-based environments using Python and the **Tkinter** library with just under **200 lines** of code, including both version

**Calculator for Matrices** | Self Project [Jun '23]

- Developed a Terminal application spanning over **300 lines** of code, for performing matrix-based calculations

## Positions of Responsibility

**SOC Mentor** | Summer of Code 2024 [Jun '24]

- Guiding 5 undergraduate students in mastering essential cybersecurity skills, including Network Security, SQL Injection, Reverse Engineering, Cryptography, and Web Exploitation
- Organized and supervised Capture the Flag (CTF) problems to enhance practical problem-solving skills

## Technical Skills

- **Softwares**: Docker-containers, ROS, Git, LTspice, Fusion 360, Eagle, DaVinci Resolve, Unity, Linux
- **Languages**: LaTeX, Python(NumPy, Pandas, Matplotlib, OpenCV, SciPy, Tkinter), C, C++, Bash, XML

## Key Courses

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|---|---|
| **Computer Science and Robotics** | • Computer Programming and Utilisation, Makerspace, Artificial Intelligence and Data Science, Control Theory, Robotics, Non-linear Dynamics, Fundamentals of Digital Image Processing, Nanodevices and Applications |
| **Physics and Electronics** | • Quantum Physics, Classical Mechanics, Analog Electronics, Digital Electronics & Microprocessors, Statistical Mechanics, Numerical Analysis, Electromagnetic Theory, Introduction to Condensed Matter Physics, Light Matter Interaction |
| **Mathematics** | • Calculus, Linear Algebra, Differential Equations, Complex Analysis and Integral Transform, Estimation on Lie Groups, Analytical and Geometric Dynamics |

## Extracurriculars

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|---|---|
| **Leadership** | • Successfully organized an event in collaboration with **Red Bull** as part of the IITB Racing Team, showcasing event management skills |
| **Sports & Cultural** | • Proudly represented Hostel-2 in the **Fine Arts GC** and achieved **1st position**<br>• Contributed to Abhyuday's **Versova Beach cleanup** initiated by IIT Bombay<br>• Was a part of National Sports Organization(NSO) - **Piano** for the first year |