

NILESH BALU

M.Sc. Mechanical Engineering
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EDUCATION

- **ETH Zurich** *Expected 2026*
Zurich, Switzerland
– Master of Science in Mechanical Engineering; Specialization in Robotics, Systems and Control.
- **Indian Institute of Technology Madras** *July 2024*
Chennai, India
– Bachelor of Technology (Honors) in Mechanical Engineering; Minor in Systems Engineering.
– CGPA: 9.69/10.0.
– Gold medal for the best academic record in B.Tech Mechanical Engineering at IIT Madras.
– Gold medal for the best individual project in B.Tech Mechanical Engineering at IIT Madras.

SCHOLASTIC ACHIEVEMENTS

- **Awards at IIT Madras:** Awarded the *Dr. Dinesh Balagangadhar Prize*, the *Dr. S Chandrasekharan Memorial Prize*, the *Dr. Vivekanand Kochikar Award*, the *Sri Raghavendra Memorial Prize*, and the *Mrs Jayashree Ananth Prize* for exemplary academic performance in the B.Tech Mechanical Engineering Program.
- **Mitacs GRI Award:** Selected by *Mitacs* and *Prof. Scott Nokleby* for the prestigious *Mitacs Globalink Research Internship (GRI)*: A 12-week research internship during summer 2023 at *Ontario Tech University*, Canada.
- **JEE Advanced:** Secured an All India Rank of 1082 in the *Joint Entrance Examination (JEE) Advanced 2020*, conducted by the *Indian Institute of Technology Delhi*, out of 150,000 candidates who took the exam.
- **KVPY:** Awarded the *Kishore Vaigyanik Protsahan Yojana Fellowship (KVPY)*, SX stream, 2019, an initiative by the Government of India, having secured an All India Rank of 1492 out of 50,000 candidates.

EXPERIENCE

- **Robotics Research Intern** *May 2023 - Aug 2023*
Mechatronic and Robotic Systems Laboratory - Guided by Prof. Scott Nokleby Ontario Tech University, Canada
– Engineered a proof of concept prototype of an autonomous electric wheelchair for safe user navigation within indoor settings, using *Robotics Operating Systems (ROS)* as the interface between the hardware and the algorithms.
– Employed the *Unscented Kalman Filter (UKF)* to perform sensor fusion by combining encoder readings with IMU sensor readings, thereby improving the precision of the estimate of the wheelchair odometry.
– Implemented the *GMapping* algorithm on *ROS* by integrating ZED Cameras, Roboteq XDC2430 motor controllers and Arduinos to create a map of the surroundings. Performed autonomous navigation using the *Adaptive Monte-Carlo Localiser (AMCL)* and *Rapidly-exploring Random Trees (RRT)* path planning algorithms.
- **Mechatronics Research Intern** *Jul 2022 - May 2023*
Rehabilitation Research and Device Development (R2D2) Laboratory - Guided by Prof. Manish Anand IIT Madras, Chennai
– Prototyped a *3-in-1 Scooter board Wheelchair*, a modular device that switches between three modes of operations - a scooter board, a wheelchair with a drive unit for indoor use and a wheelchair with a handlebar for outdoor use.
– Fabricated an ergonomic watch module, housing an *ICM42688* inertial measurement unit on a custom PCB that allows the use of gestures and tapping actions to precisely and effortlessly control the speed of the wheelchair.
– Engineered a wireless throttle module and implemented the precise speed control of a BLDC Motor by implementing PID control using an ESP32 microcontroller.
- **Mechanical Engineering Intern** *Jun 2022 - Jul 2022*
Larsen and Toubro Technology Services Chennai
– Conducted a comprehensive literature review to investigate the factors involved in automotive radiator design and employed the *Number of Transfer Units (NTU)* method to establish an analytical correlation between heat rejection and core area.
– Analyzed experimental data and conducted a comparative study between the predicted values obtained from the analytical relationship and the actual results, ensuring the validity and reliability of the analytical model.
– Carried out thermal stress test CFD simulations on OpenSim and analyzed the temperature gradient, stresses and strains to validate new designs of automotive radiators.

PROJECTS

- **Wearable Hand Assistive Device**

Aug 2023 - May 2024

Bachelor's Thesis Project - Guided by Prof. Manish Anand

- Developed the proof of concept prototype of an assistive device for the hand that would provide the assistive forces (up to 10 N) required to grasp objects and perform activities of daily living.
- Employed an *under-actuated tendon mechanism* to bring about flexion of the digits of the hand. This mechanism reduces the weight and form factor and makes the device compliant.
- Implemented EMG sensor-based intent detection to detect user intention and automate the flexion and extension motion of the device. Offers 2 modes of operation: *cylindrical grasp* and *lateral pinch*.

- **On the Parallelization of Seam Carving**

Mar 2024 - May 2024

Course Project: Parallel Scientific Computing

- Presented an implementation of the *Seam Carving* operation that enables content-aware resizing of images. Extended the use of this operator as an object removal tool.
- Demonstrated parallelism on *OpenMP (Open Multi-Processing)*, *MPI (Message Passing Interface)*, and *OpenACC (Open Accelerators)* frameworks and compared performance evaluation metrics such as *speed-up*.

- **Numerical Analysis of Fluid Flow in a Pipe with Annular Fins**

Mar 2023 - Apr 2023

Course Project: Computational Heat and Fluid Flow

- Developed a numerical solver in C++ for simulating fluid flow through a pipe with annular fins by utilizing the axisymmetric coordinate system, *Upward Differencing Scheme (UDS)* for discretization, and the *tri-diagonal matrix algorithm (TDMA)* for solving the system of equations. Validated the solver by comparing temperature profiles with analytical solutions.
- Analyzed the impact of variations in fin parameters (length, thickness, and spacing) on fin effectiveness, noting increased effectiveness with the augmentation of these parameters.

- **Simulation of a four-tank system using Model Predictive Control**

Oct 2022 - Nov 2022

Course Project: Modern Control Theory

- Developed, implemented, and fine-tuned a *Model Predictive Controller (MPC)* using Matlab for a four-tank system.
- Modeled equations that describe the system, employed the *Kalman filter* and the *Particle filter* as state estimators, and investigated the performance of the two estimators.

- **The Mini Segway Project**

Mar 2022 - May 2022

Course Project: Measurements Instrumentation and Control

- Developed a self-balancing robot using an inverted pendulum model by implementing PID control using an ESP32 microcontroller programmed in Arduino IDE and by tuning the control parameters on *Matlab Simulink*.
- Fabricated a hardware model using off-the-shelf components such as MPU6050 sensors and DC motors, integrated into a custom chassis that achieved self-balancing capabilities and robustness against minor disturbances.

SKILLS

- **Analytical Skills:** Laplace Analysis, Fourier Analysis, Principal Component Analysis, Linear Estimation Theory, Model Predictive Control, Finite Volume Method, Finite Element Analysis
- **Software and Programming Languages:** Matlab and Simulink, ROS, SolidWorks, Autodesk AutoCAD, Autodesk Fusion 360, Arduino IDE, Python, C, C++, MS Office, Latex, VESC tool, Autodesk Eagle

KEY COURSES TAKEN

- **Robotics, Systems and Control:** Probabilistic Artificial Intelligence, Image Analysis and Computer Vision, Rehabilitation Engineering - Sensory and Vegetative Functions, Robot Dynamics, Nonlinear Dynamics and Chaos I, Microrobotics, Optimal Control, Soft and Biohybrid Robotics*, Rehabilitation Engineering - Motor Functions*, Computational Models of Motion*.
- **Design:** Kinematics and Dynamics of Machinery, Mechanics of Human Movement, Theory of Vibrations, Fundamentals of Finite Element Analysis, Optimization Methods in Mechanical Design.
- **Manufacturing:** Manufacturing Processes, Manufacturing Technology, Automation in Manufacturing.

* In progress.