

NILESH BALU

Email: nibalu@student.ethz.ch | Phone: +41 762649234 | Website: nileshbalu.github.io | LinkedIn: nileshbalu2002

EDUCATION

Master of Science in Mechanical Engineering

CGPA: 5.92/6.00

Expected July 2026

ETH Zurich, Switzerland

Bachelor of Technology (Honors) in Mechanical Engineering; Minor in Systems Engineering

CGPA: 9.69/10.00

July 2024

IIT Madras, India

- Gold medal for best academic record in B.Tech Mechanical Engineering
- Gold medal for best individual project in B.Tech Mechanical Engineering

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

- **Research Intern** Aug 2025 - Dec 2025
Haptic Intelligence Department Max Planck Institute for Intelligent Systems
 - **Dynamic Modeling of Fingertip Vibrations:** Developed a finite element model to simulate high-frequency fingertip vibrations induced by soft-material-mounted magnets; analyzed the influence of fingertip geometry and mounting variability on haptic perception by fitting the model to experimental data.
 - **Modeling Asymmetric Vibrations in Electromagnetic Actuators:** Designed a lumped-parameter model of an electromagnetic actuator exhibiting asymmetric vibrations; investigated the relationship between perceived lateral forces and grip strength by parameterizing the model based on experimental measurements.
- **Student Assistant (HiWi)** Jan 2025 - Jul 2025
RobotX Robotics Summer School 2025 ETH Zurich
 - Contributed to porting the software stack from *Robotics Operating Systems (ROS)* to *ROS 2*, implementing the low-level controller interface and an object detection and localization node for identifying artefacts.
 - Supported students in a search and rescue challenge where robots had to autonomously explore unknown environments and detect artefacts, assisting with ROS 2 node integration, debugging, and deployment.
- **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 autonomous electric wheelchair for indoor navigation, using ROS as the middleware to integrate hardware and control algorithms. Implemented GMapping for SLAM using ZED cameras, Roboteq motor controllers, and Arduinos, enabling real-time environment mapping and localization.
 - Enhanced odometry accuracy through sensor fusion by employing the Unscented Kalman Filter (UKF) to combine encoder and IMU data, and achieved autonomous navigation using Adaptive Monte-Carlo Localization (AMCL) and RRT-based path planning.
- **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, modularly switching between scooter board, indoor wheelchair with drive unit, and outdoor wheelchair with handlebar modes.
 - Designed an ergonomic watch module with an ICM42688 IMU on a custom PCB for gesture and tap speed control, and developed a wireless throttle module with PID speed control of a BLDC motor via ESP32.

• Mechanical Engineering Intern

Jun 2022 - Jul 2022

Larsen and Toubro Technology Services

Chennai

- Conducted a comprehensive literature review on automotive radiator design and used the Number of Transfer Units (NTU) method to develop an analytical correlation between heat rejection and core area.
- Analyzed experimental data to validate the analytical model through comparison with actual results, and performed thermal stress CFD simulations in OpenSim to assess temperature gradients, stresses, and strains for radiator design validation.

PROJECTS

• Hand Pose Estimation for Digital Surgical Training and Assessment

Feb 2025 - Jul 2025

Semester Thesis - Guided by Prof. Dr. Mirko Meboldt

- Developed a real-time hand pose estimation pipeline for surgical twins using stereo vision and deep learning; deployed WiLoR on Jetson Orin to extract 2.5D keypoints and triangulate them into 3D coordinates using optimization. Improved accuracy and consistency via Kalman filtering and outlier detection, achieving sub-centimeter error.
- Validated the pipeline using ArUco markers, infrared motion capture, and blob marker techniques, demonstrating its suitability for surgical training and performance analysis.

• Wearable Hand Assistive Device

Aug 2023 - Aug 2024

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

- Developed a proof-of-concept assistive hand device providing up to 10N grasping force for daily activities. Employed an *under-actuated tendon mechanism* to flex digits, reducing weight and form factor while improving compliance.
- Implemented EMG sensor-based intent detection to detect user intention and automate the flexion and extension motion of the device. Offered 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.

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, ROS2, 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.