Abeer Mishra · 200260001@iitb.ac.in · +91 6265544811

C.V.

Pursuing a B. Tech. in Engineering Physics, with a minor in Systems & Controls Engineering from IIT Bombay

Scholastic background

Year of completion	Level	Institute	CPI/ %
2024*	Graduation	IIT Bombay, Mumbai, India	8.55/10
2020	Intermediate	Campion School, Bhopal, India	97 %
2018	Matriculation	Campion School, Bhopal, India	93 %

Academic achievements

- Secured All India Rank 1007 amongst 180,000+ candidates in the JEE Advanced examination *Sept '20*
- Secured 99.53 percentile amongst ∼ 1 million candidates in JEE Mains examination *Jan '20*
- Awarded the prestigious NTSE (National Talent Search Examination) scholarship by Govt. of India *Jul '18*

Research Projects

Jul '22 - now **ML optimization of Nanophotonic cavity** Prof. A. Kumar, Dept. of Physics, IITB

- Developing a nanophotonic cavity for a CMOS compatible single photon source
- Used Meep, an open-source Python framework to simulate a waveguide described in a previous research paper on ML based numerical optimization of nanophotonic cavities
- Working to replicate the transmission spectrum results of a previous paper on ML optimization of nanophotonic cavities for single photon sources
- Currently generating the training dataset by varying the cavity parameters (cavity gratings size, slot width, waveguide width etc) & corresponding photon indistinguishabilities
- Future work: Use a neural network for optimization & maximize photon indistinguishability

Dec '21-May '22 **Optical fibers for mid-IR single photon sources** Prof. Deepak Jain, Dept. of EE, IITB

- Used a Germania core fiber with silica cladding to create a room temperature single photon source, inspired by previous research on four-wave mixing in Silica core fibers
- Used COMSOL Multiphysics software - wave optics module to simulate the fiber
- Generated dataset of actual & effective refractive index for different core diameters & modes and used Pandas & Numpy to calculate the material & waveguide phase mismatch
- Used Matplotlib to plot the results & visualize the conditions for four-wave mixing
- Obtained conditions for fourwave mixing in single mode fibers at various core diameters
- **Possible improvements:** Use a multimode fiber with different modes for pump, stokes, & anti-stokes wavelengths to check for more possibilities for fourwave mixing

Technical projects

Jul'22-Sept'22 **Multiframe real-time Video Super Resolution** Ideaforge IxT Challenge

- Participated in a challenge to perform realtime VSR on an 8 GB RAM laptop, with no GPU
- After studying various previous models, customized a model that learns optical flow between low resolution frames, and use it to obtain an HR frame from previous HR frames
- Used a 3-fold loss function that uses PSNR, MSE and SSIM to train the model
- Studied the use of OpenVino framework developed by Intel to accelerate the model
- **Possible improvements:** Reduce the no. of layers in the model to reduce runtime

Apr '22 - Jul '22 **Single frame Video Super Resolution with CNNs** Web & Coding Club, IIT-B

- Studied machine learning & image processing concepts and their implementation
- Implemented 2 Single Image Super-Resolution models: SRCNN and ESPCNN
- Employed bicubic upscaling & convolution in SRCNN & transpose convolution in ESPCNN
- Used PSNR to evaluate the models and found ESPCNN to have higher PSNR
- Concluded more training and larger dataset needed for better performance

Jul '21 **Virtual bot with PID control** Electronics & Robotics Club, IITB

- Programmed a virtual bot to follow a line given any arbitrary starting point on the screen
- Implemented PID control to steer the bot & simulated using PyGame module in Python

Academic Projects

Oct'22 **Semantic segmentation of muscle cells** Prof. Sethi, Electrical engg., IITB

- Implemented a UNet model using Keras and Tensorflow to segment nuclei in muscle tissue images of the MoNuSeg challenge, trained using DICE score
- Used the Watershed algorithm to mark the boundaries of the nuclei

Oct'22 **Piano tiles using Arduino Uno & touchscreen** Prof. P Sarin, Dept. of Physics, IITB

- Used Arduino uno, a 2.4" LCD TFT screen & piezobuzzers and optimized the game according to Arduino's processing and memory limitations, using object oriented programming
- **Possible improvements:** Overclocking the arduino could reduce the screen lag time and improve the overall game experience

Sept '22 **PID control implementation on FPGA** Prof. Vachhani, Dept. of Syscon, IITB

- Implemented 8-bit digital PID control for the pulse width of a PWM signal
- Used Xilinx Vivado and wrote Verilog code for the FPGA and testbench for verification

Mar '22 **Capacitive touch sensing** Prof. Mahalingam, Physics dept., IITB

- Designed a basic touch screen of 16 x 8 grid that can store 4 touches simultaneously
- Designed a circuit consisting of 16 D-latches controlled by a clock signal of frequency 60 Hz to store the y-coordinate of the touch & also register x-coordinate for that touch
- Used priority encoders & decoders to separately store each touch coordinate in a register

Oct '21-Dec '21 **Multiplicity fluctuations in P-P collisions** Prof. S. Dash, Dept. of Physics, IITB

- Analyzed 5.5 GB data of proton-proton collisions using the ROOT software
- Calculated mean, variance, variance/mean etc & plotted the results to draw conclusions

Internships

Jun '22 - Jul '22 **Research Intern** Murkh Dobdob

- Developing the "DynaDio" which uses air bubbles to visualize 3D structures inside a gel
- Researched methods on depth estimation from a monocamera to measure the user's fingers' distance from the camera, in order to track the user's finger as they draw in the air
- Based on these, decided to use a spherical marker because of its symmetry to detect the user's finger bringing down detection time from the order of seconds to milliseconds
- Successfully tested a new gel composition based on water & aloevera for the product

Positions of Responsibility

Jan '21 - now **AUV-IITB | Business subdivision**

- Edited team's video for RoboSub 2021 & secured 2^{nd} position among 54 teams globally
- Lead & edited the team's video entry for Robosub 2022 and secured 3^{rd} position
- Built a brand new team website with improved aesthetics, navigation & interactive CADs
- Lead video submission for Singapore AUV Challenge & secured the team's qualification

Technical skills

Programming languages	Python, C++, Verilog, MATLAB; Python packages: Meep, OpenCV, Numpy, Matplotlib
Technical Software	COMSOL Multiphysics, Arduino, LTspice, Xilinx - ISE, Vivado; iVerilog, Solidworks

Key Courses

Physics	Quantum Optics**, Photonics, Group Theory Methods, Quantum Mechanics
Systems & Controls	Embedded Control & Robotics, Mathematical Structures for Control, Signals & Systems
Electrical	Image processing, Digital systems, Analog electronics, Microprocessors lab
Mathematics	Calculus, Differential equations, Complex analysis, Numerical Analysis, Linear Algebra

Extra curricular activies

- Completed a 5 day trek to Kedarkantha summit at an elevation of 12500 ft Dec '21
- Completed two month long e-tinkering bootcamp organized by Tinkerer's lab, IIT Bombay Jun - Jul '21
- Performed in the finale of Laughter riots organized by Comedy Cons, the standup club of IIT-B Jan '21
- Completed BA in Instrumental Harmonium & Bhav Sangeet from Hindustan Arts & Music Society Jul '19