Manav Doshi — Curriculum Vitae

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Personal Statement

I am a third-year undergraduate at IIT Bombay, pursuing a Mechanical Engineering major and minors in Computer Science and Data Science. I have a sharp inclination for research, particularly in the fields related to artificial intelligence and control engineering. I possess expertise using deep learning methods in computer vision and natural language processing techniques.

Education

Indian Institute of Technology (IIT) Bombay, Mumbai, India *[Nov 2020 - Present]*
B.Tech in Mechanical Engineering Overall CPI: **9.04/10.00**
Minors in Computer Science and Engineering
Minors in Data Science and Artificial Intelligence

Scholastic Achievements

- Secured **All India Rank 896** in **JEE Advanced** out of over **0.15 million** candidates nationwide (2020)
- Achieved **99.84** percentile in **JEE Main** among over **1.5 million** applicants across the nation (2020)

Publications

Siddartha Ganguly, **Manav Ketan Doshi**, et al. "An illustration of a quasi-interpolation driven technique for feedback synthesis"; **Accepted** in **International Federation of Automatic Control (IFAC) World Congress 2023, Yokohoma**

Research Experience

Quasi-interpolation for Feedback Synthesis | *Guide : Prof. Debasish Chatterjee* | (Mar 2022)

Introduction: *We aim to introduce a quasi-interpolation based approximation technique to furnish one-shot approximate unconstrained LQ feedback maps. Further research involves computation of feedback maps on constrained systems*

- Surveying literature on methods to obtain optimal feedback in LQR systems like **Hamilton-Jacobi-Bellman** formulation
- Implementing **deep ReLU neural networks** to obtain nonlinear approximations and generate control signal maps
- Implemented Quasi-interpolation schemes to obtain multidimensional feedback maps with **uniform error bounds**
- Analyzed inverted pendulum system with synthesised feedback and achieved errors less than 10^{-4} **rad**
- This allows us to compute feedback on constrained LQR systems; paper under review at **IFAC World Congress 2023**

IARC | *Unmesh Mashruwala Innovation Cell, IIT Bombay* | (Oct 2021 - Sep 2022)

International Aerial Robotics Competition (IARC) - the longest running collegiate aerial robotics challenge in the world

- Working as a **Senior Machine Learning and Computer Vision** Engineer in the AeRoVe division of UMIC, an interdisciplinary team of 40 students with the objective of developing cutting-edge fully autonomous quadcopters
- Achieved mAP of over **95%** @IoU 0.5 by training deep learning models like **YOLOv4** for custom class detection
- Developed algorithms to augment positional accuracy using state estimation techniques like **Kalman Filters**
- Decreased inference time of model by **300%** by optimizing detection and tracking algorithms by building **TensorRT engines in C++** using the Python library while deploying deep learning algorithms on **Nvidia Jetson Xavier NX**
- Evaluated literature on object detection and tracking, particularly the **R-CNN**, Fast **R-CNNs**, **YOLOv3**, **YOLOv4**, **SORT** and **DeepSORT** to enhance localisation accuracy and ensure smooth flight of the drone while tracking objects

Key Projects

DRDO's UAV-Guided UGV Navigation Challenge | *Inter IIT Tech Meet 10.0* | (Mar 2022)

Secured third place *in DRDO's navigation challenge among* 12 *other IITs as a part of the 10th InterIIT Tech Meet*

- Designed robust algorithms to assist in UGV navigation through snow covered terrains using **drone camera feedback**
- Developed python scripts using **Ardupilot firmware** to perform **road segmentation** using RGB and depth feed
- Implemented a **Stanley controller** from scratch to have the vehicle navigate across various tight turns and altitudes
- Used **OpenCV** and deep learning techniques like **YOLOv4-tiny** to calculate vehicle position and velocity vector

UAV Competition | *International Conference on Unmanned Aircraft Systems 2022* | (May 2022)

Introduction: *Our aim is to develop a codebase for fire-fighting drones for obstacle avoidance and extinguisher deployment*

- Implemented **3D obstacle avoidance algorithms** such as **Vector Field Histogram** to guide UAV through custom arenas
- Accurately localised drop location using custom dictionary **Aruco marker detection** by processing UAV imagery
- Precisely delivered payload at drop location by performing performing highly specific **"swing & drop"** maneuver

Reinforcement Learning | *Course Project* | *Prof. Shivaram Kalyanakrishnan* | (Aug 2022 - Nov 2022)
- Implemented ϵ-**greedy, UCB, KL-UCB** and **Thompson Sampling** algorithms to stochastic Multi-armed bandits
- Used **Value iteration**, **Linear Programming**, and **Policy iteration** to compute an optimal policy for an cricket-based MDP
- Guided a car through a obstacle filled parking lot using **SARSA** with Linear Approximation through **Tile Coding**

Visual Explanation for CNNs | *Winter in Data Science, Analytics Club, IIT Bombay* | (Jan 2022)
- Surveyed various papers on techniques to visualise and plot hidden layers in a **Convolutional Neural Network**
- Implemented visualisation methods like Class Activation Maps, Gradient Based Class Activation Maps, Occlusion Sensitvity and Saliency Maps on deep learning frameworks like **PyTorch and TensorFlow**

DIY FaceApp | *Summer of Code, WnCC IIT Bombay* | (Mar 2021 - Jul 2021)
- Assessed and implemented from scratch a paper on **Deep Convolutional Generative Adversarial Networks** (DCGAN)
- Trained DCGAN models on **CelebA Dataset** to generate samples of celebrity faces using **Adam Optimizer**
- Minimised appropriate loss functions using **PyTorch** with **ReLU, LeakyReLU, TanH and Sigmoid** activation functions
- Achieved an accuracy of **71%** on celebrity faces produced by generative model after training for over **500** epochs

Miscellanous Projects

Laser Micro-drilling | *Course Project* | *Prof. Ramesh Singh* (Apr 2022)
- Studied several research papers on **laser micro-drilling** and analysis of the parameters which affect the process
- Analyzed and reported the trends in taper and circularity due to the variations in power and pulse duration

Alumni Student Mentorship Program | *Student Alumni Relations Cell, IIT Bombay* | (Aug 2021)
- Revamped the website of **Alumni Student Mentorship Program**, which served as a seamless platform for fostering meaningful mentoring relationships between **1500**+ current students and **300**+ alumni over the course of a year
- Collaborated with **6 undergraduates** to develop the website | **1500**+ registrations | **150%** y-o-y increase
- Implemented features to ease selection from **150+** mentors by optimizing backend tasks using **Django** framework

Digit Recognizer | *Self Project* | (Apr 2021)
- Achieved an accuracy of **98.6%** on test set by coding a Convolutional Neural Network based on LeNet architecture
- Used **NumPy** to program the **Forward Propagation** and **Backpropagation Algorithm** on a multi-layer neural network
- Implemented **Stochastic Gradient Descent** to minimise cross entropy loss while implementing dropout to avoid overfitting

Lasso Game | *Course Project* | *Prof. Bhaskaran Raman* (Mar 2021)
- Used Object Oriented Programming concepts in conjunction with **STL** Libraries and Graphics to create a game from scratch
- Programmed additional features like difficulty levels, randomized objects, and lives while visually enhancing the game
- Documented a 6 minute **video presentation** highlighting the features, gameplay and working of the game

Customer Segmentation | *Course Project* | *Prof. Amit Sethi* (Nov 2021)
- Performed customer segmentation on a dataset with over **10,000** records using **unsupervised learning algorithms**
- Implemented various clustering techniques like **KMeans, Mean Shift, and Hierarchial Clustering** using sklearn
- Achieved a **silhouette score of 0.587** by optimising using dimensionality reduction techniques like **PCA and t-SNE**

Sarcasm | *Student Alumni Relations Cell, IIT Bombay* | (Apr 2021)
- Collaborated in a team of **5** members to develop the portal for SARCasm, the annual crypt hunt of IIT Bombay
- Developed a **theme-based** frontend and restructured the backend to enhance the user experience of SARCasm

Industrial Learning Program | *Student Alumni Relations Cell, IIT Bombay* | (Jul 2021)
- Centralized institute-wide industry internship applications, resulting in **41%** y-o-y rise in registrations and allotments
- Developed a full-stack application using **Django** and **ReactJS library** and connected them using **djangorest** framework

Airline Delay Prediction | *Course Project* | *Prof. Asim Tewari* | (Nov 2022)
One of only 5 *teams to receive a perfect of* 35/35 on the course project based on rigorous pitches and entrepreneurship ideas
- Used various datasets to predict flight delay in minutes and prepared a **mock pitch** to reduce losses in revenue caused
- Implemented classification techniques incorporating **20+ features** and achieved **91.6%** accuracy over **1.8 million** flights
- Programmed data pre-processing and multiple linear regression pipelines using sklearn to obtain RMSE error of **10.48**

Electroless Deposition | *Course Project* | *Prof. Pradeep Dixit* (Nov 2022)
- Assessed and analyzed the current literature on the electroless deposition of copper on non-organic substrates like silicon
- Presented an extensive report in front of **10+** panelists and defined areas of improvement in pre-existing methods

Positions of Responsibility

Team Manager | *Unmesh Mashruwala Innovation Cell, IIT Bombay* (Apr 2022 - Present)

Innovation Cell aims to facilitate technical start-ups and foster an atmosphere of innovation and entrepreneurship

- Managing a team of 22, responsible for developing the team's website and increasing social media outreach
- Spearheading presentations of the technical work of the team to relevant companies and firms to gain **sponsorships**
- Managed a budget of **1.5+ million INR** and responsible for procuring required equipment for the core team
- **Moderating** and **channeling** information between the Core team members and the Non-Core team members
- Conducted the non-core recruitment drive for the team and shortlisted **5** candidates out of **70+** total applicants

Department Research Co-ordinator | *Undergraduate Academic Council* (May 2022 - Present)

- Securing research opportunities to bolster the participation of **800+** students and inculcate UG research culture
- Proactively seeking collaborations to bridge the gap between research enthusiast UG students and professors
- Ideated the Summer Undergraduate Research Program, adminstered **16** research project entries from **7** professors and their allocations amongst **150+** applicants on the basis of rigorous interviews and statements of purpose

Student Mentor | *Department of Mechanical Engineering, IIT Bombay* (May 2022 - Present)

- Selected to be a part of a **43** member team responsible for transitioning incoming sophomores in the department
- Mentoring **6** sophomores in the department, providing general counsel and ensuring academic well being
- Maintaining and curating the DAMP Blog containing **150+** extensive course reviews and articles on internships

Web Team Co-ordinator | *Student Alumni Relations Cell, IIT Bombay* (Jun 2021 - Apr 2022)

Part of a 60 *member student team responsible for fostering relations among* 60K+ *alumni and students*

- Handling the web presence of Student Alumni Relations Cell (SARC) alongside a team of **6** undergraduates
- Managing the development of various websites and portals for SARC initiatives using Django and ReactJS
- Negotiated with **100+** alumni during the **34th Phonathon**, annual telephonic marathon of SARC, IIT Bombay

Teaching Assistant | *CE102 - Engineering Mechanics* | *Prof, Najeeb Shariff* (Mar 2022 - Aug 2022)

- Conducted weekly **tutorial** sessions for a batch of 80 freshmen and helped them through personal interaction
- Provided assistance to the instructor in **course logistics** by proctoring exams and evaluating answer scripts

Key Courses Taken

Computer Science	Computer Programming and Utilization, Programming for Data Science, Data Structures and Algorithms, Foundations of Intelligent Structures, Statistical Machine Learning
Miscellaneous	Calculus, Linear Algebra, Differential Equations, Quantum Physics & Application, Basics of Electricity & Magnetism, Physical Chemistry, Biology, Introduction to Electrical & Electronic Circuits, Numerical Analysis
Online Certifications*	Deep Learning & Neural Networks, Hyperparameter Tuning, Convolutional Neural Networks, Sequence Models, Structuring ML projects

* - Online Courses on Coursera

Extracurricular Activities

Sport	• Representing IIT Bombay's football team in Mumbai District Football Association • Placed second in Institute Football League - IIT Bombay's annual sports competition • Took over 8 years of coaching lessons in Shotokan Karate achieving 3rd Kyu
Mentorship	• Managing a group of **4** freshmen in CodeWars - India's first bot programming contest • Leading 10 freshmen in Summer of Code to develop a Generative Adversial Network • Mentored 4 students during the training program to use ROS, Gazebo and OpenCV

References

Prof. Dhwanil Shukla
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