# Manav Doshi

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## 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 in Data Science and Artificial Intelligence*

## Scholastic Achievements

- Won 1st place in ACCESS (ACcelerating Climate, Energy & Sustainability Solutions) — Received award of **0.4mn** (2023)
- Secured **All India Rank 896** in the **JEE Advanced Examination** out of over **0.15 million** candidates nationwide (2020)
- Achieved **99.84** percentile in **Joint Entrance Examination Main** among over **1.5 million** applicants in the nation (2020)
- Recepient of **INSPIRE** scholarship by the Maharashtra State Board for ranking in top **0.1%** of **1.4mn** students (2020)

## Publications

- Siddartha Ganguly, **Manav Ketan Doshi** et al. "*An illustration of a quasi-interpolation driven technique for feedback synthesis*"; **Accepted** and **Invited for offline presentation** at the IFAC World Congress 2023 held in Yokohama, Japan
- Subrata Mitra, **Manav Ketan Doshi** et al. "*ScaleViz: Scaling Visualization Recommendation Models on Large Data*"; Submitted to **PAKDD 2024** (Pacific-Asia Conference on Knowledge Discovery and Data Mining 2024) (under review)

## Research Experience and Professional Experience

### Scalability of Approximate Visualizations | *Adobe Research Lab* (May 2023 - Aug 2023)

*Transforming data into insightful dashboards, performing inference under a budget for different datasets of* 100Mn+ *records*

- Proposed various **novel metrics** to quantify deviations between original and visualizations produced after approximations
- Developed an end-to-end **Vis**ualization **Rec**ommendation **(VisRec)** pipelines to work on industrial **large-scale** datasets
- Profiled how visualization recommendation models are affected by noise addition in **statistical features** while sampling
- Engineered strategies to traverse **large discrete action spaces** with **10k+** actions for Reinforcement Learning Policies
- Achieved a **90%** reduction in computation, saving over **45** hours by implementing an **RL Agent** to reduce inference time
- Reduced overestimation of Q values in Deep Q-Nets and improved **training stability** by programming a target Q-network
- Amplified training speeds by **30%** by Proximal Policy Optimization | Observed MSE Losses of $10^{-4}$ after **1000** episodes

### Composed Image Retrieval | (Ongoing)

*Guide : Prof. Biplab Banerjee, Center of Studies in Resources Engineering, IIT Bombay*

Composed Image Retrieval is the extraction of images from a database by leveraging their intrinsic content attributes

- Introducing novel methods in image retrieval, leveraging zero-shot and few-shot capabilities of **OpenAI's CLIP models**
- Devising **NLP** methods to harmonize visual elements with textual prompts, seamlessly incorporating vision and language
- Engineering methods to strategically navigate around the **resource-intensive** task of manually labeling dataset triplets
- Training custom **AutoEncoders** and **Neural Networks** to map images to a concept tokens in the textual latent space

### Quasi-interpolation for Feedback Synthesis | (Mar 2022)

*Guide: Prof. Debasish Chatterjee, Systems and Controls Engineering, IIT Bombay*

**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 by applying synthesised feedback and achieved errors less than order of $10^{-4}$ **rad**

### International Aerial Robotics Challenge Mission 9 | (Oct 2021 - Sep 2022)

*Unmesh Mashruwala Innovation Cell, IIT Bombay*

*Received a special mention at IARC, highlighting innovation and research aptitude in solving the problem statement*

- Led an interdisciplinary team of **40+** mutltifaceted students as a **Senior Machine Learning and Computer Vision** Engineer in the AeRoVe division of UMIC with the long-term objective of developing cutting-edge fully autonomous drones
- Achieved mAP of over **95% @IoU 0.5** by training deep neural networks like **YOLOv4** for mast detection and tracking
- Developed algorithms to augment positional and localisation accuracy using estimation techniques like **Kalman Filters**
- Decreased inference time of model by **300%** | Built **TensorRT engines** and deployed them 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

### Airline Delay Prediction | *Statistical ML and Data Mining* (Mar 2022)

*Guide : Prof. Asim Tewari, Department of Mechanical Engineering, IIT Bombay*

*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**

### DRDO's UAV-Guided UGV Navigation Challenge | (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

### Foundations of Intelligent Learning Agents | (Aug 2022 - Nov 2022)

*Guide : Prof. Shivaram Kalyanakrishnan, Department of Computer Science and Engineering, IIT Bombay*

- Implemented $\epsilon$-**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 MDP
- Guided a car through a obstacle filled parking lot using **SARSA** with Linear Approximation through **Tile Coding**

### Visual Explanation for CNNs | (Jan 2022)

*Winter in Data Science, Analytics Club, IIT Bombay*

- Surveyed various papers on techniques to visualise and plot hidden layers in different **Convolutional Neural Networks**
- Implemented visualisation methods like Class Activation Map (CAM), Gradient Based Class Activation Map (Grad-CAM), Occlusion Sensitvity and Saliency Maps on **PyTorch**

### Customer Segmentation (Nov 2021)

*Guide : Prof. Amit Sethi, Department of Electrical Engineering, IIT Bombay*

- 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**

## Positions of Responsibility

### Department Research Co-ordinator (May 2022 - April 2023)

*Undergraduate Academic Council, IIT Bombay*

*Securing research opportunities to bolster the participation of* 800+ *students and* facilitate UG research *in the institute*

- Collaboratively ideated and structured an the Summer Undergraduate Research Programme **(SURP)** in a team of **8**
- Adminstered **600**+ research projects from **70**+ professors and their allocations among **900**+ applicants based on interviews
- Proactively brokered **collaborations** to bridge the divide between research-driven undergraduate students and professors

### Institute Student Mentor and Department Academic Mentor (July 2023 - Present)

*Student Mentorship Program, IIT Bombay*

- Selected among **380+** ISMP applicants and **110+** DAMP applicants based on interviews and extensive peer reviews
- **Web Subgroup Head** - Leading a team of **6** mentors overseeing maintenance of blogs containing **230**+ course reviews
- Assisting scholastically struggling students in the **Academic Rehabilition Program**(ARP) with their curricular endeavours
- Responsible for mentoring **14** freshmen by providing counselling pertaining to academic and extra curricular decisions

### Teaching Assistant (Mar 2022 - Aug 2022)

*CE102 - Engineering Mechanics, Prof. Najeeb Shariff*

- Facilitated regular **tutorial** sessions for a cohort of **80**+ incoming freshmen, providing guidance through direct interaction
- Collaborated with instructors to manage **course logistics**, contributing by proctoring exams and assessing answer scripts

## Relevant Courses and Skills

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|---|---|
| **Computer Science** | Computer Programming and Utilization, Programming for Data Science, Data Structures and Algorithms, Foundations of Intelligent Agents, Statistical Machine Learning and Data Mining, Advanced Methods in Satellite Image Processing, Advanced topics in deep learning for image analysis, Advanced Topics in Machine Learning |
| **Miscellaneous** | Calculus I & II, Linear Algebra, Linear Systems Theory, Ordinary Differential Equations, Introduction to Numerical Analysis, Deep Learning & Neural Networks*, Hyperparameter Tuning*, Convolutional Neural Networks*, Sequence Models*, Structuring ML projects* |
| **Programming** | C/C++, Python, OpenCV, MATLAB, Tensorflow, PyTorch, Scikit-learn, OpenAI Gym |

* - Online Courses on Coursera

## Extracurricular Activities

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|---|---|
| **Sport** | • Led a team of **6** for conduction of Aavhan Football, featuring **24 colleges** with **INR 50K** prizes<br>• One of the **24** players selected for Inter-IIT Football Camp out of **14k**+ students in the institute<br>• Represented IIT Bombay's football team in the Mumbai District Football Association for **2** years<br>• Placed **second** in IFL - IIT Bombay's annual sports competition seeing over **300**+ participants |
| **Mentorship** | • Guided a team of **4** freshmen students in CodeWars, India's inaugural robot programming contest.<br>• Directed a team of **10** students in Summer of Code program, facilitating efforts in coding GANs<br>• Mentored **4** students during a training program, aiding them in mastering ROS and OpenCV |