SAQIB AZIM

Email: sazim@ucsd.edu ◇ Homepage: saqib1707.github.io ◇ LinkedIn: linkedin.com/in/saqibazim

Education

University of California San Diego Sep '21 - Ongoing
Master of Science (MS) in *Machine Learning and Intelligent Systems*
GPA : 3.92/4.0
Advisor : Prof. Nikolay Atanasov

Indian Institute of Technology Bombay Jul '15 - Jun '19
Bachelor of Technology (B.Tech) in *Electrical Engineering* with Minor in *Computer Science*
Undergraduate Research Award *(for excellent research contribution)* [2019]

Research Interests

Machine Learning, Computer Vision, Reinforcement Learning, Robot Learning

Patent & Publication

- **Visual Localization in Dynamic Environments with Targeted-Inference SLAM** [report]
  Saqib Azim, Takumi Nito and Katsuyuki Nakamura
  Japan Patent Application, filed Aug '21 (pending)
- **Indoor Distance Estimation using LSTMs over WLAN Network** [arXiv/paper]
  Pranav Sankhe, **Saqib Azim**, Sachin Goyal, Tanya Choudhary, Kumar Appaiah and Sukumar Srikant
  In IEEE Workshop on Positioning, Navigation and Communications (WPNC 2019)
  India Patent Application, filed Dec '18 (pending)

Industry Experience

Hitachi R&D Lab Oct '19 - Sep '21
Assistant Researcher, Intelligent Vision Research Group **Tokyo, Japan**

- Developed a **Visual Localization and Navigation** system using **SLAM** and deep learning for dynamic environments.
- Implemented ORB-keypoint based camera pose estimation, keyframe-based 3D mapping, trajectory optimization and loop closure in **C++**.
- Engineered a novel time-efficient targeted inference semantic segmentation network to efficiently detect dynamic scenes which **reduces computation time by 5x** leading to patent submission in Japan.
- Achieved **47% reduction** in localization error in dynamic environments over real-time state-of-the-art methods.
- Developed an **android app** to deploy the localization system on smartphones leading to significant product impact.
- Created visual hazardous activity detection system using Mask RCNN segmentation and depth estimation. Successfully demonstrated a prototype at a Railway Factory.
- Implemented an interactive game in **Unity3D** graphics engine to generate synthetic data for deep learning training.
- Trained an end-to-end **MobileNet SSD** and **UNet** model to semantically segment hands using egocentric images, perform gesture classification, and identify hand-pointed objects with **94%** accuracy.

Samsung R&D Institute May '18 - Jul '18
Machine Learning Intern, Advanced Technology Lab *Bengaluru, India*

- Prototyped a **handwritten text recognition** system by estimating wrist movements using Samsung smartwatch sensors.
- Improved raw IMU signal-to-noise ratio using adaptive filters and devised an automated data-collection framework.
- Trained a pipelined **SVM** and **attention-LSTM** model to learn the relation between hand movement and character patterns, and achieved **93%** text recognition accuracy.

Technical Skills

- **Programming** - Python, C & C++, MATLAB, Bash, HTML, CSS, LaTeX
- **ML Frameworks** - TensorFlow, PyTorch, Scikit-Learn, NumPy, Scipy, Pandas, CUDA, OpenCV
- **Developer Tools** - Git, Docker, Android Studio, Google Colab, Jupyter Notebook, Unity, Linux, Arduino, Kubernetes

Selected Courses

- Deep Generative Models
- Deep Learning for 3D Data
- Advanced Machine Learning
- Deep Reinforcement Learning
- Statistical Learning
- Advanced Computer Vision
- Sensing and Estimation in Robotics
- Maths for Robotics
- Convex Optimization and Applications
- Advanced Image Processing
- Statistical Signal Processing
- Linear Algebra and Applications

Selected Projects

Robot Manipulation using Deep Reinforcement Learning Dec '22 - Ongoing
Graduate Student Researcher at Existential Robotics Lab *UC San Diego*

- Developing and improving **deep RL** models for wide-range of dexterous manipulation tasks.
- Employed **Soft Actor-Critic** and **Adversarial Imitation learning** algorithms (GAIL, AIRL, VMAIL) to learn optimal task-policy in **Robosuite** and **DeepMind** environments.
- Successfully transferred learned policies to a real-world Panda robot arm (**Sim2Real**) using computer vision algorithms.

Object Pose Estimation and Neural Radiance Field (NeRF) Fall '22
Advisor: Prof. Hao Su *UC San Diego*

- Developed a 6D pose estimation pipeline to predict poses of objects in a scene using RGBD images.
- Utilized **PointNet** for object segmentation, followed by 3D point cloud formation, and **Iterative closest point** algorithm for point cloud alignment and to estimate the 6D pose of segmented objects, achieving a **96%** test accuracy.
- Implemented **NeRF** to fit and generate photorealistic views of a scene, described by images and their poses.

Autonomous Vehicle Localization and Mapping Winter '23
Advisor: Prof. Nikolay Atanasov *UC San Diego*

- Implemented a **Particle-filter SLAM** algorithm for robot localization in an unknown environment using encoder and IMU odometry data, and generated a 2D **occupancy-grid map** using LIDAR measurements.
- Implemented a **Visual-Inertial SLAM** system for precise pose estimation of an IMU sensor attached to a car using an Extended kalman filter (EKF) and estimated 3D landmarks in the environment using stereo camera observations.

Adversarial Robustness Analysis of Deep Models Apr '22 - Aug '22
Advisor: Prof. Lily Weng *UC San Diego*

- Investigated neural network sensitivity to random input perturbations and evaluated the effectiveness of heuristic defense mechanisms in training robust models against powerful attacks.
- Utilized attack mechanisms, including FGSM, PGD, Auto-Attack, to generate adversarial examples and evaluated CLIP model's performance on **CIFAR10** and **ImageNet** datasets.
- **Boosted** certifiable robustness on ImageNet by achieving a **5% increase** in top-1 accuracy using randomized smoothing.

Team Member - Autonomous Self-Driving Car Aug '17 - Jul '18
Mahindra Rise Driverless Car Challenge **Innovation Cell**, *IIT Bombay*

- Contributed to the development of vision and navigation algorithms for an autonomous driverless car.
- Proposed a **compute-efficient** image processing algorithm to mitigate shadows and varying lighting conditions on roads.
- **Managed** collection and annotation of a road dataset used to train **YOLO** framework for road and obstacle detection.

Pursuer-Evader Optimal Trajectory Estimation Aug '18 - Jul '19
Advisor: Prof. Debraj Chakraborty *IIT Bombay*

- Developed an optimal control algorithm to drive multi-evader agents to destination using novel inter-agent interactions.
- Utilized **global iterative solvers** to estimate optimal agent trajectories under diverse constrained conditions.
- Learned to accurately predict pursuer-evader trajectories using an **attention-LSTM** model.

Image Inpainting for Road-Scene Understanding Winter '22
Advisor: Prof. Pengtao Xie *UC San Diego*

- Implemented a unified framework to enhance **road-scene understanding** by combining state-of-the-art semantic segmentation (**DeepLabV3**) for removing undesired objects with a generative network for inpainting missing regions.
- Trained and evaluated the model on the **CityScapes** dataset, generating superior image quality.

Speech Enhancement using Convolutional-RNN and Wavelets Fall '22

- Built an end-to-end data-driven convolutional-recurrent neural network for enhancing the quality of speech signals.
- Employed wavelet pooling instead of max-pooling and evaluated performance using SNR, PESQ, STOI metrics.
- Demonstrated improved performance with **faster** training convergence on real-world speech dataset.

Zero-Shot Learning (ZSL) for Object Recognition May '17 - Nov '17
Advisor: Prof. Subhasis Chaudhuri *VIP Lab, IIT Bombay*

- Proposed a semi-supervised VGG16 autoencoder model to learn visual-semantic mapping using Word2Vec features.
- Improved ZSL unseen class performance from 58.7% to 65.3% on Animals with Attributes dataset.

Achievements & Extra-Curriculars

- Secured rank of 1133 *(out of 1.5 million candidates)* in IIT-JEE Advanced '15 (India's toughest entrance exam).
- Awarded **Bronze Medal (3^{rd}/23 teams)** by BARC India for proposing innovative solutions to TV Audience Measurement Challenge at the 7th Inter-IIT Technical Meet 2018.
- Actively contributed to **Open Source** platforms such as Kivy and KivEnt.
- Contributed to Mood Indigo '16 website development, IIT Bombay.

Teaching & Mentorship

- **Teaching Assistant** for 5 undergraduate and graduate courses at UC San Diego.
  - *Probabilistic Modeling and Machine Learning* under Prof. Berk Ustun — Spring '23
  - *Image Processing* under Prof. Ben Ochoa — Winter '23
  - *Probability and Statistics for Data Science* under Prof. Alon Orlitsky — Fall '22
  - *Engineering Probability and Statistics* under Prof. Alon Orlitsky — Spring '22
  - *Linear Signals and Systems* under Prof. Saharnaz Baghdadchi — Winter '22
- **Teaching Assistant** for *Signals and Systems* under Prof. Jayakrishnan Nair — Spring '19
- Volunteered to teach underprivileged kids at **LCCWA NGO** under IIT Bombay's Education Outreach program.
- **Mentor** at Summer of Science '19 & '20, IIT Bombay (guided 4 undergraduates, 2 Masters students)
- **Mentored** two student teams at *Institute Technical Summer Project '17*, IIT Bombay.