SAQIB AZIM

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Education

Indian Institute of Technology Bombay, *Mumbai, India* Jul '15 - Jun '19
B.Tech: Electrical Engineering (major), Computer Science (minor)

- **Award :** Undergraduate Research Award (URA 01) *(for excellent research contribution)* [2019]

Work Experience

Hitachi Central Research Lab, *Tokyo, Japan* Oct '19 - Present
Assistant Researcher in the Intelligent Vision Research Group advised by Dr. Katsuyuki Nakamura

Samsung Research Institute, *Bengaluru, India* May '18 - Jul '18
Summer Internship in the Advanced Technology Lab working under Dr. Shankar Venkatesan

Research Interests

Theoretical and Applied aspects of Machine Learning, Deep Learning, Optimization, Statistics, Computer Vision, Robotics, Signal and Image Processing

Patent & Publication

- **Indoor Distance Estimation using LSTMs over WLAN Network** [**arXiv**/**paper**]
  IEEE Workshop on Positioning, Navigation and Communications (WPNC), 2019
  P. Sankhe, **S. Azim**, S. Goyal, T. Choudhary, K. Appaiah and S. Srikant
- **Indoor Positioning System for position estimation in an indoor environment**
  Indian Patent Application - 201821047043, *filed Dec '18 (pending)*
  P. Sankhe, **S. Azim** and S. Goyal

Research Experience [1]

Handwritten Character Recognition using Smartwatch Summer Internship '18
Advisor: Dr. Shankar Venkatesan ***Samsung Research Institute**, Bengaluru*

· Prototyped a handwritten text recognizer by estimating wrist movements using smartwatch IMU sensors. Used learned frequency filters and adaptive thresholding to improve signal-to-noise ratio. Learned the relationship between hand movements (IMU signals) and character patterns using a pipelined SVM classifier (detecting valid IMU segments), and LSTM (for character recognition) network. Collected dataset of 50 people, and trained the end-to-end system on the custom-created dataset, achieving 87% recognition accuracy.

Indoor Positioning System over WLAN Network [paper] Jan '17 - Dec '18
Advisors: Prof. Kumar Appaiah & Prof. Sukumar Srikant *IIT Bombay*

· Designed, developed and prototyped a SOTA self-adaptive system to locate an object with high accuracy ($\leq$ 10 cm) in indoor environments. Proposed a setup of stationary signal receivers to account for indoor topology and signal attenuation effects. Used a LSTM to estimate the relation between strength of received wireless signals and the distance from a wireless access point. Further, designed a bot traversing a predetermined path for training data collection. Quarter-Finalist of India Innovation Challenge '18 conducted by DST & Texas Instruments.

[1] *Excluding research work conducted at Hitachi Research due to information security protocols*

Optimal Pursuer-Evader Shepherding Problem [report] Aug '18 - Jul '19
Advisor: Prof. Debraj Chakraborty *IIT Bombay*

· Defined a novel pursuer-evader problem of estimating optimal pursuer strategy for driving a multi-evader system to destination using inter-agent interactions, and formulated as a constrained optimization task. Generated optimal trajectories and introduced dipole analogy to find pursuer control algorithm. Proposed to learn the optimal trajectory patterns (generated with optimization solvers) using time-series based LSTM module, producing promising results for various initial conditions.

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

· Proposed a semi-supervised VGG16-based encoder-decoder network to learn visual-to-semantic space mapping using novel combination of margin-based hinge-rank loss and Word2Vec embeddings. Explored multiple networks for better visual feature representations. Achieved improvement in recognition performance from 58.7% to 65.3% on the Animals with Attributes dataset compared to existing methods.

Image Registration using FFT (*Selected in Top* 5/40 *projects*) Jan '18 - Apr '18
Advisor: Prof. Vikram Gadre, Digital Signal Processing *EE, IIT Bombay*

· Built a FFT based tool for registering and mosaicing images captured from different view-points and scales. Used phase correlation and impulse location for rotational and translational alignment resp. Achieved better results than SIFT based alignment in case of aerial images. Presented at MHRD-TEQIP-KITE Resource Creation Workshop under the initiative of MHRD, Govt. of India.

TV Audience Measurement Winter '18
Bronze Medal (3rd/23 teams), *7th Inter-IIT Technical Meet* *IIT Bombay*

· Proposed scalable and robust solutions for various challenges put forward by BARC India such as channel identification, advertisement and content classification and recognition, age and gender recognition of viewers, providing hardware free solution to capture TV viewership data of India. Helped IIT Bombay achieve overall Runner-up (2^{nd}/23 IITs) at the event

Simultaneous sensing & sparsifying dictionary optimization Feb '18 - Apr '18
Advisor: Prof. Ajit Rajwade, Advanced Image Processing *CSE, IIT Bombay*

· Implemented a compressed sensing framework using coupled-KSVD and OMP algorithm for joint design and optimization of sensing matrix and non-parametric dictionary. Improved reconstruction accuracy compared to standard approach which uses gaussian sensing matrix and overcomplete dictionary learned using KSVD.

Photoplethysmogram (PPG) Signal Acquisition Module [report] Jan '18 - Apr '18
Advisor: Prof. P C Pandey, Electronics Design Lab *EE, IIT Bombay*

· Designed and developed a hardware module for faithful PPG signal acquisition with low noise and minimal filtering. Implemented baseline restoration and auto-intensity control for varying skin attributes (color, shape). Provided bluetooth connectivity to display the acquired PPG signal on mobile devices

Music Information Retrieval from EEG signals Sep '17 - Nov '17
Advisor: Prof. Gaurav Kasbekar *EE, IIT Bombay*

· Applied onset detection techniques on EEG recordings to extract tempo of the corresponding stimulus. Implemented tempogram estimation using autocorrelation technique assuming EEG as the novelty curve. Achieved 1 bpm difference in actual tempo and calculated tempo from the EEG data.

Pipelined Reduced Instruction Set Computer Aug '17 - Nov '17
Advisor: Prof. Virendra Singh, Microprocessors *EE, IIT Bombay*

· Designed and implemented a 6-stage pipelined multicycle RISC processor in VHDL, with arithmetic, logical and branching instructions, and tested on DE0-Nano FPGA board. Implemented fully associative cache, flushing, data-forwarding, etc. to maximize the theoretical throughput of the processor.

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

· Studied the effect of shadows and varying lighting conditions on roads and provided low-computation solution using image processing techniques. Collected and prepared custom-dataset of Mumbai roads and learned to detect roads, obstacles, zebra-crossing, etc. with YOLO-based network.

Achievements

- Ranked among **top 0.75%** *(out of 150000)* candidates in JEE Advanced '15
- Ranked among **top 0.15%** *(out of 1.5 million)* candidates in JEE Main '15
- Awarded **financial scholarship** from Educational Co-ordination Committee and **academic excellence** award from Humayun Kabir Institute for outstanding performance in 10th Grade Exam [2012]

Extra-Curricular

- **Undergraduate Teaching Assistant** at IIT Bombay in *Signals and Systems* Spring '19
  - Responsible for assisting Prof. J K Nair in evaluation and grading of 140 students
- **Teaching Member**, Educational Outreach, *National Service Scheme IITB* [2015-16]
  - Completed one year teaching Maths and Science to underprivileged secondary school students
- **Mentor**, *Summer of Science '19 & '20*, IIT Bombay (guided 4 undergraduates, 2 Masters students)
- **Mentor**, *Institute Technical Summer Project '17*, IIT Bombay (guided 2 UG student teams)
- **Open Source** - Actively contributed to Kivy, Kivent [2016-17]
- **Web Coordinator**, Mood Indigo '16, IIT Bombay - Contributed to Mood Indigo website development

Relevant Courses & Skills

- **Computer Science** - Advanced Machine Learning, Computer Vision, Advanced Image Processing, Data Structures & Algorithms, Operating Systems, Computer Networks, Optimization Techniques
- **Electrical Engineering** - Estimation and Identification, Probability and Random Processes, Data Analysis, Control Systems, Signal Processing, Digital & Analog Communication, Microprocessors
- **Programming** - Python, C/C++, MATLAB, Java (Android), HTML/CSS, Assembly, LaTeX
- **Softwares Tools** - OpenCV, Tensorflow, Pytorch, Numpy, Git, Docker, Scilab, VHDL, Wireshark, GNU Radio, Quartus, Arduino

References

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