SAQIB AZIM

azimsaqib10@gmail.com ⬦ Homepage ⬦ Github ⬦ (+81) 70 4358 5435

EDUCATION

Indian Institute of Technology Bombay, *Mumbai, India*   Jul '15 - Jun '19
B.Tech in Electrical Engineering, Minor in Computer Science
- **GPA** : 8.46/10
- **Award** : Undergraduate Research Award (URA 01) *(for excellent research contribution)*   [2019]

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**   [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. Patent Pending
  P. Sankhe, **S. Azim** and S. Goyal

RESEARCH EXPERIENCE

Human Navigation Support using Visual-Inertial SLAM   Feb '20 - Ongoing
Advisor: Dr. Katsuyuki Nakamura   **Hitachi Research**, *Tokyo*

· Developed a robust and reliable human navigation support system in unfamiliar dynamic real-world environments using visual-inertial SLAM and deep-learning methods
· Implemented feature-based SLAM performing device tracking, 3D mapping and bundle adjustment
· Integrated a system for dynamic object detection into the visual-SLAM pipeline to mitigate inaccuracies from dynamic scenes, and demonstrated performance improvement on public datasets
· Built a smartphone application for real-time device localization in a pre-built 3D map

Risky Activity Detection   Oct '19 - Jan '20
Artificial Intelligence Lab   **Hitachi Research**, *Tokyo*

· Developed method for quantitative risk estimation of human workers in factory environment based on positional relationship between a person and dangerous heavy objects
· Implemented camera-based system to estimate position of human and dangerous objects in factories
· Established proof-of-concept for the successful working of this technology at a Japanese Factory
· Presented this research technology at Hitachi Image Processing Research (IPR) Symposium 2020

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

· QuarterFinalist of India Innovation Challenge conducted by DST & Texas Instruments
· Developed a self-adaptive WiFi based system to locate a target wireless node in indoor environment
· Proposed stationary WiFi reference nodes setup to model the shadowing and multipath fading effects

- Used an LSTM network for time-series modeling of signal strength received at all nodes to estimate target object distance from the reference node
- Demonstrated superior performance of our approach compared to CNN and FCN based network by achieving mean localization error of 5.85 cm with 93% confidence on a scale of (8.46 x 6.98) m

Handwritten Character Recognition using Smartwatch
Advisor: Dr. Shankar Venkatesan

Summer Internship '18
Samsung Research Institute

- Prototyped an end-to-end IMU-based handwritten character recognition system using a smartwatch
- Employed learned frequency filters followed by adaptive thresholding to improve raw signal SNR
- Learned the relationship between hand movements (IMU signals) and character pattern using an SVM classifier (detecting valid character segments), and an LSTM (for character recognition)
- Achieved 87% accuracy for english alphabet recognition on a custom-created dataset

Optimal Pursuer-Evader Shepherding Problem [Thesis]
Advisor: Prof. Debraj Chakraborty

Aug '18 - Apr '19
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
- Formulated the task as constrained optimization problem and generated optimal solutions
- 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
Advisor: Prof. Subhasis Chaudhuri

May '17 - Nov '17
VIP Lab, IIT Bombay

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

Miscellaneous Projects

Image Registration using FFT (*Selected in Top 5/40 projects*)
Signal Processing under Prof. Vikram Gadre

Jan '18 - Apr '18
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
Bronze Medal (3rd/23 teams), *Inter-IIT Technical Meet*

Winter '18
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 and providing hardware free solution in order to capture TV viewership data of the country

Simultaneous sensing & sparsifying dictionary optimization
Advanced Image Processing under Prof. Ajit Rajwade

Feb '18 - Apr '18
CSE, IIT Bombay

- Implemented a framework for joint design and optimization of sensing matrix and non-parametric dictionary. Improved reconstruction accuracy on image patches using coupled K-SVD and OMP Algorithm compared to using gaussian sensing matrix and overcomplete dictionary learned using KSVD

Photoplethysmogram (PPG) Signal Acquisition Module [Report]
Advisor: Prof. Prem C Pandey

Jan '18 - Apr '18

EE, IIT Bombay

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

Music Information Retrieval from EEG signals
Probability & Random Processes under Prof. Gaurav Kasbekar

Sep '17 - Nov '17

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 a difference of 1 bpm in actual tempo and calculated tempo from the EEG data

Pipelined Reduced Instruction Set Computer
Microprocessors under Prof. Virendra Singh

Aug '17 - Nov '17

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
Mahindra Rise Driverless Car Challenge

Sep '17 - Mar '18

Innovation Cell, *IIT Bombay*

· Studied the effects of shadows and varying lighting conditions for road, lane and zebra-crossing detection. Provided solution using image processing techniques. Developed proof-of-concept with YOLO network trained on our own custom-created Indian Road Dataset for detection of roads, obstacles, person, etc.

MISCELLANEOUS

- 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

- **Undergraduate Teaching Assistant** at IIT Bombay in *Signals and Systems*   Spring '19

- **Teaching Volunteer**, *National Service Scheme, IITB*   [2015-16]
  - Completed one year teaching Maths and Science to underprivileged secondary school students

- **Mentored** four UGs, two Masters' IITB students on their *Summer of Science* projects (Summer '19 & '20), and guided two freshmen group in *Institute Technical Summer Project* (Summer '17)

- **Open Source** - Actively contributed to Kivy, Kivent in 2016-17

- **Web Coordinator** for Mood Indigo '16 at IIT Bombay

RELEVANT COURSES & SKILLS

- **Computer Science** - Advanced Machine Learning, Computer Vision, Advanced Image Processing, Data Structures & Algorithms, Operating Systems, Computer Networks
- **Electrical Engineering** - Probability & Random Processes, Data Analysis, Control Systems, Signal Processing, Digital & Analog Communication, Microprocessors, Optimization Techniques
- **Advanced** - Python, C++, MATLAB, Java (Android), Git, Docker, OpenCV, LaTeX
- **Intermediate** - Assembly, Scilab, AutoCAD, VHDL, Arduino, Quartus, Wireshark, GNU Radio