Anshul Shah

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COMPUTER SCIENCE
UNIVERSITY OF MARYLAND

Education

University of Maryland, College Park **Aug. 2018- Present**
Ph.D in Computer Science
Advisor : Prof. Rama Chellappa

Indian Institute of Technology Madras, Chennai **CGPA : 9.39/10**
Dual Degree B.Tech.(Honors) & M.Tech. in Electrical Engineering *2013–2018*
Minor in Robotics

Navrachana School, Vadodara **95.6%**
Class XII CBSE *2013*

Coursework

Computer Science & Signal Processing: Image Understanding[1], Advanced Techniques in Visual Learning and Recognition[1], Image Signal Processing, Deep Learning, 3D Computer Vision[2], Machine Learning for Computer Vision, Data Structures and Algorithms, DSP Architectures for Embedded Systems, Microprocessor Laboratory, Digital Signal Processing
Photonics and Optics: Optical Signal Processing, Electronic and Photonic Nanoscale devices, Introduction to Photonics
Robotics and Control: Introduction to Robotics, Non Linear Control Systems,Flight Control Systems [2],Control Engineering
Mathematics: Probability, Statistics and Stochastic Processes, Linear Algebra and Numerical Analysis, Functions of one Variable, Functions of several variables, Mathematical Finance

Skills

Languages: C, C++, Python, MATLAB, Lua, Verilog
Libraries & Tools: TensorFlow, Torch, PyTorch, SciLab, OpenCV, PIL, OpenNI, Kinect SDK, Unity 3D, LaTeX
Hardware: Raspberry Pi, Arduino, Microsoft Kinect, Xilinx Spartan-3E

Academic Research and Course Projects

Blurred Image to Video Generation **Jun'17-May'18**
Guide : Prof. A.N. Rajagopalan *IIT Madras*

- Developed an approach to extract a temporally consistent sequence of clean frames from a single motion blurred image and set a baseline for the novel task
- Extensively studied areas of deblurring, future frame prediction, optical flow estimation and experimented with Generative Adversarial Networks, Spatial Transformer Networks and Recurrent Neural Networks
- Proposed a novel approach to train a Video AutoEncoder using a modified version of Convolutional LSTMs and trained a blurred image encoder to match feature generated by video encoder
- Trained the network on GoPro dataset which has both camera motion and independent object motion. Tested the network on standard deblurring datasets and blurred images obtained from the internet

Defocus Map Generation **Jul'17-Dec'17**
Guide : Prof. A.N. Rajagopalan *IIT Madras*

- Addressed the problem of obtaining an optical blur based binary segmentation map of a 3D scene
- Trained a CNN to classify blur in overlapping patches and used a refinement module to get final segmentation map
- Experimented with methods like Markov Random Fields and superpixel based grouping to refine the map
- Obtained performance which was comparable to state-of-the-art techniques without any hand designed filters
- Paper accepted for publication at **International Conference on Image Processing 2018, Athens**.

3D Reconstruction System **Oct'16-Jan'17**
Guide : Prof. Radim Šára *Czech Technical University in Prague*

[1]Ongoing course at University of Maryland, College Park
[2]Done at Czech Technical University in Prague, Czech Republic

- Developed a system to reconstruct 3D scenes using images captured from an internally calibrated camera
- Estimated the Essential Matrix for each pair of images using the five point algorithm and refined it by minimizing Sampson reprojection error ; The optimal matrix was obtained using RANSAC
- Performed stepwise gluing to obtain camera positions and obtained the point cloud

All Optical Digital to Analog Convertor **Oct'17-Nov'17**
Guide : Prof. Deepa Venkitesh *IIT Madras*

- Simulated a 2-bit and 3-bit all optical digital to analog converter using non linear optical loop mirrors (NOLM)

Industrial Research Experience

Virtual Cognitive Mirror **May'16-Jul'16**
IBM Research Lab, India

- Developed innovative algorithms using machine learning and image processing techniques to detect neck feature points in a face image and overlay a necklace image accurately without use of expensive depth sensors
- Project was part of a product to give suggestions and improvise the jewellery buying experience. Was named a co-inventor in a patent filed at US PTO

Surveillance Camera Video Enhancement **May'15-Jul'15**
Matrix ComSec R&D, India

- Extensively studied various image enhancement techniques like edge enhancement, gamma correction, lens distortion correction and implemented algorithms on the TI DM38x media processor for security camera video enhancement
- Obtained quality enhancement on 3MP stream, improved the motion detection functionality and implemented a TripWire functionality to detect intruders

Projects at Centre for Innovation, IIT Madras

Robot Navigation using Kinect **May'14-Jun'14**
Centre for Innovation *IIT Madras*

- Developed a system to locate a robot in an area using trilateration and control it autonomously using Kinect Sensor
- Used RGB-D information to identify markers, plan trajectory and actuate via an Arduino Microcontroller

Kinect Meets DJ **Aug'14-Jan'15**
Centre for Innovation *IIT Madras*

- Developed an intuitive user centric system where music is generated using gestures captured using a Kinect Sensor
- Programmed a 3D character using Unity3D to replicate movements, play music and dance in tune with gestures
- Showcased it in front of 2500+ people during Envisage 3.0, India's largest student-run techno-entertainment show

Teaching and Mentoring experience

Teaching Assistant **Jan'18-May'18**
EE5175 : Image Signal Processing *IIT Madras*

Teaching Assistant **Jun'17-Nov'17**
PH1010 : Physics I *IIT Madras*

Project Mentor **Aug'15-Jan'16**
Centre for Innovation *IIT Madras*

Academic and Extra Curricular Achievements

- **Department Topper 2015-16** : Awarded the Kolluri Memorial Prize for best Academic record in Electrical Engineering in 3rd Year with a GPA of 9.75
- **Semester Abroad** : Among 8 selected from IIT Madras for a semester exchange at Czech Technical University in Prague from Sep'16 to Jan'17
- **IIT - Joint Entrance Examination Advanced 2013** : Ranked 1074 among more than 150,000 candidates
- **Robotics Competitions** : Part of a team that won in many technical events in the campus like , 1st in Autonomous Robotics (TechSoc'15), 1st in Roboceana (Wavez'15), 2nd in Manual Robotics (Shaastra'14)
- **Hindustani Classical Music** : Completed Madhyama Purna (Diploma) level in Hindustani Classical Vocals in 2009