Shubhang Bhatnagar

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Education

University of Illinois Urbana-Champaign Aug '21- Present
Ph.D. student in Electrical and computer engineering, Advisor- Prof. Narendra Ahuja

Indian Institute of Technology, Bombay Jul '16- Jul '21
Dual Degree (B.Tech + M.Tech) Electrical Engineering, Specializing in Signal Processing, Minor in CS
GPA 9.81/10, **Institute Silver medal, Department Rank 1/72**, Advisor- Prof. Amit Sethi

Nanyang Technological University, Singapore Jul '19- Dec '19
GPA 4.82/5, TFLearn Funded Semester Exchange Program in Electrical Engineering

Professional Experience

Bosch Research, CA | Computer Vision & Mixed Reality intern *(May'22 - Sep'22)*

- Designed a long distance **gesture recognition** system for interacting with home robots, achieving state-of-the-art recognition accuracy on the LD-ConGR dataset while **reducing model** size by 3x using a novel **spatially dynamic** 3D neural network .

Qualcomm | Modem Firmware Intern *(May'19 -Jul'19)*

- Developed a tool to help optimize modem firmware for chipsets by **analyzing data** and automating multiple tasks, with the tool being eventually deployed on 50+ workstations for the team

Decimal Point Analytics | Image Pulse *(Jun'18- Aug'18)*

- Worked on designing a **CNN** based system to estimate household income using images by localizing objects and features of interest

Publications

- **PAL - Pretext Based Active Learning** [paper], **S. Bhatnagar**, S. Goyal*, D. Tank*, A. Sethi, in **BMVC 2021**
- **Analyzing Cross Validation in Compressed Sensing with Gaussian and Impulse Measurement Noise with L1 Errors** [paper] **S. Bhatnagar***, C. Gurjarpadhye*, A. Rajwade, in **EUSIPCO 2021**
- **QR Code Denoising Using Parallel Hopfield Networks** [preprint], **S. Bhatnagar** *, I. Bhatnagar *, Arxiv Pre print, 2018
- **Memory Efficient Attention For Multi Domain Learning** [preprint], H.Aswani, A.Kanse, **S.Bhatnagar**, A.Sethi, 2021

* denotes that these authors contributed equally

Key Research Projects

PAL - Pretext Based Active Learning [paper][slides], *BMVC '21* *Masters Thesis, IITB (Mar '20 -Mar'21)*

- Proposed a **novel technique** to predict informativeness of a sample combining supervision and self supervision for better **reliability** and **robustness**. Outperformed **state-of-the-art** techniques in experiments on classification and segmentation

Deep Metric Learning with Local Proxies (Ongoing) *Prof. Narendra Ahuja, UIUC (Oct'22 -Current)*

- Proposed a new method to help CNNs learn effective **representations for semantic visual search** using a local, proxy based loss which enables learning of a wide variety of features. The proposed method achieved **state-of-the-art performance** on large scale image retrieval benchmarks on the Cars-196, CUB200 and SOP datasets.

CCNet : Explainable CNN's through clustering *Prof. Narendra Ahuja, UIUC (Sep'21 -May'22)*

- Proposed novel CA (clustering algorithm) used to train convolutional layers without using fully connected layers, helping better **interpretability (OOD, error awareness)** and upto **90 % lower network size** without loss in performance.

Efficient Music Conditioned Dance Motion Prediction *Prof. Liangyan Gui*, UIUC *(Jan'22 -Jul'22)*

- Proposed a multi modal spatio-temorally **separable GCN** to generate human dance poses conditioned on music using the AIST ++ dataset. Proposed model used **10x fewer parameters** than SOTA.

Robust CV in Compressed Sensing [paper] [slides], *EUSIPCO '21* *Prof. Ajit Rajwade, IITB (Mar '20 -Oct '20)*

- **Proposed a novel technique** for selecting parameters using the L1 **cross-validation (CV)** error and **theoretically proved** it yields optimal reconstruction in presence of noise demonstrating **order of magnitude gain** over other techniques empirically

Real Time Wireless Video Transmission Through Obstacles [report] *Prof. Shalabh Gupta, IITB (Jan'19-May'19)*

- Designed, simulated and tested PAL video transmitter and receiver modules including upconverter, downconverter, noise rejection filters and amplifiers at 400 MHz for real time exchange of video achieving a range of more than **100 m out of line of sight**

Designing of pipelined RISC processors [code] *Prof. Virendra Singh* (Oct'18-Dec'18)

- Designed and implemented **datapath and control unit** of a multicycle and a pipelined processor, based on the IITB-RISC instruction set on an FPGA

Noise Tolerant QR Code Recognizer using Hopfield Network [pre-print] *(May'18-Dec'18)*

- Proposed a **novel technique** to use Hopfield networks in **parallel** using the energy gradient difference around trained and false energy minima, providing a method to deal with applications requiring large storage capacity, like QR code denoising

Few-Shot Interactive Segmentation *Prof. Amit Sethi, IITB (Jan'21 -Jul'21)*

- Proposed a **novel architecture** for interactive segmentation to effectively generalize using only a few images, outperforming by more than 10% suitably adapted segmentation methods on the **PASCAL-5i** dataset

Honors and Awards

- **Institute Silver Medal**, IIT B for graduating at the top of my batch ('21)
- **Bhavesh Gandhi memorial award** given to most outstanding student in EE IITB ('21)
- **Institute Award** for **academic excellence**, IIT B (twice) ('18,'20)
- **Temasek Foundation TFLearn** fellowship ('19)
- **INSPIRE** scholarship, Govt of India for being in top 1% of class 12 ('15)
- **KVPY fellowship** awarded by Govt of India with All India Rank 93 ('13)

Technical Projects

- **End to End licence plate recognition**
- **Music genre recognition using CNN's**
- **Low cost class D amplifier design**
- **General equalizer design using DSP**
- **Face Image de-specularization**
- **Iris Recognition**
- **Designing Efficient Network Caching Algorithms**
- **Noise cancelling headphones**
- **Bus tracking system**
- **Steganography using wavelet transform**

Skills

- **Programming Languages**: Python, Pytorch, TensorFlow, Java, MATLAB, C, C++, ROS, VHDL
- **Software Packages**: NGSPICE, Quartus, AutoCad, Git, GNURadio, Selenium, Pandas, Gazebo

Positions of Responsibility

Graduate Teaching Assistant ('18,'20,'21)

- Responsible for tutorials, guiding and evaluating the performance of students in MA 207 Complex analysis, EE214 Digital circuits lab and EE 308 Communication systems.

Institute Student Mentor| SMP, IIT B ('20)

- Responsible for **mentoring** and **guiding** incoming batch of freshmen in academic and co-curricular endeavors

Key Courses Undertaken

Computer Vision	Computer Vision, Efficient and predictive vision, Digital Image Processing, Advanced Image Processing
ML and Optimization	Intro to Machine Learning, Stochastic Optimization, Deep learning theory, Advanced Signal Processing, Pattern recognition
Math and statistics	Markov chains, Calculus, Probability and Random Processes, Linear Algebra, Vector space signal processing
Electrical Engineering	Microprocessors, Audio signal processing, Information security, Digital Signal Processing, Digital Communication
Computer Science	Computer Networks, Operating Systems, Data Structures and Algorithms

Miscellaneous

- Served as a **Reviewer** for ICPR '20 , CVPR '22
- Presented a poster on Steganography at the **MHRD-TEQIP-KITE** workshop for knowledge incubation ('19)
- **Represented India** in the **Young Asian Leaders** Forum for development held at NUS,Singapore ('19)