

# 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, implemented and demonstrated a long distance **gesture recognition** system to interact with and control mobile robots, achieving state-of-the-art recognition accuracy on the LD-ConGR dataset while **reducing model** size by 2x using a novel **spatially dynamic** 3D neural network (presented @ IROS'23). Patent under review .

### 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 | Computer Vision intern

(Jun'18- Aug'18)

- Worked on designing a CNN based product to estimate household income from photos by recognizing objects of interest.

## SELECTED PUBLICATIONS

- Long-Distance Gesture Recognition using Dynamic Neural Networks** [\[paper\]](#), S. Bhatnagar, S. Gopal, N. Ahuja, L. Ren, in **IROS 2023**
- 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

### Long-Distance Gesture Recognition using Dynamic Neural Networks [\[project page\]](#), IROS '23 UIUC, Bosch

- Proposed a **novel dynamic neural network** to enable gesture recognition from long distances by identifying and focusing on processing only gesturing subject features. Outperformed **SOTA** in terms of recognition accuracy while using 40% lesser compute.

### Potential Field based Metric Learning, Under Review

[Prof. Narendra Ahuja](#), UIUC

- Proposed a new loss function to help CNNs learn effective **representations for semantic visual search**. A potential field is used to model point influence helping enable learning of rich intra and inter-class features while being minimized using proxies. The proposed method achieved **SOTA** on zero-shot image retrieval benchmarks on the Cars, CUB200 and SOP datasets.

### PAL - Pretext Based Active Learning [\[paper\]](#)[\[slides\]](#), BMVC '21

*Masters Thesis, IITB*

- 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

### Efficient Music Conditioned Dance Motion generation

[Prof. Liangyan Gui](#), UIUC

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

### Robust CV in Compressed Sensing [\[paper\]](#) [\[slides\]](#), EUSIPCO '21

[Prof. Ajit Rajwade](#), IITB

- 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

- 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*

- Designed and implemented **datapath and control unit** of a multicycle and a pipelined processor, based on the Turing complete IITB-RISC instruction set on an FPGA. Designed logic for hazard detection, data forwarding and stalling in the pipeline design.

## Noise Tolerant QR Code Recognizer using Hopfield Network [\[pre-print\]](#)

- 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*

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

## TECHNICAL PROJECTS [↗](#)

- End to End licence plate recognition
- Iris Recognition
- Music genre recognition using CNN's
- Designing Efficient Network Caching Algorithms
- Low cost class D amplifier design
- Noise cancelling headphones
- General equalizer design using DSP
- Bus tracking system
- Face Image de-specularization
- 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)
- Institute Student Mentor | SMP, IIT B** ('20)
- Responsible for tutorials, guiding and evaluating the performance of students in MA 207 Complex analysis, EE214 Digital circuits lab and EE 308 Communication systems.
- 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)