Saurabh Saini

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Research Interests

I am a researcher at Center for Visual Information Technology, IIIT-Hyderabad. My interests and experiences are in the topics lying at the intersection of Computer Vision, Graphics and Machine Learning. My thesis is focused on *Image Decompositions for Inverse Rendering* involving problems like intrinsic image decomposition, illumination factorization, exposure manipulation, estimation of scene shape, lighting and reflectance. My broader research interests include image based rendering, shape reconstruction, model interpretability, optimization and transfer learning. Currently, I am working on scene illumination analysis for low light image enhancement and neural networks interpretibility and debiasing techniques.

Education

2013 - present (2019 - 2022 break)
Integrated M.S. & Ph.D., Computer Science — CGPA: 9.13/10
Center for Visual Information Technology (CVIT), IIIT-H, India
Advisor: Prof. P. J. Narayanan
Thesis: Image Factorizations for Inverse Rendering

2006 - 2010
B.E. (Hons.), Electrical and Electronics Engineering — CGPA: 9.15/10
Birla Institute of Technology and Science (BITS), Pilani, India — (Distinction)

2004 - 2006
Central Board of Secondary Education — 91.6%
BCM Arya Model Senior Secondary School, Ludhiana, India

Experience

Mar '22 - Present
Research Assistant - Center for Visual Information Technology, IIIT-Hyderabad
Mentoring graduate research students and advancing my personal research work on image factorizations for image based rendering applications.

Mar '20 - Mar '22
AI/ML Scientist - Verisk Analytics, Global R&D team, Hyderabad
Simultaneously worked on multiple projects. Lead a small team exploring document layout analysis for generic documents. Collaborated with external university faculty members and student researchers on industry oriented academic projects. Directly contributed to 3D scene analysis for internal projects two internal projects. Additionally, I was also involved in varying capacity in communicating with other team members/interns in understanding and exploration of new research directions, tasks formulation, experiments designing, results analysis, prototype development and framework deployment.

Jan '15 - May '15
Teaching Assistant - Machine Learning, IIIT-Hyderabad
Conducted tutorials, provided project assistance, performed grading and evaluations for a class of approx. 100 undergraduate and graduate students for the institute's ML course.

Aug '13 - Dec '19
Research Assistant - Center for Visual Information Technology, IIIT-Hyderabad
Worked on collaborative projects, supervised undergraduate and dual degree students along with exploration of my own research topics and solutions.

Aug '10 - July '12 **Engineer - Qualcomm India Pvt. Ltd., Bangalore**
Contributed as Physical Design Engineer for the implementation of cellular SoC modems (45nm). Assisted the newly starting Corporate R&D India team by building assistive automation and annotation tools for their scene text recognition and translation prototype.

Jan '10- July '10 **Interim Intern - Cisco India Pvt. Ltd., Bangalore**
Worked on design and development (frontend and backend) of an internal web service for automatic generation and analysis of Network Implementation Plan.

May '09- July '09 **Research Intern - Central Scientific Instruments Organization,**
Council of Scientific and Industrial Research, Chandigarh
Researched, designed, prototyped and published work on the development of a Medium Voltage Pulse Generator for generating alternating electric fields required in strategic liquid food preservation.

May '08- July '08 **Undergraduate Intern - Indian Institute of Remote Sensing,**
Department of Space, Dehradun
Worked on content creation, deployment and management of the institute's Learning Management System focused on remote sensing applications.

Publications

Rahul Goel, Sirikonda Dhawal, Saurabh Saini and P J Narayanan, "*Interactive Segmentation of Radiance Fields*", Conference on Computer Vision and Pattern Recognition (CVPR), 2023.

Saurabh Saini and P. J. Narayanan, "*Quaternion Factorized Simulated Exposure Fusion for Low Light Image Enhancement*", Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP) 2022 [*Oral*].

Avani Gupta, Saurabh Saini and P. J. Narayanan, "*Interpreting Intrinsic Image Decomposition using Concept Activations*", Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP) 2022 [*Oral,* ***Best Paper Award***].

Rahul Goel, Sirikonda Dhawal, Saurabh Saini and P J Narayanan, "*StyleTRF: Stylizing Tensorial Radiance Fields*", Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP) 2022 [*Spotlight*].

Hsin-Ping Huang, Hung-Yu Tseng, Saurabh Saini, Maneesh Singh and Ming-Hsuan Yang, "*Learning to Stylize Novel Views*", International Conference on Computer Vision (ICCV), 2021.

Saurabh Saini and P. J. Narayanan, "*Semantic Hierarchical Priors for Intrinsic Image Decomposition*", Arxiv, 2019 [IJCV reject].

Aakash KT, Parikshit Sakurikar, Saurabh Saini and P. J. Narayanan, "*A Flexible Neural Renderer for Material Visualization*", Siggraph Asia (Technical Briefs), 2019.

Saurabh Saini and P. J. Narayanan, "*Semantic Priors for Intrinsic Image Decomposition*", British Machine Vision Conference (BMVC), 2018 [*Oral,* ***Best Industrial Paper****, Honourable Mention*].

Gaurav Mishra, Saurabh Saini, Kiran Varanasi and P. J. Narayanan, "*Human Shape Capture and Tracking at Home*", IEEE Winter Conference on Applications in Computer Vision (WACV), 2018 [*spotlight*].

Saurabh Saini and P. J. Narayanan, "*Intrinsic Image Decomposition using Focal Stacks*", Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP), 2016 [*Oral*].

Aditya Singh, Saurabh Saini, Rajvi Shah and P. J. Narayanan, "*Learning to Hash-Tag Videos with Tag2Vec*", Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP), 2016 [*Oral*].

Aditya Singh, Saurabh Saini, Rajvi Shah and P. J. Narayanan, "*From Traditional to Modern : Domain Adaptation for Action Classification in Short Social Video Clips*", German Conference on Pattern Recognition (GCPR), 2016 [*Oral*].

C Ghanshyam, Saurabh Saini, Nilotpal, K Khanikar, Vijay Kumar Verma and Garima Bajwa, "*Design and Construction of Programmable Medium Voltage Pulse Generator for the Preservation of Liquid Semi-Liquid Food Items*", International Conference on Wireless Networks & Embedded Systems, 2009 [*Oral*].

Industrial Projects

Verisk Analytics

Document Layout Analysis: Parse a random document image for various layout elements like headers, figures, tables, paragraphs *etc.* and perform intra-page / inter-page elements analysis.
TASKS: pdf type categorization, layers decomposition, fundamental elements schema selections, layout elements detection, inter-element relationship analysis, inter-page elements associations, reading flow estimation, synthetic dataset and annotation tools construction *etc.*

3D Reconstruction: Worked on several problems aiming at 3D reconstruction of various objects like houses, indoor rooms, standalone objects *etc.* from varying input data types like aerial footage, panoramic image, multiview images, monocular image *etc.*
TASKS: SfM/COLMAP based 3D reconstruction, aerial footage analysis, 3D implicit functions learning, point cloud data manipulation, direct depth maps estimation, room layout estimation, high fidelity reconstruction, LoD decomposition, convex primitive analysis, computational solid geometric analysis *etc.*

Data Augmentation: Using stylization and manipulation techniques to obtain synthetic data for deep learning.
TASKS: 3D point cloud colorization, single image photorealistic stylization, synthetic documents preparation via elements rearrangement, building required annotation tools and platforms, automatic annotations validation *etc.*

Jotter.ai

Automatic Apparel Analysis: Provided short-term consultation to a small team trying to parse various apparels for direct automatic draping on 2D model images for online e-retail platforms.

Qualcomm

Physical Designing of Cellphone Components: Worked as physical design engineer involved in the construction of various VLSI components of advanced mobile phone chips.
TASKS: chip floorplan design, placement, routing, static timing analysis, power analysis, DRCs *etc.*

Scene Text Analysis: Assisted the newly setup R&D team in their scene text detection, recognition and translation project by building various assistive tools and GUIs.

Academic Work

Ongoing:

Model-driven Low Light Image Enhancement (Thesis Project: CVIT, IIIT-H) - Developing an end-to-end unrolled neural network for a newly proposed algorithm for low light image enhancement task using Learned ADMM [Under Review ICCV].

Concept Distillation: Generalizing Neural Network by Concept Debiasing (Research Project, Mentoring): CVIT, IIIT-H) - Removing neural network biases using interpretable XAI techniques [Under Review NeurIPS].

Self-supervised Exposure Correction (Thesis Project: CVIT, IIIT-H) - Working on dataset creation, cleaning, self-supervised pseudo-ground truth generation and learning pipeline for the task of exposure correction using a hypercomplex algebra based optimization framework.

Single Image Illumination Factorization (Research Project: CVIT, IIIT-H) - Studying feasibility of using color-space geometric analysis techniques for Illuminant effect separation in a single RGB image.

Previous:

Research Surveys (Self): Several comprehensive literature surveys pertaining to a variety of research topics: image decompositions, quaternion color analysis, inverse light transport, color constancy estimation, autoML for 3D deep learning solutions, material analysis and rendering, geometric deep learning, domain adaptation, image symmetry analysis, matting, image based rendering, proximal methods, convex optimization, probabilistic graphical methods, various 3D modalities, disentanglement metric estimation, etc.

Inverse Light Transport (Research Exploration: CVIT, IIIT-H) - Studying feasibility of estimating bounces of light in a scene from a single image by inverting the light transport equation and possibility of extending the specularity removal methods towards this goal.

Image Decompositions and Manipulation Methods (Research Exploration: CVIT, IIIT-H): - Various possible IID like layer separation methods for image information disentanglement and their image editing applications.

Geometric Deep Learning (Research Exploration: CVIT, IIIT-H): - Spectral, graph and charting based Non-Euclidean Convolutional Neural Networks and their applications.

3D Skeletonization and Image Symmetry Analysis (Research Exploration: CVIT, IIIT-H): - Various symmetry based mesh skeleton estimation techniques for use in shape/image correspondence, retrieval and segmentation.

Geometric Domain Adaptation (Research Exploration: CVIT, IIIT-H): - Use of geometry based discrete and continuous domain adaptation methods for knowledge transfer.

AutoML Assisted 3D CNN Analysis (Collaborative Project: CVIT, IIIT-H & MSR Independent Researcher) - Analyzing different 3D deep learning models using AutoML techniques towards the goal of better understanding their strengths and weaknesses for various 3D problems [discontinued].

Image Search Web Tool using Bag of Words Model (Course Project: Computer Vision, IIIT-H): - Matlab backend and python frontend based web service for implementation of an image based search engine .

Diverse M-Best Solutions in Probabilistic Inferences (Course Project: Machine Learning, IIIT-H): - A comprehensive study on Linear Programming relaxation techniques used in MAP optimizations for diverse retrieval.

Multiple Image Fusion for Image Enhancement (Course Project: Digital Image Processing, IIIT-H): - Creating an all-in-focus image from a focal stack using Generalized Random Walk algorithm implementation in Matlab.

SVM Image Classification Full Implementation (Course Project: Statistical Methods for AI, IIIT-H): - SVM classifier implementation, training and testing from scratch using basic C++ Linear algebra libraries.

Studying SLAM algorithms (Independent Study Project: RRL, IIIT-H): - Studying the basics of various SLAM algorithms and trying out some incremental approaches on standard datasets.

Undergraduate:

Design and Simulation of MEMS logic gates (Independent Project: MEMS-Lab, CEERI-Pilani): - Understanding and simulating both partial and full fixed micro-cantilevers for developing micro-switches based logic circuits.

Analysis and Simulation of Performance Enhancing Techniques in a Wireless Network (Independent Project: Communications Lab, BITS-Pilani): - Study of various wireless scheduling algorithms and software implementation (Matlab) of Wireless Fair Queuing algorithm in order to perform network traffic management.

Study, Simulation and VLSI Implementation of Encryption Algorithm (Independent Project: VLSI-Lab, BITS-Pilani): - Software (Matlab) and hardware (FPGA) implementation of Advanced Encryption Standard.

VLSI Circuit Desig (Course Projects: VLSI-Lab, BITS-Pilani): - Designed and simulated 8-bit serial-to-parallel converter and 10-bit digital-to-analog converter circuits using the VLSI design flow from scratch.

Game on Chip (TechFest Project: Quark, BITS-Goa): - System designing and coding of a small hand-held micro-controller based gaming device (first prize).

Tracking Bug (TechFest Project: Apogee, BITS-Pilani): - Development of microcontroller based transmitter-receiver circuits, data serialization protocols and computer-module interface for visualization. (second prize).

Technical/Academic Skills

Programming:	`Matlab, Python, C++, Java, Visual Basic`
Libraries/API:	`PyTorch, TensorFlow, Qt, GLPK, CVX`
Core Courses:	Statistical methods in AI, Digital Image Processing, Machine Learning, Optimization, Computer Vision
Other Courses:	Database Management Systems, Linear Algebra, Functional Analysis, Discrete Mathematics, Numerical Analysis, Communication Systems, Control Systems

Other Achievements

Best Paper Award, ICVGIP, IIT-Gandhinagar, India	2022
Best Paper Honorable Mention, BMVC, Northumbria University, Newcastle, UK	2018
TCS PhD Research Scholarship	2013 - 2017
Multiple *QualStars* - Team appreciation awards, Qualcomm - Bangalore	2010 - 2012
Certificate of Appreciation, IIRS - Dehradun	2007
MCN Scholarship, BITS - Pilani	2007 - 2010
Merit Scholarship (top 10), BITS - Pilani	2006
National Top 1% merit (AIR 17), National Standard Examination in Physics	2005 - 2006
Indian National Chemistry Olympiad, National Standard Examination in Chemistry	2005 - 2006
Regional Mathematics Olympiad, North India Zone	2005 - 2006

References

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