

SNEHAL SINGH TOMAR

Pre-Doctoral Fellow,
Visual and Embodied AI Group, [TCS Research](#)

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Research Interests

Computer Vision: Deep Generative Models, Disentangled Representations, Self-Supervised Deep Learning, AR/VR, Implicit Neural Representations, Graph Neural Networks; Computational Photography; Robotics; Autonomous Systems.

Education

- Indian Institute of Technology Madras** Chennai, India
 - M.S. (by Research) in EE, Advisor: [Prof. A.N. Rajagopalan](#); CGPA: 9.0/10.0* 2020 - 2023
 - Area of Focus: Image Processing and Computer Vision
 - Recipient of the **IIT Madras Institute Research Award** for excellence in research. Only 3 out of the 746 MS (by Research) students at IIT Madras were selected for the prestigious honor based on their research.
 - Relevant Coursework: Linear Algebra, Probability Foundations for EE, Digital Signal Processing, Fundamentals of Deep Learning, Image Signal Processing, Computational Photography
- Manipal Institute of Technology** Manipal, India
 - B.Tech. in ECE, Minor in Signal Processing; CGPA: 8.42/10.0* 2016 - 2020
 - Activities: Member of the AI Robotics club, multiple research internships in robotics and control systems at IIT Delhi, research on applications of Fuzzy Logic
 - Awarded the Institute Research Incentive and was a part of the team that secured the ninth position (overall) at the Intelligent Ground Vehicle Competition (IGVC) 2018, Michigan, USA.

Employment

- Pre-Doctoral Fellow** New Delhi, India
 - Visual and Embodied AI Group, [TCS Research](#); Mentor: [Dr. Brojeshwar Bhowmick](#)* June, 2023 - Present
 - Research focus: Efficient and physically consistent 3D Particle Mesh simulation using Graph Neural Networks.
 - Working on improving the state of the art in Garment Simulation and Animation for virtual try-on applications.

Peer-Reviewed Publications

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| Submitted to TMLR | PNeRV: A Polynomial Neural Representation for Videos , Sonam Gupta, Snehal Singh Tomar, Grigorios Chrysos ⁺ , Sukhendu Das, and A.N. Rajagopalan, Transactions on Machine Learning Research (Under Review). |
| AAAI 2023 | Exploring the Effectiveness of Mask-Guided Feature Modulation as a Mechanism for Localized Style Editing of Real Images (Student Abstract) , Snehal Singh Tomar, Maitreya Suin, and A.N. Rajagopalan, Proceedings of the AAAI Conference on Artificial Intelligence, 37(13). Paper |
| ECCV 2022 | Hybrid Transformer Based Feature Fusion for Self-Supervised Monocular Depth Estimation (Oral) , Snehal Singh Tomar*, Maitreya Suin*, and A.N. Rajagopalan, Advances in Image Manipulation Workshop at the European Conference on Computer Vision (ECCV) 2022. Paper , Code |
| CVPR 2022 | Latents2Segments: Disentangling the Latent Space of Generative Models for Semantic Segmentation of Face Images , Snehal Singh Tomar and A.N. Rajagopalan, Workshop on Computer Vision for Augmented and Virtual Reality (CV4ARVR) at the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), New Orleans, LA, 2022. Paper , Code |
| SOCPROS 2017 (Best Paper Award) | Python-Based Fuzzy Classifier for Cashew Kernels , Snehal Singh Tomar and Narendra V.G., Proceedings of the 7 th International Conference on Soft Computing for Problem Solving (SOCPROS) 2017, In: Advances in Intelligent Systems and Computing, vol 816 (2019). Springer, Singapore. Paper , Best Paper Award |

⁺[Dr. Chrysos](#) is an Assistant Professor at UW-Madison ECE.

*Equal Contribution.

Projects & Internships

Low-Light Light Field Restoration

Prof. Kaushik Mitra

- *Computational Photography course research project at IIT Madras* *Spring 2021*
 - The project was geared towards building a Deep Neural Network capable of restoring raw Light Fields captured in Low-Light using the Lytro camera sans any pre-processing or decoding operation. [Slides](#).
 - To this end, our team extended the L3FNet ([Lamba et al.](#), IEEE TIP 2021). We replaced all pre-processing operations used by L3FNet that were derived from the MATLAB Light-field toolbox with python functions for integration with the pytorch model. We retained minimal preprocessing steps in doing so.
 - We applied post-capture data augmentations to the L3F-wild dataset and experimented with the L3FNet's objective function to attain restoration PSNR and SSIM metrics comparable to those achieved by the vanilla L3FNet which uses decoded and pre-processed LF-views.

Undergraduate Internships in Robotics and Control Systems

Prof. Shubhendu Bhasin

- *Indian Institute of Technology Delhi* *2017 - 2020*
 1. **Torque-Based Position Controller for a Five DOF Robotic Manipulator** (*B.Tech. Project, Spring 2020*):
 - (a) Objective: To control a position controlled robotic manipulator (the ROBOTIS Open Manipulator-X) using torque input returned by a pre-designed control algorithm
 - (b) Tasks:
 - i. Tele-Operated the ROBOTIS Open Manipulator-X in position control mode using its Robot Operating System (ROS) packages and characterized its transfer function
 - ii. Implemented a torque-position transformer in line with ([Khatib et al.](#), ICRA 2008) using the knowledge of the Open Manipulator's inertia tensor, forward kinematics, and inverse kinematics. The cascaded transfer functions were tested in a Gazebo simulation
 2. **Torque Transformer for Position Controlled Robotic Joints** (Summer Internship, 2019):
 - (a) Selected through the Global Internship Program in Engineering Design and Innovation (GIPEDI) 2019
 - (b) Interfaced the Herkulex-DRS 0101 DC servo motor on an Arduino-Mega to get continuous position feedback
 - (c) Modeled the motor's transfer function as a PID controller
 - (d) Implemented a torque-position transformer on the lines of ([Khatib et al.](#), ICRA 2008) to provide torque input as a control signal to the motor
 3. **Target Detection in Aerial Videos** (Summer Internship, 2018):
 - (a) Selected through the Global Internship Program in Engineering Design and Innovation (GIPEDI) 2018
 - (b) Curated a dataset consisting of aerial image sequences of the IIT Delhi campus and certain scene sequences from the *Stanford Drone Dataset* for training a Deep Neural Network for object detection in such sequences.
 - (c) Trained a modified version of YOLO ([Redmon et al.](#), CVPR 2016) with appropriate geometric transforms on the dataset to obtain meaningful results for object detection in videos captured via quadrotor imagery
 4. **Error Characterization of a Motion Capture System** (Winter Project, 2017):
 - (a) Studied the IR camera based Opti-Track Motion Capture System and characterized the error in position of the objects tracked by it over a series of experiments in different scenarios
 - (b) proposed an optimal IR camera set-up for a dedicated motion capture laboratory at IIT Delhi

Fuzzy Throttle Versus Brake Controller for an Autonomous Vehicle

Manipal Institute of Technology

- *Project MANAS - The AI robotics club of Manipal* *2017 - 2018*
 - Built a Fuzzy throttle versus Brake controller to realize the speed predicted by a path planning algorithm on a *Mahindra e20* electric vehicle
 - Integrated the controller with a pre-designed ROS network, interfaced via a Controller Area Network (CAN) with the vehicle's Electronic Control Unit (ECU) to perform real-world tests

Scholastic Highlights

- Awarded the IIT Madras Institute Research Award for excellent research contributions as an MS (by Research) student (3/746)
- Awarded the IIT Madras Institute Travel Grant for attending CVPR 2022 at New Orleans, Louisiana, U.S.A.

- Awarded Half Time Research Assistantship (HTRA) as funding support for pursuing graduate studies by Ministry of Education, Govt. of India
- Awarded Research Incentive and Certificate of Appreciation in October, 2018 by Manipal Academy of Higher Education (MAHE) for producing award winning research work at SOCPROS 2017
- Was a part of the team that stood 9th overall at the Intelligent Ground Vehicle Competition (IGVC) 2018 and was a finalist in the *Mahindra Rise Prize Challenge*, India's first autonomous vehicle competition
- Qualified the National Talent Search Examination (Stage-I), conducted by National Council of Educational Research and Training (NCERT) from Uttar Pradesh state in 2011 & 2013 (Selected among top 500 students from Uttar Pradesh, India)
- National Cyber Olympiad 2007 - All India Rank: 11, Unified Cyber Olympiad 2008 - All India Rank: 50, National Cyber Olympiad 2009 - All India Rank: 35

Academic Service & Teaching Assistantships

- Served as a reviewer for the Advances in Image Manipulation Workshop at ECCV 2022
- Served as a TA for the courses mentioned below at IIT Madras. My responsibilities included the preparation and evaluation of tutorials, assignments, and exams.
 - EE5175 (Image Signal Processing) offered by Prof. A.N. Rajagopalan in Spring, 2023
 - EE5178 (Modern Computer Vision) offered by Prof. A.N. Rajagopalan in Fall, 2022
 - EE5175 (Image Signal Processing) offered by Prof. A.N. Rajagopalan in Spring, 2022
 - EE6132 (Deep Learning for Imaging) offered by Prof. A.N. Rajagopalan in Fall, 2021
 - EE5180 (Introduction to Machine Learning) offered by Prof. Avhishek Chatterjee in Spring, 2021

Presentations and Talks

- Attended AAAI 2023 virtually.
- Attended (in-person) and presented at CVPR 2022. [Video](#).
- Attended (virtually) and presented at ECCV 2022. [Video](#).
- Attended and presented at the 7th International Conference on Soft Computing for Problem Solving (SOCPROS) 2017

Technical Skills

- **Programming Languages:** Python, C++, HTML/CSS
- **Deep Learning Frameworks:** Pytorch, Tensorflow
- **Tools and Packages:** MATLAB, Swift(Xcode), OpenCV, Scikit-Fuzzy, Blender, MeshLab
- **Familiar Embedded Systems and Hardware:** NVIDIA Jetson, Raspberry Pi, TI Hercules, Arduino Uno, Quanergy 3D LiDAR, Ultrasonic sensors

Social Endeavors

- Mathematics and Physics solver at *SolveitNow*, an online community that helps K-12 students with their study doubts.
- Associated with the IITM Tamil Confluence for helping selected K-12 Tamil Nadu Govt. School students with their study doubts.

More about me

I enjoy swimming, playing table tennis, and poetry in my leisure time.