SNEHAL SINGH TOMAR

Final Year Masters Student,
Dept. of Electrical Engineering, IIT Madras

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Research Interests

Deep Generative Visual Models, Self-Supervised Deep Learning Methods for Computer Vision applications, Computer Vision for AR/VR, Implict Neural Representations, Computational Photography, Robotics, Autonomous Systems, Human-Computer Interaction

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 (expected)*
  - 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 Institute Research Incentive and was a part of the team that secured the 9^{th} position (overall) at the Intelligent Ground Vehicle Competition (IGVC) 2018, Michigan, USA.

Publications

Submitted to CVPR 2023 — **Poly-INR: Towards Capturing Multiplicative Interactions for Enhanced Implicit Neural Representation of Videos**, *Sonam Gupta, Snehal Singh Tomar, Grigorios Chrysos*[+], *Sukhendu Das, and A.N. Rajagopalan*

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 37^{th} AAAI Conference on Artificial Intelligence 2023 (To Appear)
link to paper

ECCVW 2022 (Oral) — **Hybrid Transformer Based Feature Fusion for Self-Supervised Monocular Depth Estimation**, *Snehal Singh Tomar*, Maitreya Suin*, and A.N. Rajagopalan*, Advances in Image Manipulation Workshop at the European Conference on Computer Vision (ECCV) 2022
link to paper

CVPRW 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
link to paper

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.
link to paper

[+]The co-author is a scientist at EPFL, Switzerland. The paper is a joint effort by CSE (IIT Madras), EE (IIT Madras), and the LIONS lab at EPFL.
*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.
  - 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 Edcuation, 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 9^{th} 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)
- National Cyber Olympiad 2007 - All India Rank: 11, Unified Cyber Olympiad 2008 - All India Rank: 50, National Cyber Olympiad 2009 - All India Rank: 35

Experience

- Served as a reviewer for the Advances in Image Manipulation Workshop at ECCV 2022
- Attended and presented at CVPR 2022 (in-person), ECCV 2022 (virtually)
- Attended and presented at the 7^{th} International Conference on Soft Computing for Problem Solving (SOCPROS) 2017

Teaching Assistantships

Served as a TA for the courses mentioned below at IIT Madras. My responsibilities included the preparation and evaluation of tutorials, assignments, and exams.

- 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

Technical Skills

- **Programming Languages**: Python, C++, HTML/CSS
- **Deep Learning Frameworks**: Pytorch, Tensorflow
- **Tools and Packages**: MATLAB, Swift(Xcode), OpenCV, Scikit-Fuzzy
- **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.

References

- Prof. A.N. Rajagopalan, EE, Indian Institute of Technology Madras (*Available on Request*)
- Prof. Mitesh Khapra, CSE, Indian Institute of Technology Madras (*Available on Request*)
- Prof. Kaushik Mitra, EE, Indian Institute of Technology Madras (*Available on Request*)
- Prof. Shubhendu Bhasin, EE, Indian Institute of Technology Delhi (*Available on Request*)
- Prof. Narendra V.G., CSE, Manipal Institute of Technology (*Available on Request*)