Sandeep Nagar

Final year PhD Student
ML Lab, IIIT-Hyderabad

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My research interests include generative models, focusing on probabilistic methods, normalizing flows, and their theoretical foundations. My goal is to develop efficient and interpretable models for real-world applications.

Education

2018 - present **PhD in CS**, *ML Lab, International Institute of Information Technology (IIIT) - Hyderabad*, India.
Advisor:- Prof. Girish Varma.
Thesis:- Fast & Efficient Normalizing Flows and Applications of Image Generative Models

2013 - 2017 **BTech in CS**, *Harcourt Butler Technological University (HBTU) - Kanpur, India*.

Research Internships

Aug 23 – Jan 24 **Advance Research Group, Samsung R&D Institute-Bangalore (SRI-B)**.
Supervisor: Dr. SVR Dendi, Dr. Pravin Nair, Mr. Raj Narayan Gadde
Project: Diffusion Model for Image Super-Resolution.
Paper: Affine-Stables: Coupling-Layer based Lightweight Autoencoder and Diffusion Model for Image Super-Resolution

Nov 21 – Feb 22 **School of Mathematics and Statistics, University of New South Wales, Australia**.
Supervisor: Prof. Rohitash Chandra, in collaboration with Dr Ehsan Farahbakhsh, The University of Sydney, Australia.
Project: Autoencoder for Geochemical Anomalies Detection and Lithological Mapping.
Journal: Remote Sensing Framework for Lithological Mapping via Stacked Autoencoders and Clustering.

June - Oct 21 **Computer Vision and Robotics Laboratory, University of Illinois - Champaign, US**.
Supervisor: Prof. Narendra Ahuja in collaboration with Dr David Beiser, College of Medicine at UIC.
Project: Remote Sensing of Physiological Measurements Using Camera.
Paper: R2I-rPPG: Robust Region of Interest Selection for the Remote PPG.

Research Assistantships

Sep 22 – July 23 **Dept. of Ophthalmology and Genomic Medicine, University of Leicester, UK**.
Supervisor: Dr Mervyn G Thomas
Project: Machine learning-based classification of foveal development.
Detection of fovea maturity using optical coherence tomography and machine learning.

March - June 22 **Deva Lab, IIIT-Hyderabad**.
Supervisor: Prof U. Deva Priyakumar and Prof Girish Varma
Project: Generative models for *de novo* 3D molecule generation.
Designing a normalizing flow-based deep learning model that learns the energy function from data in an end-to-end fashion by generating energetically favorable molecular conformations that are more likely to be observed experimentally.

July 19 – Feb 22 **Machine Learning Lab, IIIT-Hyderabad**.
Supervisor: Prof. Girish Varma
i.) Fast and efficient normalizing flow models and designing an invertible convolutional deep network to learn and generate fake images. ii.) Designing a flow for the corn seed's automatic labeling and classification using generative models and active learning. iii.) Panoptic Segmentation Models for the India Driving Dataset. iv.) Conn seed image dataset for advancement in food and agriculture development, -details, code link

Teaching

Aug - Dec 25 **Instructor**, IIIT-Hyderabad, India.
M24 CS0.101 Computer Programming:
Responsibilities: delivering lectures, developing course material and tutorials, conducting lab sessions, office hours, advising and mentoring, guiding, and course auto-grading platform. Course webpage: http://cpro-iiit.github.io/

Oct 21 - July 24 **Associate Mentor**, TalentSprint, Hyderabad, India.
PG Certification Program for Mid-to-Senior Tech Professionals: Responsibilities: delivering lectures, guiding hands-on group projects, mentoring lab sessions, tutorials, walk-through sessions, hackathons, and mentoring capstone projects. Courses: i) Advanced Certification Course in Computational Data Science, IISc Bangalore, 2023, 2024. ii) Advanced Certification Course in AI and MLOps, IISc Bangalore, 2023. iii) Certification Course in Artificial Intelligence and Machine Learning, IIIT-Hyderabad, 2022, 2021.

Jan 19 – May 23 **Teaching Assistant**, IIIT-Hyderabad, India.
Mathematical Foundations of Data Science, Instructor: Prof Suryajith Chillara, Prof Girish Varma
Linear Algebra, Instructor: Prof Chittaranjan Hens and Prof Siddhartha Das, Spring-23
Computer Programming, Instructor: Dr. S Chakraborty, Dr. Varma, and Dr A. Deshpande, Monsoon-22
Math for CS: Linear Algebra, Instructor: Prof Girish Varma, Monsoon-22
Maths for CS: Probability and Statistics, Instructor: Prof Girish Varma, Monsoon-21
Linear Algebra, Instructor: Prof Girish Varma, Spring-21
Probability and Statistics, Instructor: Prof Pawan Kumar, Monsoon-20
Probability and Statistics, Instructor: Prof Girish Varma, Monsoon-19
Computer Network, Instructor: Prof Shatrunjay Rawat, Spring-19

Publications

Deep Generative Models:

In preparation **Data anonymization in Indian Driving Dataset using Imparting**, **Nagar, S.**, Puttagunta, S., Varma, G..

In preparation **Inverse of Convolution for Sparse Blind Deconvolution**, ***Nagar, S.***, *Varma, G.*

AISTATS **Parallel Backpropagation for Inverse of a Convolution with Application to Normalizing Flows**, ***Nagar, S.***, *Varma, G.*, The 28th International Conference on Artificial Intelligence and Statistics 2025. arXiv.

Under review **Affine-Stables: Coupling Layer-based Lightweight Autoencoder and Stable Diffusion Model for Image Super-Resolution**, ***Nagar, S.***, *Dendi, SVR., and Gadde, R. N*, pre-print.

ICPR **ICPR 2024 Competition on Safe Segmentation of Drive Scenes in Unstructured Traffic and Adverse Weather Conditions**, *Furqan, S. A.*, ***Nagar, S.***, *Varma, G.:*, 27th International Conference on Pattern Recognition 2024, Springer Nature, arXiv:2409.05327 (oral).

ASR Journal **Remote Sensing Framework for Geological Mapping via Stacked Autoencoders and Clustering**, ***Nagar, S.***, *Farahbakhsh, E., Awange, Joseph., and Chandra, R.: Advances in Space Research Journal, 2024 Volume 74, Issue 10,2024, Pages 4502-4516, ISSN 0273-1177,*, doi:j.asr.2024.09.013.

VISIGRAPP **FInC Flow: Fast Invertible Convolutions for Normalizing Flows**, *Kallappa, A.*, ***Nagar, S.,*** *and Varma, G.:*, In 18th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP 2023) - Volume 5: VISAPP; ISBN 978-989-758-634-7, SciTePress, pages 338-348. DOI: 10.5220/0011876600003417 (code) (oral).

UAI-W **CInC Flow: Characterizable Invertible 3×3 Convolution. In 4th Workshop on Tractable Probabilistic Modeling**, ***Nagar, S.***, *Dufraisse, M. and Varma, G.:*, The Conference on Uncertainty in Artificial Intelligence (UAI) 2021, arXiv:2107.01358 (code) (oral).

PReMI **Automated Seed Quality Testing System using GAN and Active Learning.**, **Nagar, S.**, Pani, P., Nair, R., Varma, G.: 9th International Conference on Pattern Recognition and Machine Intelligence 2021, doi:link.springer.com/book/10.1007/978-3-031-12700-7, arXiv.2110.00777(code) (oral).

Computer Vision and Application:

Under review **R2I-rPPG: Robust Region of Interest Selection for the Remote PPG**, ***Nagar, S.***, *Alam M., Beiser, D., and Ahuja, N.:*, under review,, pre-print, arxiv.2410.15851.

MTMM-SIMS **Unlocking simple features to predict DFT spin state gaps of 3D metal complexes using Machine Learning**, *Ray, A.*, ***Nagar, S.,*** *and Varma, G., Priyakumar, U. D., Paul, A.:*, In 4th International Conference on Modern Trends in Molecular Magnetism and Spins in Molecular System (MTMM-SIMS) 2024.

IEEE-ICETCI **Adaptation of the Super Resolution SOTA for Art Restoration in Camera Capture Images**, ***Nagar, S.,*** *Bala, A., and Patnaik, S. A.:*, In International Conference on Emerging Techniques in Computational Intelligence, Hyderabad, India, 2023, pp. 158-163,doi:10.1109/ICETCI58599.2023.10331102, (code) (oral).

NCVPRIPG **C4MTS: Challenge on Categorizing Missing Traffic Signs from Contextual Cues**, *Gupta, V.*, ***Nagar, S.***, *Choudhury, S. P., Singh, R., Jamwal, A., Gupta, V., Subramanian A., Jawahar, C.V., and Saluja, R.:*, The 8th National Conference on Computer Vision, Pattern Recognition, Image Processing, and Graphics 2023. doi: link.springer.com/book/9789819752119 (oral).

ICEP **Remote Heart Rate Estimation From Videos for Minority Populations in Emergency Department**, ***Nagar, S.*** *Alam, M., Chatterjee, M., Patel, K., Khosla, S., Harvill, J., Johnson, M. A. H., Chestek, D., Ahuja, N.:*, Abstract accepted: Illinois College of Emergency Physicians, Spring Symposium - 2022 (oral).

ICEP **Respiratory Rate Estimation from Audio Signals from a Public Sound Database**, *Patel, K., Alam, M., Chatterjee, M.*, ***Nagar, S.,*** *Khosla, S., Harvill, J., Johnson, M. A. H., Chestek, D., Ahuja, N.:*, Abstract accepted: Illinois College of Emergency Physicians, Spring Symposium - 2022 (oral).

ICEP **Respiratory Rate Estimation From Videos for Minority Populations in Emergency Department**, *Alam, M., Chatterjee, M., Patel, K.,* ***Nagar, S.****, Khosla, S., Harvill, J., Johnson, M. A. H., Chestek, D., Ahuja, N.:*, Abstract accepted: Illinois College of Emergency Physicians, Spring Symposium 2022 (oral).

Achievements and Awards

Feb 25 **ACM travel grant**, *ACM India-IARCS*.

Aug 23 **PhD Fellowship**, *iHub-Data and IIIT Hyderabad*, selected for one year PhD fellowship.
Project proposal: Fast and Invertible Convolution layers for Normalization Flow Models

Sep 23 **NVIDIA Competitions: AI Art Restoration**, Won 1st prize and presented at IEEE-ICETCI 2023 -link.

June 23 **C4MTS: Challenge on categorizing missing traffic signs**, Won 1st prize and presented the results at NCVPRIPG 2023, IIT Jodhpur, -link.

Mar 23 **ML4Science Workshop**, TIFR Hyderabad - IIIT Hyderabad - Madurai Kamaraj University.
Modern Machine Learning methods in the general area of molecular sciences (Molecule/Drug/Material design, Inter-atomic potentials, MD simulations, etc.)- organized & participated , Won cash prize in ML4Science Hackathon -code

May 22 **MS Fellowship**, *iHub-Data and IIIT Hyderabad*, One year MS fellowship, Project proposal: Invertible Convolution layers for Normalization Flows.

Jun - Aug 24 **Climate Change AI Summer School**, *Virtual Summer School, Climate Change AI*.

Jan 23 **Research week with Google**, Google Research, India, -details.

July 22 **Amazon ML Summer School India**, Amazon, India, -link.

Mar – June 22 **Machine Learning for Chemistry and Drug Design**, iHub-Data, IIIT-Hyderabad, India.
12-week certificate program, with a strong emphasis on applications of AI/ML in drug discovery.-details

May 22 **3D Vision Summer School**, IIIT-Hyderabad, India, -details.

July 19 **Computer Vision & Machine Learning Summer School**, IIIT-Hyderabad, India.
In top 20 out of 400 (won cash prize)-details.

Professional Service

Reviewer: Journal of Photogrammetry and Remote Sensing.

Supervision: Three research interns, Two MS thesis students.

Talks: Vision-Transformer, DRDO, India.

Talks: Normalizing Flow models for de-nova Drug Design, ML4Science Workshop 2023.

Projects: curated list

Research **Generative models for 3D Molecules sampling**, End-to-end design of chemically and conformationally valid 3D molecules with high drug-likeness using graph-based generative models (and Normalizing Flow).

Research **Corn Seeds Image Dataset**, ML Lab, IIIT-Hyderabad and AdTech Corp.
New corn image dataset to focus on computer vision and solve agriculture-related problems. Trained BigGAN to generate fake corn seed images to solve the imbalance dataset and added fake images to create a balanced dataset. -dataset.

Research **Deep Web Crawling using Reinforcement Learning (A2C, ϵ-greedy)**, *-details, code*.

Relevant Coursework

IIIT-H Advanced Mathematics Structure, Probabilistic Graphical Models, Statistical Methods in Artificial Intelligence, Adv. Robotics: Path Planning and Control, Mobile Robotics: Mechanism and Control, Computer Vision: Digital Image Processing.

MOOC Topics in Applied Optimization, Optimization Methods, Reinforcement Learning, Deep Learning Models.

Technical Skills

Working Bash, C/C++, Python, MATLAB, Octave, OpenCV, ROS.

Tools GNU/Linux, HTML, CSS, JavaScript, LaTeX

Frameworks PyTorch, TensorFlow, Keras, CUDA-GPUs, Caffe

References (available upon request)

i). PhD Thesis supervisor: Prof Girish Varma, Machine Learning Lab, IIIT-Hyderabad, India.

ii). Research Intern supervisor: Dr. SVR Dendi, Samsung Research, Bangalore, India.

iii). Research Intern supervisor: Prof Narendra Ahuja, Computer Vision and Robotics Lab, UIUC.

iv). Research Intern supervisor: Prof Rohitash Chandra, School of Mathematics and Statistics, UNSW Sydney.