JAYAPRAKASH KATUAL

PhD Researcher, Electrical Engineering · IIT Bombay

Interpretable Machine Learning | Deep Unfolded Networks | Inverse Problems in Signal & Image Processing

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RESEARCH PROFILE

PhD researcher in interpretable machine learning, working on algorithm unfolding — classical optimization algorithms rebuilt as learnable architectures that retain their structure, convergence behaviour and parameter economy. Work spans image restoration, sparse signal recovery and sampling theory, together with the theory that explains when such models generalize. Earlier work applied deep learning to thermal and visual image analysis for medical diagnosis, where explainable and controllable model behaviour matters as much as accuracy.

EDUCATION

Ph.D., Electrical Engineering — Indian Institute of Technology Bombay 2023 – Present

Research area: interpretable machine learning, deep unfolded networks, inverse problems. Advisor: Prof. Satish Mulleti. Expected completion: August 2028.

M.Tech., Signal Processing and Control — National Institute of Technology, Hamirpur 2021 – 2023

CGPA 8.50/10 · [Gold Medallist/Class], Electrical Engineering · Dissertation graded "A": Thermal Image Analysis Using Deep Neural Networks.

B.Tech., Electrical Engineering — Indira Gandhi Institute of Technology, Sarang (BPUT) 2015 – 2019

CGPA 8.56/10

RESEARCH EXPERIENCE

Doctoral Researcher — Electrical Engineering, IIT Bombay 2023 – Present

- Design unfolded architectures that map iterative optimization algorithms onto network layers, giving a fixed inference budget and far fewer parameters than comparable black-box models.
- Develop learned reconstruction methods for image deblurring and related linear inverse problems.
- Build LISTA-type models for sparse signal recovery under structural priors.
- Recover bandlimited signals from modulo (unlimited sampling) ADC measurements, where dynamic range rather than resolution limits acquisition.
- Analyse convergence behaviour and generalization bounds of unfolded networks, and the conditions under which their efficiency claims hold.

Master's Researcher — Electrical Engineering, NIT Hamirpur 2022 – 2023

- Built CNN, GAN and classical ML pipelines for thermal image analysis, extracting temperature-difference patterns for pre-diagnosis of diabetic foot, sinusitis and related conditions.
- Designed an optimized ensemble classifier for emotion recognition from thermal imagery; this line of work led to four conference and journal publications.

PUBLICATIONS — 3 MOST RECENT (FULL LIST ON GOOGLE SCHOLAR)

- S. Reddy*, J. Katual* and S. Mulleti, "Tunable Domain Adaptation Using Unfolding," *IEEE Transactions on Artificial Intelligence*, 2026. *Equal contribution.
- J. Katual and A. Kaul, "Optimized Ensemble Machine Learning Approach for Emotion Detection from Thermal Images," *International Journal of Pattern Recognition and Artificial Intelligence*, vol. 38, 2024.
- J. Katual, A. Kaul and S. Joel, "Integrating Information in Visual and Thermal Image for Crack and Moisture Detection in Concrete Structures through CNNs," *2nd Int. Conf. on Vision Towards Emerging Trends (ViTECoN)*, IEEE, 2023.

TECHNICAL SKILLS

Languages & Tools	Python, MATLAB, LaTeX, Git
Frameworks	PyTorch, TensorFlow, Keras, NumPy, SciPy, scikit-learn
Domains	Signal processing, image processing, inverse problems, sparse recovery, convex optimization, deep learning

ACHIEVEMENTS & RESPONSIBILITIES

GATE 2020, Electrical Engineering — qualified · PG Training & Placement Representative, NIT Hamirpur · Member, Departmental Master's Programme Committee, NIT Hamirpur (2021–23)