Website: sawhney-medha.github.io LinkedIn: medha-sawhney|GoogleScholar

Medha Sawhney

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RESEARCH FOCUS

My research focuses on generative AI for science, with an emphasis on diffusion-based models for image and video generation that embed domain constraints into model architectures to preserve physical consistency and motion dynamics.

EDUCATION

Virginia Tech, Blacksburg, Virginia, USA **GPA: 4.00 / 4.00** *May 2023 – Aug 2026*
PhD in Computer Science. Advisor: *Dr. Anuj Karpatne*

Virginia Tech, Blacksburg, Virginia, USA **GPA: 4.00 / 4.00** *Aug 2021 - May 2023*
MS in Computer Science. Advisor: *Dr. Anuj Karpatne*

Manipal Institute of Technology, MAHE, Manipal, India **GPA: 8.34 / 10.00** *Aug 2016 - Aug 2020*
Bachelor's in technology, Major -Electronics and Communication Engineering, Minor -Data Science

WORK EXPERIENCE

Applied Scientist Intern, Amazon *Oct 2025– Jan 2026*
- Developed a cascaded diffusion architecture for novel view synthesis from sparse orthogonal views, decoupling geometric structure learning at low resolution from high-resolution texture refinement, significantly reducing inference cost.

Deep Learning Automation Intern, NVIDIA *May 2024 – Aug 2024*
- Developed a multitask video corruption detection model using a ViT-style shared encoder with task-specific heads, trained across heterogeneous datasets with varying resolutions and class distributions. Addressed dataset imbalance, catastrophic forgetting, through controlled shared vs. task-specific optimization, achieving >90% accuracy across datasets.

Machine Learning Engineering Intern, Twitter *Jun 2022 – Aug 2022*
- End to end development and deployment of a broadly applicable ML model using XGBoost within the account health space. Boosted Key performance indicators by 74%. Challenges: Data imbalance, feature sparsity, enormous data, data distribution drift

Machine Learning Engineer Hewlett-Packard R&D *Jan 2020 – June 2021*
- Engineered a self-resolution tool for dynamic troubleshooting of PC/printer issues, with a 3x BLEU score, employing AWD-LSTM and Natural Language Processing.
- Applied optimization strategies to build hardware-efficient and reliable ML models, including a) identifying performance bottlenecks using CUDA Kernel Profiling with NVIDIA Nsight Systems & Compute and b) examining ML models for bias

Research Intern, IIIT Hyderabad *May 2019 – Jul 2019*
- Designed and deployed an object recognition tool on NVIDIA Jetson TX2 board, funded by Defence Organisation (DRDO), India
- Successfully identified landmarks in aerial imagery also from viewpoints different than trained on, using YOLO and Deep Learning

RESEARCH EXPERIENCE

Graduate Research Assistant, Knowledge Guided Machine Learning Lab *Aug 2021– Present*
- Developing diffusion models for solving Partial Differential Equations integrating physics-guided machine learning and neural operators, enabling faster inference sampling and high-fidelity super resolution in highly sparse, noisy settings
- Designed a generative-unified, invertible framework, via latent space translations & normalizing flows to jointly solve forward and inverse problems in seismic imaging, achieving robust generalization to real-world out-of-distribution datasets. (***ICLR 2025***)
- Foundation Model for aquatic ecosystems to, (a) learn effective representations of process variables (b) represent ecosystem entities, (c) predict in 2D across temporal & depth axes and (d) handle variable frequency signals from highly sparse observations
- Designed a novel training-free open-world scene graph generation method, leveraging pretrained VLMs for zero-shot object-relation prediction, reframing predicate classification as multiple-choice QA (***CVPR W 2025***)
- Reasoning evaluation of VLMs on VQA tasks for scientific images, fine-grained trait understanding & prediction (***NeurIPS 2024***)
- Constructed an algorithm to detect and track microscopic bacteria cells with a 95% precision by utilizing motion, temporal cues & optical flow for an NSF funded cancer research project. Challenge: Hard to distinguish from background media. (***AISY 2024***)
- Engineered an approach to predict force applied by a human cell on underlying fiber intersections using multi-object detection techniques in Computer Vision like RetinaNet (***PNAS 2025***)

AWARDS / HONORS/ TALKS

- Awarded the Pratt Fellowship (PhD) by Virginia Tech College of Engineering, 2025
- Lightning talk at CV4Science, CVPR'25 - "Physics-guided Diffusion Neural Operators for Solving Forward & Inverse PDEs."
- Lightning talk at Imageomics, AAAI'24 - "Motion Enhanced Tracker: Tracking in Dense & Low-Contrast Environments."
- Scholarship to attend Grace Hopper Celebration Conference by AnitaB.org and Virginia Tech, 2022
- Best Paper Presentation for "An Efficient Approach to Detect Driver Distraction during Mobile Phone Usage", ICECNS-GOA 2018
- 2nd place for building a conversational agent to raise awareness of STDs, OK Google: Let's Build Hackathon, WTM Manipal, 2018
- 2nd position in Advanced Robotics Challenge by World Robot Olympiad Association (WRO) for Tetris solving bot, 2017

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PUBLICATIONS (* denotes equal contribution)

1. *Improving the Accuracy–Latency Frontier of Diffusion-based PDE Solvers Using Physics-Informed Spectral Attention* — *Under Review*
   Medha Sawhney, Abhilash Neog*, Mridul Khurana*, Anuj Karpatne
2. *A Unified Framework for Forward and Inverse Problems in Subsurface Imaging using Latent Space Translations* — *ICLR 2025*
   Naveen Gupta*, **Medha Sawhney***, Arka Daw*, Youzuo Lin, and Anuj Karpatne
3. *Investigating PDE Residual Attentions in Frequency Space for Diffusion Neural Operators* — *NeurIPS ML4Physics 2025*
   Medha Sawhney, Abhilash Neog, Mridul Khurana, Arka Daw, Anuj Karpatne
4. *Physics-guided Diffusion Neural Operators for Solving Forward and Inverse PDEs* — *(Oral) CVPR CV4Science 2025*
   Medha Sawhney, Abhilash Neog, Mridul Khurana, Amartya Dutta, Arka Daw, Anuj Karpatne
5. *Open World Scene Graph Generation using Vision Language Models* — *CVPR CVinWild 2025*
   Amartya Dutta, K.S. Mehrab*, **Medha Sawhney***, ..., Ismini Lourentzou, Arka Daw, Anuj Karpatne
6. *Scientific Foundation Models for Aquatic Ecosystems* — *ICML FMSD 2025*
   Abhilash Neog, **Medha Sawhney**, K.S. Mehrab, Sepideh Fatemi Khorasgani, ..., Anuj Karpatne
7. *VLM4Bio: A Benchmark Dataset to Evaluate Pretrained VLMs for Trait Discovery from Biological Images* — *NeurIPS 2024*
   Maruf, M, Arka Daw, K.S. Mehrab, Harish B. Manogaran, Abhilash Neog, **Medha Sawhney**, ..., Anuj Karpatne
8. *MEMTrack: A Deep Learning-Based Approach to Microrobot Tracking in Dense and Low-Contrast Environments* — *AISY 2024*
   Medha Sawhney*, Bhas Karmarkar*, Eric J. Leaman, Arka Daw, Anuj Karpatne, and Bahareh Behkam
9. *Detecting and Tracking Hard-to-Detect Bacteria in Dense Porous Backgrounds* — *(Oral) CVPR CV4Animals 2023*
   Medha Sawhney*, Bhas Karmarkar*, Arka Daw, Anuj Karpatne, and Bahareh Behkam
10. *Investigating a Model-Agnostic and Imputation-Free Approach for Irregularly Sampled Multivariate Time-Series Modeling*
    Abhilash Neog, Arka Daw, Sepideh Fatemi, **Medha Sawhney**, Aanish Pradhan, ..., Anuj Karpatne — *TMLR 2026*
11. *Deep Learning Enabled Label-free Cell Force Computation in Deformable Fibrous Environments* — *PNAS 2025*
    Abinash Padhi*, Arka Daw*, **Medha Sawhney**, Atharva Agashe ..., Anuj Karpatne and Amrinder Nain

VOLUNTEER EXPERIENCE

- Conference & Journal Reviewer for KDD'22, IJCV'23, SDM'25, ICLR'25, NeurIPS'25, AAAI'26, ICLR'26
- Workshop Reviewer: Imageomics AAAI'24, CV4Animals CVPR'24 & CVPR'25, ICLR'25 DeLTa & XAI4Science, NeurIPS'25 ML4PS
- Organizing Committee: First Imageomics Workshop at AAAI'24
- Guided a team of 30+ members as Coding Head, RoboManipal, official robotics student project team at MIT, Manipal 2018-2019
- Mentored 150+ students under the GirlScript Manipal Winter Programme on C++, Java, & Object Detection using OpenCV,2018

TECHNICAL SKILLS

Languages: Python, Java, C++, MATLAB **Frameworks**: PyTorch, TensorFlow, Keras JupyterLab, Git, Docker, HuggingFace