Vishal Purohit

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EDUCATION

Purdue University, West Lafayette, USA *2021 - 2026 (expected)*
PhD student in Electrical and Computer Engineering (Deep Learning & Computer Vision)
Advisor: Prof. Qiang Qiu
Graduate Level Courses: Linear Algebra, Optimization for Deep Learning, Deep Learning, Computer Vision, Advanced Topics in Reasoning with LLMs, Machine Learning Theory, Artificial Intelligence, Generative Models, Random Variables and Signals

KLS Gogte Institute of Technology, India *2014 - 2018*
Bachelor of Engineering in Electronics and Communication

PUBLICATIONS

Conference Publications

[C2] **Decomposed Generative Imaging** - **Vishal Purohit**, Ze Wang, Qiang Qiu. *under review, 2024.*

[C1] **Generative Quanta Color Imaging** - **Vishal Purohit**, Junjie Luo, Yiheng Chi, Qi Guo, Stanley H. Chan, Qiang Qiu. *IEEE Conference on Computer Vision and Pattern Recognition **(CVPR)**, 2024.*

Journal Publications

[J3] **A Label Efficient Semi Self-Supervised Learning Framework for IoT Devices in Industrial Process** - Vandana Bharti, Abhinav Kumar, **Vishal Purohit**, Amit Kumar Singh, Sanjay Kumar Singh. *IEEE Transactions on Industrial Informatics, 2024. (impact factor : 12.3)*

[J2] **MediSecFed: Private and Secure Medical Image Classification in the Presence of Malicious Clients** - **Vishal Purohit***, Abhinav Kumar*, Vandana Bharti, Rishav Singh, Sanjay Kumar Singh. *IEEE Transactions on Industrial Informatics, 2021. (impact factor : 12.3)*

[J1] **MetaMed: Few-Shot Medical Image Classification using Gradient based Meta-Learning** - Rishav Singh, Vandana Bharti, **Vishal Purohit**, Amit Kumar Singh, Sanjay Kumar Singh. *Pattern Recognition, Elsevier, 2021. (impact factor : 7.1)*

Technical Reports

[R4] **Decomposed Prompt Synthesis for Large Language Models** - **Vishal Purohit**

[R3] **Reproducing MaskFormer in TensorFlow** - **Vishal Purohit**, Wenxin Jiang, Akshath R. Raghav, James C. Davis *arXiv, 2023.*

[R2] **Counterfactual Outcome Prediction using Structured State Space Model** - **Vishal Purohit**, *arXiv, 2023.*

[R1] **Ortho-ODE: Enhancing Adverserial Robustness of Neural ODEs** - **Vishal Purohit**,

RESEARCH EXPERIENCE

Purdue University - QLab *May 2022 - Present*
Research Assistant, Advisor: Prof. Qiang Qiu

- **Audio-aided video reconstruction using diffusion models (Ongoing)** - Working on a multimodal generative model for reconstructing videos from sparse pixel data at high throughput with possible application in augmented reality glasses.

- **Pretrained model ranking tool (Ongoing)** - Spearheading the development of an advanced recommendation and ranking tool for pre-trained models, specifically focusing on Vision-Language Models and Large Language Models (LLMs). [Dataset] [Code]

- **Signal conditioning and reconstruction under highly sparse measurements using diffusion models** - Developed a novel, optimization-free technique to faithfully reconstruct image under very sparse measurements specifically focusing on image inpainting with 99% pixel masked and compressed sensing under high compressive ratios. Introduced a reparameterization strategy for the reverse diffusion process, facilitating multiple generative pathways and integrating them for accurate reconstructions. Improved reconstruction by +3dB compared to state-of-the-art approaches. [C2]

- **Controlled generation of multi-exposure images for colorization** – Developed a GAN-based framework for colorization of binary images captured by 1-bit quanta image sensor under extreme situations like over or underexposed conditions. Our method synthesized a set of exposure-bracketed images from a single binary image (overexposed or underexposed). Outperformed existing solutions by nearly 23 FID score points. [C1]

- **Decomposed prompt synthesis for large language models** – Designed a framework for synthesizing synthetic prompts to improve the performance on few-shot arithmetic reasoning task. Leveraged generative abilities of LLM to synthesize Chain-of-Thought and Program-Aided Prompting techniques. Experience with LLaMA-7B and text-davinci-002.

Google *January 2023 - October 2023*
Research Assistant, Advisors: Prof. James Davis & Dr. Abdullah Rashwan (Google, USA)

- **Reproducibility of vision models** - Led the development, validation, and performance verification of production-ready reproducible implementations of universal semantic segmentation models - MaskFormer and Mask2Former. Ensured code quality and maintainability with a focus on API design principles, enabling clean and efficient codebase enhancements, and optimized training and inference for cloud TPUs. [Code]
- Experience with code optimization and profiling on TPU v3-128 and large-scale GPU clusters. Improved TPU utilization by more than 90% and ensured minimal latency in the data pipeline. Research supported through TPU cloud research program.

Indian Institute of Technology, Varanasi *October 2020 - August 2021*
Research Intern, Advisor: Prof. Sanjay Kumar Singh

- **Meta-learning for long-tailed data distributions** - Conceptualized and Developed a meta-learning based classifier for medical datasets with the long-tail distribution and examined the empirical benefits of advanced augmentation techniques like MixUp and CutMix on medical images. [J1]
- **Federated knowledge distillation** - Developed a framework for enhancing privacy in federated learning algorithm FedAVG. Achieved knowledge sharing among the clients with the help of model inversion techniques for data synthesis and knowledge distillation. [J2]
- **Semi self-supervised federated learning** - Developed a framework dubbed WeCollab, for collective labeling of unlabelled data in federated learning scenarios. Introduced augmented contrastive loss to improve the confidence of generated labels and hypervolume loss to tackle the convergence issues. [J3]

WORK EXPERIENCE

Mobiquest Solutions *June 2020 - October 2020*
Machine Learning Software Engineer

- Led the deployment of object detection models using TensorFlow JS and developed a website using JavaScript for real-time monitoring. Collaborated and brainstormed ideas with the cofounder for rapid prototyping of deep learning-based solutions.

Tata Elxsi *September 2018 - May 2020*
Engineer

- Responsible for development, deployment, and model validation of object detection models - Faster RCNN for bacteria colony enumeration. Optimized inference pipeline of vision models time by 0.5 seconds and reduced memory footprint of the model by 30% using techniques like quantization on Nvidia Jetson platform.
- Designed & shipped scalable and production-quality algorithms for optical system calibration with improvement in performance by 50% for MTF calculation, chromatic aberration detection, and spatial distortion. Successfully shipped multiple image processing algorithms in C++. Led development of customer-facing desktop application for predictive model validation, deployment, implementation and support continuous training and model updates. Solely responsible for increasing project revenue by $100k.

SKILLS

- Programming Languages & Frameworks - Python (5+ years), PyTorch (3+ years), TensorFlow (2+ years), C++ (1+ year), JS (1 year), OpenMP, CUDA.
- ML skills - Diffusion Models, GANs, Large Language Models, Multimodal Machine Learning, Foundational Models, Transformers, Object detection & Segmentation, Meta-Learning, Distributed training on TPUs and GPUs.

HONORS & PROFESSIONAL RESPONSIBILITIES

- *Reviewing:* CVPRW 2022, IEEE International Conference on Multimedia & Expo (ICME) 2023, ICMEW 2023, ICML 2023/24, NeurIPS 2023, ICLR 2024.
- *Undergraduate Teaching Assistantship (May 2021 - May 2022)* - Vertically Integrated Programs, Purdue University.
- *Awards:*

- Research Assistantship from Google, USA for reproducibility, research supported by TPU cloud research program.
  - "Outstanding graduate mentor" - Purdue University, 2022
  - "Share with the world" award - Purdue University, 2022
- *Mentoring:*
  - Leading open-source efforts for reproducibility in deep learning at Purdue University and supervised a team of 20+ undergrads.
  - Mentored team of 20+ undergrads for the 2022 IEEE Autonomous Unmanned Aerial Vehicles (UAV) Chase Challenge organized at Purdue UAS Research and Test Facility (PURT), funded by the NSF and sponsored by the IEEE.