

LAVSEN DAHAL

COMPUTER VISION | LARGE LANGUAGE MODELS | MEDICAL IMAGING
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RESEARCH INTERESTS

Robust and reliable deep learning for medical image analysis, with a focus on building physically grounded representations that generalize across institutions. Current work addresses shortcut learning and distribution shift in CT triage via anatomy-conditioned architectures and measurement-supervised representation learning. Broader interests include generative models for controlled simulation of patient anatomy and vision–language models for radiology with applications in CT triage, radiotherapy planning, and virtual imaging trials.

EDUCATION

Duke University, Ph.D. in Electrical & Computer Engineering | GPA: 4.0 | Expected Graduation - 2026 *Durham, NC, USA*
University of Girona, Erasmus+ Master of Science in Medical Imaging | 2017-2019 *Girona, Spain*
VNIT Nagpur, Bachelor of Technology | 2010-2014 *Nagpur, India*

RESEARCH

Center for Virtual Imaging Trials, Department of Radiology *June 2022 – Present*
Research Associate / Ph.D. Student *Duke University*

- **JANUS: Anatomy-Conditioned Gating for Robust CT Triage:** Lead author on a physiology-guided fusion architecture that integrates segmentation-derived physical measurements (organ volumes, tissue densitometry) with deep visual features via multiplicative gating. Introduces the Physiological Veto Rate (PVR) as a diagnostic quantifying selective suppression of physically inconsistent overconfident predictions; achieves macro-AUROC 0.881 on MERLIN (N=5,082) and up to +20.5% external gains on measurement-defined findings; *manuscript in preparation*.
- **Organ-Aware CT Triage:** Lead author on an organ-aware multi-label CT triage framework grounding visual representations in anatomical structure via organ-masked attention and scalar radiology priors. Trained on 50,000+ CT scans with 48 disease labels; achieves state-of-the-art macro-AUROC/AUPRC on CT-RATE, RAD-ChestCT, and MERLIN over global pooling and vision–language baselines.
- **Macro-Radiomics for CT Triage:** Designed organ-level physical measurement features (volumes, HU statistics, shape/intensity descriptors) for CT disease classification. Trained interpretable logistic-regression models on 25,000+ studies, reaching performance comparable to deep CNNs on measurement-defined abdominal findings providing evidence that physical measurements alone carry strong diagnostic signal for scale- and density-defined pathologies.
- **3D Digital Twins (XCAT 3.0):** Led end-to-end development of a generative pipeline producing 2,500+ personalized 3D anatomical phantoms for virtual imaging trials, enabling controlled simulation of physical variation (organ morphometry, tissue properties) independent of scanner appearance. First-author *Medical Image Analysis* paper; two invention disclosures; library requested by 10+ research groups for clinical simulation and treatment-planning studies.
- **Vision–Language Segmentation:** Developed a prompt-conditioned abdominal CT segmentation model integrating radiology text prompts as auxiliary input, reducing false-positive lesion predictions while maintaining Dice performance comparable to standard segmentation baselines.
- **COVID-19 Classifier:** Led a physics-based virtual imaging trial with XCAT chest radiography phantoms to evaluate deep-learning COVID-19 classifiers, showing that performance is largely insensitive to dose but is strongly driven by the extent of pneumonia. Work presented at SPIE Medical Imaging.
- **Research Leadership:** Supervised 5+ graduate projects (diffusion models, Monte Carlo simulation, active learning); established reproducible codebases, Docker/Singularity environments, and experiment-management practices for the lab.

NAAMII (Nepal Applied Mathematics and Informatics Institute for Research) *July 2019 – August 2020*
Research Associate *Kathmandu, Nepal*

- **Uncertainty Estimation in Echocardiography:** Developed an ensemble-based uncertainty framework for segmentation on CAMUS and EchoNet-Dynamic, combining MC Dropout, test-time augmentation, and a training-trajectory ensemble of checkpoints. Proposed a probabilistic atlas uncertainty metric and showed that automatically rejecting the most uncertain 20% of cases improves Dice scores beyond published state-of-the-art baselines without manual quality filtering.
- **Automatic Cobb Angle Estimation for Scoliosis:** Built an automatic scoliosis assessment pipeline that detects vertebrae with Faster R-CNN and regresses vertebral corner landmarks with a DenseNet-based model on 600+ spinal AP X-rays. Added cropping, outlier rejection, and polynomial smoothing of predicted landmarks to compute three Cobb angles, achieving performance competitive with top entries in the AASCE MICCAI 2019 spinal curvature challenge.

- **Community Building in Medical AI:** Co-organized an international AI workshop (100+ participants) focused on AI, and delivered hands-on labs on generative models.

VICOROB, University of Girona

Research Intern

February 2019 – June 2019

Girona, Spain

- **MRI Super-Resolution:** Developed a deep-learning-based brain MRI super-resolution model that improved PSNR and SSIM over conventional interpolation. Demonstrated improved downstream tissue segmentation accuracy on super-resolution volumes.

BioMedIA, Imperial College

Research Intern

July 2018 – August 2018

London, UK

- **Lung Nodule Malignancy Classification** Developed 3D CNN models on the LUNA dataset to classify benign vs malignant lung nodules in low-dose CT.

Kantipur Engineering College

Lecturer

November 2016 – August 2017

Lalitpur, Nepal

- **Teaching & Mentorship:** Designed and taught Computer Programming and Artificial Intelligence courses. Supervised multiple undergraduate theses applying machine learning to real world data.

SKILLS

Programming Languages	Python, C++, MATLAB, R, SQL, Bash
Libraries	PyTorch, MONAI, Hugging Face, NumPy, Pandas, SciPy, scikit-learn, SimpleITK
Technologies	CUDA, PyTorch DDP, Slurm, Docker, Singularity, GCP, Linux, Git, Jupyter
Medical Imaging	CT physics (HU, dose), DICOM, NIfTI, digital phantoms (XCAT3), virtual imaging trials, radiomics
Developer Skills	Distributed training, experiment tracking, reproducible pipelines, large-scale data preprocessing

SELECTED PUBLICATIONS

1. L. Dahal, et al. "Organ-Aware Attention Improves CT Triage and Classification" arXiv preprint arXiv:2601.13385.
2. L. Dahal, et al. "XCAT 3.0: A Comprehensive Library of Personalized Digital Twins Derived from CT Scans." Medical Image Analysis, 2025.
3. L. Dahal, F. I. Tushar, E. Abadi, et al. "Virtual vs. Reality: External Validation of COVID-19 Classifiers Using XCAT Phantoms for Chest Radiography." SPIE Medical Imaging 2022: Physics of Medical Imaging.
4. L. Dahal, A. Kafle, B. Khanal. "Uncertainty Estimation in Deep 2D Echocardiography Segmentation." arXiv:2005.09349, 2020.

Full publication list: [Google Scholar](#)