Nidhin **Harilal**

Computer Vision · Representation Learning · AI for Climate

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I am a third-year Ph.D. student at the University of Colorado, Boulder. My general research area is machine learning, with an emphasis on representation learning, and AI for science. I'm motivated by challenges that arise when trying to apply machine learning techniques for climate applications. Towards this end, I've been focusing on deep learning methods for identifying spatiotemporal structures that can help enhance climate data resolution for improved climate predictions. I'm also interested in using GenAI to improve modern machine learning methods. Most recently, I've been working on techniques on using synthetic data to improve self-supervised representations.

Education

University of Colorado, Boulder — *GPA - 4.0/4.0*

Ph.D in Computer Science advised by Dr. Claire Monteleoni — *2021 - Present*

Indian Institute of Technology Gandhinagar — *GPA - 8.51/10*

B.Tech. (with Honours) in Computer Science and Engineering — *2017 - 2021*

Research Papers

***** indicates equal contribution

Peer-reviewed

Parameter Efficient Fine-tuning of Self-supervised ViTs without Catastrophic Forgetting
Reza Akbarian*****, Nidhin Harilal*****, Claire Monteleoni, and Maziar Raissi.
(Oral) Accepted in *CVPR 2024 - Efficient Large Vision Models (eLVM)*

EnhancedSD: Downscaling Solar Irradiance from Climate Model Projections. (PDF)
Nidhin Harilal, B. M Hodge, Claire Monteleoni, and Aneesh Subramanian.
In *NeurIPS 2022 -Tackling Climate Change with Machine Learning (Climate Change AI)*

Image Caption Generator using Siamese Graph Convolutional Networks and LSTM. (PDF)
Athul Kumar, Aarchi Agrawal, KS Ashin Shanly, Sudip Das, and Nidhin Harilal
In *5th Joint International Conference on Data Science & Management of Data* (9th ACM IKDD CODS and 27th COMAD) 2022

HDRVideo-GAN: Deep Generative HDR Video Reconstruction. (PDF)
Mrinal Anand*****, Nidhin Harilal*****, Chandan Kumar*****, and Shanmuganathan Raman
In *Proceedings of 12th Indian Conference on Computer Vision, Graphics and Image Processing* (ICVGIP) 2021

Augmented Convolutional LSTMs for Generation of High-Resolution Climate Change Projections. (PDF)
Nidhin Harilal, Mayank Singh, Udit Bhatia
In *IEEE Access, Volume 9.* 2021

CARO: An Empathetic Chatbot for People with Major Depression. (PDF)
Nidhin Harilal, Rushil Shah, Saumitra Sharma, and Vedanta Bhutani
In *3rd Joint International Conference on Data Science & Management of Data* (7th ACM IKDD CoDS and 25th COMAD) 2020

Preprints & Manuscripts

DiffMix: Mixing Natural and Synthetic Images for Robust Self-Supervised Representations
Reza Akbarian*****, Nidhin Harilal*****, Claire Monteleoni and Maziar Raissi.
In Submission to *International Conference on Machine Learning* (ICML) 2024.

STint: Self-supervised Temporal Interpolation for Geospatial Data (PDF)
Nidhin Harilal, B. M Hodge, Aneesh Subramanian and Claire Monteleoni.
ArXiv preprint *arXiv:2309.00059*. 2023; In submission to European Conference on Machine Learning (ECML) 2024

Bayesian Deep Learning Hyperparameter Search for Robust Function Mapping to Polynomials with Noise. (PDF)
Nidhin Harilal, Udit Bhatia, and Auroop Ganguly
ArXiv preprint *arXiv:2106.12532*. 2021

Talks

2023 **AAAI: AI for Climate Science,** 'Semi-supervised spatiotemporal downscaling of climate projections'

2022 **Eastern European Machine Learning Summer School,** 'Generating High-resolution Climate Change Projections'

Research Experiences

University of Colorado, Boulder — *Jan. 2022 - Present*

Research Assistant in CS — *Advisor: Dr. Claire Monteleoni*

Northeastern University, Boston *Jul. 2020 - Dec. 2020*

Research Intern in Sustainability and Data Sciences (SDS) Lab *Advisor: Dr. Auroop R. Ganguly*

Indian Institute of Technology, Gandhinagar *May. 2019 - Dec. 2019*

Research Assistant in Machine Intelligence and Resilience (MIR) Lab *Advisor: Dr. Udit Bhatia*

Awards and Honors

2022 **Awardee,** Early Career Professional Development Fellowship at CU Boulder
2021 **Awardee,** Awtar and Teji Singh Graduate Fellowship at CU Boulder
2020 **Awardee,** Notable Undergraduate Research & Publication at IIT Gandhinagar
2018, '19 **Dean's List,** Excellent Academic Performance at IIT Gandhinagar
2014 **National Winner,** CBSE All India Annual Science Exhibition held in New Delhi

Teaching & Services

• **Teaching Assistant**, CSCI 5622: Machine learning (Spring 2024) and CSCI 4622: Machine learning (Fall 2022) at CU Boulder.

• **Teaching Assistant**, ES 654: Machine learning (Spring 2021) and ES 102: Introduction to computing (Fall 2020) at IIT Gandhinagar.

• **Mentor**, Academic Discussion Hours (Fall 2019-20), assisting freshmen with academic workload challenges.

• **Reviewer**, WACV 2021-22, NeurIPS 2023.

• **Academic Coordinator**, IIT Gandhinagar Students' Council (2019-21).

• **Organizer**, HackRush: IITGN's annual intra-college hackathon (2018-21).

Selected Projects

Self-supervised Temporal Interpolation for Geospatial Data *CU Boulder*

Mentor: Dr. Claire Monteleoni, Dr. Aneesh Subramanian *Aug. 2022 - July. 2023*

- Addressed the failure of optical-flow based methods on geospatial data with varied temporal movements and deformations.
- Developed STint- a self-supervised method that uses a dual cycle-consistency pretext task to temporally interpolate geospatial data.
- Demonstrated STint's effectiveness on various geospatial datasets. Preprint is available here.

Image Defogging Using Conditional Denoising Diffusion Probabilistic Models (DDPMs) *CU Boulder*

CSCI 5822: Probabilistic Models (Research Project) *Feb. 2023 - April. 2023*

- Studied traditional single-image defogging methods which relied on the physical scattering model or utilized ML-based techniques.
- Designed a denoising diffusion-based probabilistic model for image defogging and evaluated it on the Cityscapes dataset.
- The project repository can be found here.

Generating Machine Learning-based Dynamic Climate Projections *CU Boulder*

Mentor: Dr. Bri-Mathias Hodge, Dr. Aneesh Subramanian (Climate Change AI Innovation Grants'21) *Jan. 2022 - Aug. 2022*

- Studied the challenge of resolution and bias differences between climate model outputs and climate reanalysis, aka downscaling.
- Developed EnhancedSD - a deep learning framework for downscaling climate variable including solar irradiance over CONUS.
- Addressed the limitation of checkerboard artifacts with existing downscaling methods. Presented at NeurIPS Climate AI'22.

Accelerating Large Network Data Analytics using Graph Neural Networks (GNNs) *CU Boulder*

CSCI 6502: Big Data Analytics (Research Project) *Feb. 2022 x- April. 2022*

- Investigated GNNs' effectiveness on approximating various network centrality measures like degree, closeness and betweeness centrality.
- Designed and tested convolutional GNNs on synthetically generated networks dataset consisting ER, BA and Gaussian partition graphs.
- The project repository can be found here.

Investigating Occam's Razor on Neural Networks with Uncertainties *Northeastern University*

Mentor: Dr. Auroop Ganguly *July. 2020 - Dec. 2020*

- Studied accuracy vs complexity trade-offs in Monte-Carlo (MC) dropout Bayesian neural networks on varying depth, width and ensembles.
- Analysed optimality in terms of efficiency in extracting polynomials with varying degrees from different noisy samples.
- Results suggested possible existence of an optimal network depth with no discernible optimality for width. Manuscript.

Relevant Skills

Programming [Extensive] Python (PyTorch, Tensorflow), Shell
[Basic] R, C++, PySpark, Web (Django, Flask), HTML/CSS
Workflow Cluster (Slurm), Cloud (GCP), Integrations (VSCode, Jupyter)
Design LaTeX, Vector graphics (BioRender, InkScape)