SABYASACHI SAHOO

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Ph.D. candidate with industry experience (Nvidia) interested in building robust models for real-world deployment.

EDUCATION

Mila/Inria/Université Laval Sep 2021 - Present
Ph.D. in Machine Learning. Advisors: Christian Gagné & Frédéric Precioso. (GPA: 3.9/4)

Indian Institute of Science (IISc), Bangalore Aug 2014 - Jul 2016
Masters in Computational and Data Science. Advisor: Sathish Vadhiyar. (Top 5 in class)

Sardar Vallabhbhai National Institute of Technology (NIT), Surat Aug 2010 - Jul 2014
Bachelors in Mechanical Engineering.

RESEARCH EXPERIENCE

Mila/Université Laval - Graduate Research Assistant Sep 2021 - Present

Work on understanding and improving model robustness and generalization across various domains.

- **Test-Time Adaptation (TTA)** & **Continual Learning**: Online early stopping to learn new features during TTA without forgetting pretrained features [1], and low-rank approximation for continual learning improves robustness to task order and forgetting [4].
- **Out-of-Distribution (OOD)** & **Adversarial Robustness**: Mixup improves OOD detection in gradient space [3], output logits to cheaply detect samples vulnerable to adversarial attacks [2], and improved adversarial robustness using test time adaptation (TTA) [10].
- **Domain Generalization**: Improved generalization by minimizing out-of-distribution detection [7], or denoising classifier predictions using diffusion model [11].
- **Reinforcement Learning (RL)** & **Ensembles**: Reformulate the microservice partitioning problem as an RL problem [15], and simple ensemble approaches can outperform complex ensembling strategies [20].
- **Robotics**: Differentiable SLAM framework for LiDAR [8], to improve learning based robotics perception [6].

ML Lab, IISc Bangalore - Research Assistant Feb 2019 - Aug 2021

Worked on improving model performance and explainability in healthcare and robotics applications.
Advisor: Chiranjib Bhattacharyya

- **Multi-task learning**: for improved disease diagnosis from compressed chest X-ray images [5], which was deployed as an automatic report generation tool during the pandemic [21].
- **Explainability**: Non-negative matrix factorization for expert-aligned concept extraction [13, 23], and exposed vulnerability of popular saliency-based explanation methods to input perturbations [14].
- **Lidar generation**: Adversarial autoencoder-based model for self-driving cars [9], and improved scene flow prediction by adaptively fusing learning-based and geometry-based approaches [16].
- **ADAS** & **Image generation**: Cost-effective ADAS system optimized for adverse conditions on Indian roads [24], and Discrete Cosine Transform improves high-resolution image generation in Variational Autoencoders [22].

Computational and Data Science, IISc Bangalore - Graduate Research Assistant Aug 2015 - Jul 2016

Worked on analyzing deep learning models and optimizing computational performance.

- **Representation Learning**: Extracted hierarchical relationships between visually similar classes in CNNs [18].
- **High-performance computing**: Multi-CPU hierarchical graph partitioning algorithm for scaling molecular dynamics [17] and efficient hybrid CPU-GPU implementation for Traveling Salesman Problem [19].

ONGOING WORKS

- S. Sahoo *et al.* **A Mechanistic Interpretable Approach to Finetuning of Foundation Models**.
- M. Sandhu, S. Sahoo *et al.* **Zero-shot Image Classification using von Mises–Fisher-based CLIP**.
- M. ElAraby, S. Sahoo *et al.* **Pruning based Out-of-Distribution Detection in Interpolated Manifolds**.
- J. Ngnawe, S. Sahoo *et al.* **Detecting Adversarially Vulnerable Input Hyperspace in Pretrained Models**.
- D. Vattikonda, S. Sahoo *et al.* **Leveraging Motion Priors for Improved Text-to-Video Generation**.

INDUSTRY EXPERIENCE

Nvidia - Software Engineer II — Aug 2016 - May 2018

Led display team responsible for all self-driving platforms.

- **Display Functionality**: Implemented various new features, reducing bugs (60%), improving user experience.
- **Device Tree Modularization**: Designed reusable module, cutting the development time (30%) across teams.
- **Jetson Xavier Chip Launch**: Implemented critical modules, for successful launch & performance boost (25%).

Donut Research Labs - Deep Learning Engineer — May 2018 - Feb 2019

Led NLP and computer vision projects for e-commerce applications.

- **Text Normalization**: Improved Walmart's brand name extraction accuracy (40%) using a Seq2Seq model, pretrained on product descriptions, fine-tuned on noisy annotations, and top-k sampling with beam search.
- **Object Detection**: Built custom information extraction module by fine-tuning Single Shot Detector (SSD) model on product images, improving product attribute identification (35%).
- **Long Tail Classification**: Class-imbalance aware LSTM improved accuracy (25%) and sped inference (10%).
- **Dataset Development**: for text normalization & object detection projects (collection, annotation, cleaning).

PREPRINTS (UNDER REVIEW)

[1] S. Sahoo, M. ElAraby, J. Ngnawe, Y. Pequignot, F. Precioso, and C. Gagné. **Layerwise Early Stopping for Test Time Adaptation**. In: *arxiv. Under review* (2024). [link].

[2] J. Ngnawe, S. Sahoo, Y. Pequignot, F. Precioso, and C. Gagné. **Detecting Brittle Decisions for Free: Leveraging Margin Consistency in Deep Robust Classifiers**. In: *arxiv. Under review* (2024). [link].

[3] M. ElAraby, S. Sahoo, Y. Pequignot, P. Novello, and L. Paull. **GROOD: GRadient-aware Out-Of-Distribution detection in interpolated manifolds**. In: *arxiv. Under review* (2024). [link].

PUBLICATIONS

[4] J. Li, R. Wang, Y. Lai, C. Shui, S. Sahoo, C. X. Ling, S. Yang, B. Wang, C. Gagné, and F. Zhou. **Hessian Aware Low-Rank Weight Perturbation for Continual Learning**. In: *Transactions on Knowledge and Data Engineering (TKDE) Journal*. [link]. 2023.

[5] M. Antony, S. T. Kakileti, R. Shah, S. Sahoo, C. Bhattacharyya, and G. Manjunath. **Challenges of AI driven diagnosis of chest X-rays transmitted through smart phones: a case study in COVID-19**. In: *Scientific Reports Journal, Nature*. [link]. 2023.

[6] P. Kumar, D. Vattikonda, V. B. S. Nadkarni, E. Dong, and S. Sahoo. **Differentiable SLAM Helps Deep Learning-based LiDAR Perception Tasks**. In: *Proceedings of the British Machine Vision Conference (BMVC)*. [link]. 2023.

[7] S. Sahoo, F. Zhou, Y. Pequignot, J. Ngnawe, F. Precioso, and C. Gagné. **Domain Generalization by Minimizing Out-of-Distribution Detection**. In: *Proceedings of the Montreal AI Symposium (MAIS)*. [link]. 2022.

[8] F. Aryan, D. Vattikonda, E. Dong, and S. Sahoo. **Grad-lidar-SLAM: Fully differentiable global SLAM for lidar with pose-graph optimization**. In: *IROS Workshop on Probabilistic Robotics in the Age of Deep Learning*. [link]. 2022.

[9] S. Sahoo, P. Kumar, V. Shah, V. Kondameedi, A. Jain, A. Verma, C. Bhattacharyya, and V. Vishwanath. **Dynamic to static lidar scan reconstruction using adversarially trained auto encoder**. In: *Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI) Conference*. [link]. 2021.

OTHER WORKS

[10] K. Samanta, S. Sahoo, and C. Gagné. **Test Time Adaptation as an Adversarial Defense Strategy**. Internship Report. [link]. Université Laval, 2023.

[11] A. Verma, S. Sahoo, and C. Gagné. **Diffusion based Pseudolabeling under Distribution Shifts**. Internship Report. [link]. Université Laval, 2023.

[12] S. Sahoo, F. Precioso, and C. Gagné. **Test-time Out-of-Distribution Generalization**. PhD Proposal. [link]. Université Laval, 2022.

[13] D. Tiwari, R. Shah, S. Sahoo, and C. Bhattacharyya. **Enhancing Explainability in Medical Images using Global Methods**. Masters Thesis. [link]. IISc Bangalore, 2022.

[14] G. Parashar, S. Sahoo, and C. Bhattacharyya. **Adversarial Robustness for Local Interpretable Methods**. Masters Thesis. [link]. IISc Bangalore, 2021.

[15] S. Sahoo and K. Sellami. **Automated Microservice Extraction using Reinforcement Learning**. [link]. Université Laval, 2021.

[16] D. Shanbag, S. Sahoo, C. Bhattacharyya, and V. V. **An Approach For Accurate Sceneflow Prediction for LiDAR-based Sensors**. Masters Thesis. [link]. IISc Bangalore, 2020.

[17] S. Sahoo and S. S. Vadhiyar. **Hierarchical Task Mapping on Dragonfly topology for Scaling Molecular Dynamics**. Masters Thesis. [link]. IISc Bangalore, 2016.

[18] S. Sahoo and V. Kondameedi. **Establishing Semantic relationships among Object Classes using Deep Networks for Image Classification**. [link]. IISc Bangalore, 2015.

[19] S. Sahoo and V. Kondameedi. **Hybrid Execution of Travelling Salesman Problem**. [link]. IISc Bangalore, 2015.

PROJECTS

[20] S. Sahoo, S. Karami, A. Safarnejadian, and A. Tupper. **Deep Ensemble Methods for Vehicle Classification**. [link]. Université Laval. 2021.

[21] S. Sahoo, R. Shah, S. T. Kakileti, C. Bhattacharyya, and G. Manjunath. **A new AI-driven platform will facilitate early-COVID interventions over Whatsapp**. [link]. Department of Science and Technology, Government of India. 2021.

[22] T. Varshney, S. Sahoo, V. Kondameedi, and C. Bhattacharyya. **DCT-VAE: Capturing Low-level and High-level Features for Image Generation**. [link]. IISc Bangalore. 2021.

[23] S. Sahoo, A. Jain, R. Shah, and C. Bhattacharyya. **Improving Automatic Concept Extraction for Global Model Explainability**. [link]. Niramai Health Analytix. 2021.

[24] V. Kondameedi, S. Shet, A. Verma, S. Sahoo, P. Kumar, C. Bhattacharyya, and S. Biswas. **Frugal Advanced Driver Assistance System (ADAS) for Indian Roads**. [link]. TATA Motors. 2020.

[25] S. Sahoo, P. Kumar, C. Bhattacharyya, and V. V. **Proximal Pose Search for Adapting SLAM in Dynamic Environments on Slow Moving UGVs**. [link]. Ati Motors. 2019.

TEACHING AND LEADERSHIP ROLES

- **Teaching Assistant** of Machine Learning course at Université Laval (fall 2022/2023): Conducted weekly tutorial sessions and graded homework/exams.
- **Student Mentor**, SHARE Research Labs (2020-21): Teaching and mentoring students on the platform for working towards a research paper for top-tier conferences.
- **Organizer**, various reading groups on topics like Machine Learning (2022-23), Out-of-Distribution (2022-24), and Autonomous Navigation (2019-20).
- **Placement Coordinator**, IISc (2015-16): Invited, organized, and coordinated on-campus placement for numerous industries and startups.

HONORS AND AWARDS

- Awarded IID Excellence scholarship 2022.
- Secured research funding from DEEL (2021-Present).
- Secured research funding from Ati Motors (2019-21), and ARTPARK (2021).
- Awarded distinction for my master's thesis.
- Won various competitions: 1st place in NeurIPS 2017 Challenge, top finalist in NVIDIA Reinforcement Learning Competition 2018, 3rd place in SO1 Product Recommendation Competition 2018.