Akshaya Athwale

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Overview

I'm a research scientist and engineer with a strong background in machine learning, deep learning, and computer vision, specializing in geometric deep learning and wide-angle imagery. I build robust, efficient, and scalable ML systems by integrating geometric priors into neural networks, enabling real-time perception with limited data. With experience bridging academic research and industrial applications, I focus on solutions that generalize well and are ready for deployment in autonomous systems and vision-based products.

PUBLICATIONS

- **A. Athwale, O. Ahmad, J.-F. Lalonde**:
  - "Network-agnostic distortion-invariant projections for wide-angle image understanding". **Under review**.

- **A. Athwale, I. Shili, Émile Bergeron, O. Ahmad, J.-F. Lalonde**:
  - "DarSwin-Unet: Distortion Aware Encoder-Decoder Architecture". IEEE Winter Conference on Applications of Computer Vision **(WACV) 2025**.

- **A. Athwale, A. Afrasiyabi, J. Lague, I. Shili, O. Ahmad, J.-F. Lalonde**:
  - "DarSwin: Distortion Aware Radial Swin Transformer". In IEEE International Conference on Computer Vision, **ICCV 2023**.

- **Y. Hold-Geoffroy, A. Athwale, J.-F. Lalonde**:
  - "Deep Sky Modeling for Single Image Outdoor Lighting Estimation". In IEEE Conference on Computer Vision and Pattern Recognition, **CVPR 2019**.

- **S. Sengupta, A. Athwale, T. Gulati, V. Lakshminarayanan**:
  - "FunSyn-Net: Enhanced Residual Variational Auto-encoder and Image-to-Image Translation Network for Fundus Image Synthesis". in **SPIE Medical Imaging Conference 2020**.

Education

- **Université Laval, Thales digital solution**, Quebec City, Canada *2021 – 2025 (Expected)*
  Doctorate in Computer Vision and Machine Learning
  Thesis: Geometry-Aware Deep Learning for Robust Perception with Wide-Angle Cameras
  Research focuses on integrating lens geometry into deep networks for robust perception in autonomous systems.

- **Aalto University**, Espoo, Finland *2019 – 2020*
  Project Employee
  Developed a physics-informed neural network framework grounded in Lagrangian mechanics for energy-consistent catalyst prediction in industrial workflows at Neste.

- **Indian Institute of Technology (IIT-ISM) Dhanbad**, India *2014 – 2019*
  Integrated Master of Technology in Mathematics and Computing
  Thesis: Generative Modeling and Applications
  GPA: 8.85 / 10.0

Work EXPERIENCE

- **Deep Learning Research Intern, Thales Digital Solutions** **Quebec City, Canada**
  Supervised By: Ola Ahmad and Prof. Jean-François Lalonde, June 2023 - December 2023
  - **Objective:** Developed a distortion-invariant pixel-level recognition framework for wide-angle images that generalizes to unseen fisheye lenses without retraining, enabling real-time obstacle avoidance in autonomous drones with seamless adaptability to future lens changes.
  - Designed a transformer-based encoder-decoder architecture that integrates lens geometry to enable distortion-invariant performance across diverse wide-angle lenses, ensuring seamless adaptability to future lens changes through geometry-aware feature learning. The model was implemented in **PyTorch** and trained using a **multi-GPU** setup for scalable experimentation.
  - The model is being prepared for deployment on obstacle avoidance on autonomous drones, with depth results presented at **WACV 2025**.

- **Deep Learning Project Employee, Aalto University, Neste** **Espoo, Finland**
  Supervised By: Prof. Alexander Ilin, May 2020 - August 2021
  - **Objective:** Developed a physics-informed neural network (PINN) to solve differential equations from Lagrangian and Hamiltonian mechanics for catalyst behavior prediction in industrial chemical processes.
  - Modeled system dynamics by minimizing the action integral and enforcing energy conservation, using **PyTorch** and **DeepXDE** for PINN implementation.
  - Integrated the framework into industrial workflows at **Neste**, demonstrating its effectiveness for real-world catalyst optimization.

- **Deep Learning Researcher, Arya.ai, Lithasa Technologies** **Mumbai, India**

  Supervised By: Deekshith Marla, May 2017 - July 2017

  - **Objective** : Automated the reading of trader's documents and capture all documents, including the ones that were not just structured layouts, and make that data actionable with a minimum of human intervention.
  - Our first task was to implement a data driven model that can recognize different documents. To build this classifier we implemented a SVM classifier using term frequency document inverse frequency (TFIDF) vectorizer to extract a feature from the document
  - Second task was to implement a model that can understand the context such as what an identity number is not and what should (or shouldn't) be around the number, For this we implemented an OCR that can read a text image which was extracted from the document

RESEARCH EXPERIENCE

- **Graduate Research Assistant, Université Laval** **Quebec City, Canada**

  Supervised By: Prof. Jean-François Lalonde and Ola Ahmad, August 2021 - August 2025 (expected)

  - **Project 1: Geometrically Informed Transformer for Wide-Angle Images**
    - **Objective:** Address the challenge of severe geometric distortions in wide-angle images, which degrade recognition performance, by developing a geometrically informed model that learns distortion-invariant features and generalizes to unseen fisheye lenses.
    - Proposed the **Radial Transformer Network**, a distortion-equivariant architecture that embeds fisheye lens geometry into the network using novel angular positional encoding and polar representations.
    - Leveraged geometric priors to enable distortion-invariant feature learning, allowing the model to generalize across lens types without fine-tuning.
    - Demonstrated out-of-distribution generalization to novel distortions on classification tasks, outperforming distortion-agnostic baselines.
    - Published at **ICCV 2023**, establishing the value of distortion-aware, geometry-guided deep learning for robust wide-angle image understanding.
  - **Project 2: Distortion-invariant, model-agnostic wide-angle image projection**
    - **Objective:** Develop a distortion-invariant projection method for wide-angle images that generalizes across architectures, making any network distortion-invariant in a model-agnostic way and enabling easy deployment without network-specific modifications
    - Proposed a model-agnostic projection approach using square-to-disc mappings from computer graphics, enabling consistent distortion handling with fewer artifacts.
    - Unlike network-specific methods like the Radial Transformer, this approach supports any architecture, simplifying integration into production systems.
    - The method is currently **under review** for publication.

- **Mitacs Globalink Research Intern, Université Laval** **Quebec City, Canada**

  Guide: Prof. Jean-François Lalonde, May 2018 - December 2018

  - **Objective:** Estimate physically plausible HDR sky environment maps from a single low dynamic range (LDR) image.
  - Proposed a three-stage architecture to model HDR skies using complementary datasets: Laval HDR (radiometrically accurate HDR panoramas) and SUN360 (diverse LDR panoramas).
  - Learned a latent space of HDR skies from Laval HDR, training the encoder to be robust to white balance, exposure, and occlusions.
  - Converted SUN360 LDR panoramas to HDR, extracted representations, and supervised LDR-to-HDR mapping using cropped image pairs.
  - Published as a conference paper at **CVPR 2019**.

- **Research Intern, University of Waterloo** **Waterloo, Canada**

  Guide: Prof. Vasudevan Lakshminarayanan, May 2019 - July 2019

  - **Objective** : Solved the data scarcity problem in medical imaging by generating synthetic retinal images.
  - We proposed a pipeline of two models for generating retinal images and corresponding blood vessel.
  - The first model outputs the blood vessel using enhanced Residual Variational Auto-Encoder using a random normal vector as input. The second model is an image-to-image translation network which takes the generated blood vessel as input to output retinal fundus image.
  - Results were clinically relevant and our research paper was published in **SPIE Medical Imaging Conference 2020**.

REFERENCES

- **Prof. J. F. Lalonde**: Professor, Department of Electrical and Computer Engineering, Université Laval, jflalonde@gel.ulaval.ca
- **Ola Ahmad**: Chief AI Scientist at Thales Canada, ola.ahmad@thalesdigital.io
- **Prof. Alexander Ilin**: Professor, Computer Engineering, Aalto University, +358415014497, alexander.ilin@aalto.fi
- **Prof. Vasudevan Lakshminarayanan**: Professor, Electrical and Computer Engineering, University of Waterloo, vengulak@uwaterloo.ca
- **Deekshith Marla**: Founder & CTO (Featured in Forbes 30 Under 30), Lithasa Technology, Arya.ai, deekshith@arya.ai