CHINMAY SAHU, Ph.D.

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RESEARCH INTERESTS

Computer Vision • Generative Models • Vision-Language Models • Domain Adaptation • Multi-Modal Learning • Open-World Perception • Large-Scale ML Systems

RESEARCH STATEMENT

Computer Vision & Imaging Researcher with demonstrated success delivering state-of-the-art recognition systems deployed at scale. Achieved top-tier results in international benchmarks, with deep expertise in robust visual recognition under real-world capture variability, domain adaptation, generative modeling for photorealistic data synthesis, and multi-modal fusion. Proven ability to translate research innovations into production-ready deep learning systems across biometrics, imaging, and applied AI domains.

PROFESSIONAL EXPERIENCE

Senior AI Research Scientist | Thales Digital Identity & Security, Pasadena, CA *Aug 2021–Present*

Multi-Modal Perception & Recognition Systems

- Achieved **#1 global ranking in NIST IREX-10** among 28 international competitors, demonstrating state-of-the-art performance in **fine-grained visual iris recognition under extreme domain shift** (cross-sensor, cross-population, varying illumination) technical challenges directly relevant to robust camera and imaging pipelines.
- Designed **compact visual representations** reducing feature dimensionality by **>60%** while maintaining accuracy, enabling efficient large-scale matching in resource-constrained environments.
- Trained finger-recognition models for NIST ELFT and E1N submissions, improving **Rank-1 performance by 16%** on internal latent evaluation benchmark and reducing FRR by **39% at** $1e^{-4}$ **FAR** compared with existing solutions.
- Developed **multi-modal fusion strategies** combining visual features with metadata, achieving robust recognition across heterogeneous sensor modalities directly applicable to computational photography, camera metadata utilization, and mobile imaging systems.

Generative Modeling

- Led research in **generative modeling and domain adaptation techniques** using CycleGAN, diffusion models, and adversarial augmentation for **photorealistic image synthesis** and cross-domain style transfer.
- Generated large-scale **photorealistic synthetic datasets (1M+ samples)** for training segmentation, denoising, and recognition models demonstrating **synthetic-to-real transfer** capabilities - directly applicable to camera simulation, data augmentation, and imaging algorithm validation in real-world products.

Large-Scale Deep Learning Systems

- Designed and trained production systems using **PyTorch DDP and FSDP** on **10M+ sample datasets**, enabling efficient multi-GPU training on high-resolution imagery for training latent finger recognition models, suitable for real-time and near-real-time imaging applications.
- Delivered **4 DL modules for production** : segmentation, denoising, pose alignment, and feature extraction for Thales multi-modal (Fingerprint, Iris, Face) biometric SDK.
- Built distributed training pipeline with experiment tracking, model validation, demonstrating ability to bridge research innovation with production delivery.

Model Optimization & Deployment

- Optimized models with **ONNX and OpenVINO**, achieving low-latency CPU inference through graph simplification, operator fusion, and hardware-aware quantization critical for edge deployment in embodied AI.
- Designed **embedding-level, score-level, and rank-level fusion** strategies to ensemble multiple models, improving robustness across heterogeneous systems.
- Developed high-performance classical image processing pipelines including **dense correspondence, and geometric alignment** for CPU-bound environments.

Research Innovation & Impact

- Contributed to **7–9 invention disclosures** including 4 under internal review, 4 trade secrets, and 1 patent filed, demonstrating consistent research innovation.
- Published in top-tier venues including **IEEE T-BIOM**, **IEEE Sensors** with work spanning multiple domains demonstrating adaptability and research breadth.

Research Assistant | Clarkson University, CoSiNe Lab, Potsdam, NY *Jan 2019–Aug 2021*

- Designed novel approaches to mitigate **demographic bias in face recognition** across **1M+ images**, addressing fairness and robustness in open-world perception systems.
- Developed **multi-modal learning pipeline** combining visual features with behavioral data (keystroke dynamics), achieving **98.87% classification accuracy**; published in **IEEE T-BIOM**.
- Designed **data-driven localization algorithms** for biomedical and environmental applications, demonstrating **cross-domain research adaptability**; published in **IEEE Sensors Journal**.

Research Data Scientist Intern | Potsdam Sensors, Potsdam, NY *May 2020–Aug 2020*

- Built data-driven spatial modeling and **localization algorithms** for real-time sensor data analysis.
- Designed systems for handling **temporal dynamics and spatial reasoning** in complex environments.

EDUCATION

Ph.D., Electrical and Computer Engineering | Clarkson University, Potsdam, NY *2017–2021*
GPA: 4.0/4.0 | Focus: Computer Vision, Machine Learning, Multi-Modal Perception

M.S., Process Control Engineering | NIT Tiruchirappalli, India *2013–2015*
GPA: 9.2/10.0

B.S., Electrical and Electronics Engineering | Biju Patnaik University of Technology, India *2008–2012*
GPA: 8.77/10.0

TECHNICAL SKILLS

Programming & Frameworks: PyTorch (DDP, FSDP), Python, C++, MATLAB, TensorFlow, Keras
ML/CV Libraries: OpenCV, ONNX, OpenVINO, NumPy, Pandas, SciPy, scikit-learn, DLIB, Albumentations
ML/DL Expertise: *Computer Vision:* Image segmentation, object detection, pose estimation, image synthesis, feature extraction, dense correspondence, optical flow • *Deep Learning:* CNNs, Vision Transformers (ViT), Attention mechanisms, Diffusion models, GANs (CycleGAN, StyleGAN), neural rendering • *Multi-Modal Learning:* cross-modal fusion, sensor fusion, multi-task learning • *Domain Adaptation:* Cross-sensor generalization, adversarial training, sim-to-real transfer, synthetic data generation, open-set recognition • *Model Optimization:* Knowledge distillation, quantization, pruning, ONNX/OpenVINO deployment • *Distributed Training:* PyTorch DDP, FSDP, mixed precision training, gradient accumulation
Classical ML: Dimensionality reduction (PCA, t-SNE, NCA), clustering (GMM, DBSCAN), ensemble methods
Tools: Docker, LaTeX, Git, Weights & Biases, TensorBoard

SELECTED PUBLICATIONS & RESEARCH IMPACT

Multi-Modal Learning & Domain Adaptation:

1. **Sahu, C.**, M. Banavar, S. Schuckers, "A novel non linear transformation based multi user classification algorithm for fixed text keystroke behavioral dynamics," *IEEE Transactions on Biometrics, Behavior, and Identity Science (T-BIOM)*, 2022.

Cross-Domain Perception & Localization:

2. **Sahu, C.**, M. Banavar, J. Sun, "Data-driven Source Localization in Complex and Nonlinear Signal Dynamics," *IEEE Sensors Journal*, 2024.
3. **Sahu, C.**, V. Kirubakaran, T. K. Radhakrishnan, N. Sivakumaran, "Explicit model predictive control of split-type air conditioning system," *Transactions of the Institute of Measurement and Control*, vol. 39, no. 5, pp. 754–762, 2017.

Conference Presentations: 10+ presentations at IEEE conferences including Asilomar (2019–2023), IEEE FIE (2021), IWBF (2021), demonstrating active engagement with research community
Research Breadth: Published across 4+ domains (biometrics, localization, biomedical, environmental), demonstrating adaptability and ability to quickly master new research areas

HONORS & AWARDS

- **NIST IREX-10 #1 Global Ranking** (single-eye iris recognition), outperforming systems from other international competitors, 2023
- **Best Poster Presentation** (Computational Methods, Graduate), Clarkson University, 2019
- **Session Chair**, "Applications of Deep Learning I," Asilomar Conference on Signals, Systems and Computers, 2020
- **MHRD Scholarship** for M.S. studies, Government of India

PROFESSIONAL SERVICE

Program Committee & Reviewer: ACM FAccT (2023) | CVPR PBVS Workshop (2023, 2024) | IEEE ICME (2023) | IWBF (2023) | IEEE ICIP (2023) | IJCB (2023, 2024, 2025) | IEEE T-Biom | IEEE Access | Pattern Recognition | IEEE IoT