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Contact Details

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Research Interests

- LLMs (Generation and Evaluation)
- VLMs (Multimodal Learning)
- Large-scale Image Analytics
- Image Classification & Segmentation
- Detection and Gesture Recognition
- Time-series Forecasting
- Deep Learning Optimization

Research Domain

- Computer Vision
- Biomedical AI and Medical Imaging
- Multimodal and Generative AI
- Cloud and Distributed Computing

Selected Research Publications

- MICCAI 2026
- CVPR 2026
- NeurIPS 2025
- Expert Systems with Apps. 2024
- ACM Computing Surveys 2023

Professional Memberships

- IEEE – Senior Member
- ACM

Technical Skills

Generative AI

◇ Architectures: Transformers, LLMs, Attention Mechanisms, Multimodal Learning
◇ LLM Systems: RAG, LangChain, Vector Databases (ChromaDB)
◇ Model Optimization: LoRA Fine-tuning, Knowledge Distillation, Quantization
◇ Training Paradigms: Self-supervised Learning, Pretraining, Fine-tuning

Computer Vision

◇ Image Classification: Vision Transformers (ViT) and Multiple Instance Learning
◇ Object Detection: YOLO, DETR (Detection Transformer)
◇ Image Segmentation: U-Net, nnU-Net, SegFormer, Segment Anything Model
◇ Gesture Recognition: MediaPipe, Gesture-to-Audio Mapping
◇ Annotation Tools: QuPath, Roboflow, LabelMG

MLOps & Data Engineering

◇ Lifecycle: MLflow, Experiment Tracking, Model Versioning
◇ Inference & Deployment: vLLM, Streamlit Prototyping, Docker Containerization
◇ Infrastructure: GPU Cluster Management with Slurm, Linux Administration (Ubuntu)
◇ Distributed Systems: Hadoop, Apache Spark, Apache Kafka
◇ Databases: NoSQL Databases (MongoDB, Cassandra), Vector Stores (ChromaDB)

Cloud & DevOps

◇ Platforms: AWS, Google Cloud Platform (GCP), OpenStack
◇ Virtualization: KVM, VirtualBox, Docker
◇ CI/CD: GitHub Actions, Git Version Control

Programming: Python, Groovy Script; working knowledge of C and Java
Frameworks: PyTorch, PyTorch Lightning, TensorFlow

Hands-on Experience

- Designed end-to-end digital pathology pipelines for artifact filtering, tissue mask generation, classification, survival prognostication, and tissue segmentation.
- Developed visualization frameworks for WSI-level predictions, tile-level attention maps, and interpretability in attention-based MIL models.
- Fine-tuned medical multimodal models, including CLIP, Qwen, and Meditron, for medical image analysis, clinical feature extraction, and report generation.
- Fine-tuned pathology foundation models, including UNI, CONCH, Virchow, Prov-GigaPath, PLIP, and CTransPath, for tile-level and WSI-level pathology tasks.
- Applied segmentation models, including nnU-Net and SegFormer, for tissue segmentation and augmentation under limited-data settings.
- Developed a semi-automated framework (DeepCluster++) to generate large-scale tile-level dataset (STARC-9) to support benchmarking and reproducibility.
- Designed optimization and activation-function enhancements to improve deep learning convergence and prediction under data-constrained settings.
- Built applied computer vision systems for manufacturing defect detection and face anti-spoofing using YOLO and FFT-based feature analysis.
- Developed a real-time gesture-driven music generation system using MediaPipe and causal convolution for gesture-to-audio mapping.
- Orchestrated GPU workloads using Slurm and managed multi-user GPU servers and NAS systems for large-scale medical image analysis.
- Deployed OpenStack-based virtual clusters and Hadoop/Spark environments for large-scale data processing.
- Applied meta-heuristic optimization methods, including ACO, GA, and PSO, to solve discrete and continuous optimization problems.

Employment History

Post-Doctoral Scholar **10/2024 – Present**
◇ Stanford University, California, USA.

Post-Doctoral Fellow **08/2023 – 10/2024**
◇ University of Houston-Victoria, Texas, USA.

Post-Doctoral Associate **03/2021 – 08/2023**
◇ Kyungpook National University, Daegu, South Korea.

Research Scientist and Corporate Trainer **09/2019 – 08/2020**
◇ Duratech Solutions, Coimbatore, India.

Education

Ph.D. in Information Technology **2015 – 2020**
◇ National Institute of Technology Karnataka, India.

Research Projects Involved

◇ AI-based Histopathology **2024 – Present**
◇ AI-Driven Climate Risk Assessment at the Hanford Site **2023 – 2024**
◇ Optimizer Enhancements for Deep Neural Networks **2022 – 2023**
◇ Automated Fabric Defect Detection and Visualization **2022 – 2023**
◇ Real-time fault detection in fused deposition modelling **2022 – 2022**
◇ Gesture recognition system for sign language and music generation **2022 – 2023**
◇ Korean handwritten text recognition **2021 – 2022**
◇ Small object detection in manufacturing and smart city **2021 – 2022**

Research Publications

Upcoming Research Submissions (3)

1. Rathinaraja Jeyaraj, et al., "MUFASA: An Information Utility-Aware Preprocessing Framework for Reliable Model Reasoning in Computational Pathology," in preparation for submission to Nature Biomedical Engineering.
2. Rathinaraja Jeyaraj, Barathi Subramanian, Anand Paul, et al., "HMS: Bounded Harmonic Mean Perturbations for Stabilizing SGD-Based Regression Optimization," in preparation for submission to AAAI 2027.
3. Barathi Subramanian, Rathinaraja Jeyaraj, Anand Paul, et al., "APALU: A Trainable, Adaptive Activation Function for Deep Learning Networks," in preparation for submission to Neurocomputing.

Journal Articles (top list)

1. Basil Kuriachen*, Rathinaraja Jeyaraj*, et al., "Defect Detection in Fused Deposition Modelling using Lightweight Convolutional Neural Networks," Engineering Applications of Artificial Intelligence, **2025**. *Equally contributed.
2. K. Gangadharan, A. Purandaran, K. Malathi, B. Subramanian, Rathinaraja Jeyaraj, and S. K. Jung, From Data to Decisions: The Power of Machine Learning in Business Recommendations, in IEEE Access, **2025**.
3. Rathinaraja Jeyaraj, Thirunavukarasu Balasubramaniam, et al., "DeepWalk with Reinforcement Learning (DWRL) for Node Embedding," Expert Systems with Applications, **2024**.

Conference Proceedings (top list)

1. Barathi Subramanian, Rathinaraja Jeyaraj, et. al., "TRIAGE-MIL: Multi-Axis Instance Selection and Semantic Hypergraph Modeling for Survival Prediction from Whole-Slide Images," accepted at MICCAI **2026**.
2. Rathinaraja Jeyaraj, Barathi Subramanian, Kapilya, et al., "Gesture2Music: A Low-Latency Real-Time Framework for Continuous Gesture-Driven Music Generation," 1st International Workshop on Interactive Physical AI (IPA), CVPR **2026**.
3. Barathi Subramanian, Rathinaraja Jeyaraj, Anand Paul, "Contrast-Enhanced Gating in GRUs for Robust Low-Data Sequence Learning," Workshop on Women in Computer Vision Proceedings Track, CVPR **2026**.
4. Barathi Subramanian*, Rathinaraja Jeyaraj*, et al., "STARC-9: A Large-scale Dataset for Multi-Class Tissue Classification for CRC Histopathology," NeurIPS **2025**. *Equally contributed
5. Rathinaraja Jeyaraj, Barathi Subramaniam, Karnam Yogesh, et al., "YSAF: Yolo with Spatial Attention and FFT to Detect Face Spoofing Attacks," IEEE 3rd International Conference on AI in Cybersecurity (ICAIC), **2024**.