Rathinaraja Jeyaraj

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Computer Vision, LLMs, Multimodal, Healthcare AI, and Distributed Systems

Education

Ph.D. in Information Technology, National Institute of Technology Karnataka, Mangalore, India. 07/2015–08/2019

Experience

Post-Doctoral Scholar, Stanford University, California, USA. 10/2024–10/2026

- Developed end-to-end computational pathology workflows for whole-slide image preprocessing, artifact-aware quality control, tissue classification, segmentation, biomarker modeling, and model evaluation.
- Worked on pathology-specific RAG pipelines using PathologyBERT and ChromaDB, integrating Grounding DINO, SAM2, and CONCH for language-guided tumor annotation and morphology-aware histopathology sample selection.
- Built and evaluated multimodal and pathology foundation-model workflows for image-text analysis, feature extraction, and downstream prediction; developed patch- and cell-level methods for signet-ring cell analysis.
- Managed dedicated lab GPU servers with NVIDIA L40S and RTX PRO 6000 Blackwell GPUs, including Slurm scheduling, resource allocation, workload monitoring, user support, and troubleshooting for shared AI workloads.
- Developed a 3D visualization integrating MRI, ultrasound, DICOM, STL meshes, and biopsy-track data for image-guided clinical research.

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

- Developed LSTM, GRU, attention, and Transformer models for long-horizon groundwater contamination forecasting, with systematic benchmarking and error analysis.
- Applied GAN and diffusion-based methods for synthetic sequence generation and missing-data imputation; built reproducible Python-based training and evaluation workflows.

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

- Modified optimizers and activation functions to accelerate SGD/Adam convergence; integrated them into PyTorch.
- Developed theoretical proofs, ran ablation studies, and provisioned a distributed GPU cluster for experiments.
- Developed autoencoder-based anomaly localization for fabric defect detection and localization.
- Gesture Recognition: Modified GRU model for real-time sign-language recognition and gesture-driven music generation.
- 3D Printing Fault Detection: CNN-based real-time classification of fused deposition modelling defects (staircase, overfill, void).
- Korean Handwriting OCR: HOG-based preprocessing and Bi-LSTM transcription, evaluated by character error rate.
- Smart City Object Detection: Benchmarked detectors for illegal parking in accessible spaces and misplaced objects.

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

- Developed distributed ML and deep learning solutions using MapReduce and Spark on GPU clusters, with scalable NoSQL storage in HBase and Cassandra; led technical training for professional audiences.

Featured Publications

• lead/equal author ○ co-author

Peer-Reviewed

- Gesture2Music: A Low-Latency Real-Time Framework for Continuous Gesture-Driven Music Generation, **CVPR 2026**.
- ○ Contrast-Enhanced Gating in GRUs for Robust Low-Data Sequence Learning, **CVPR 2026**.
- ○ TRIAGE-MIL: Multi-Axis Instance Selection and Semantic Hypergraph Modeling for Survival Prediction from WSIs, **MICCAI 2026**.
- Defect Detection in Fused Deposition Modelling using Lightweight Convolutional Neural Networks, **EAAI (ScienceDirect) 2025**.
- STARC-9: A Large-scale Dataset for Multi-Class Tissue Classification for CRC Histopathology, **NeurIPS 2025**.
- ○ From Data to Decisions: The Power of Machine Learning in Business Recommendations, **IEEE Access 2025**.
- DeepWalk with Reinforcement Learning (DWRL) for Node Embedding, **Expert Systems with Applications (ScienceDirect) 2024**.
- YSAF: Yolo with Spatial Attention and FFT to Detect Face Spoofing Attacks, **IEEE ICAIC 2024**.

Current/Upcoming Research Submissions

- MUFASA: An Information Utility-Aware Preprocessing for Reliable Model Reasoning in Computational Pathology, **Nature Communications**.
- HMS: Bounded Harmonic Mean Perturbations for Stabilizing SGD-Based Regression Optimization, **CVPR 2027**.
- ○ Real-Time Vision-Based System for Continuous Gesture-Controlled Music Generation, **CHI 2027**.
- ○ APALU: A Trainable, Adaptive Activation Function for Deep Learning Networks, **Neurocomputing**.
- A Decision-Support Application for Signet Ring Cell Carcinoma Detection in Whole-Slide Images, in preparation to submit.
- ○ An Advanced Deep Learning Approach Combining Long-and Short-term Memory (LSTM) and Graph Convolutional Networks (GCN) to Predict Groundwater Hexavalent Chromium Concentrations, in preparation to submit.

Technical Skills

AI/ML: Deep Learning, Computer Vision, Multimodal AI, Foundation Models, LLMs, RAG, Generative AI, Representation Learning, Transformers
Modeling: Classification, Segmentation, Detection, Time-Series Forecasting, GANs, Model Evaluation, Ablations, Error/Failure Analysis
Engineering: Python, PyTorch, TensorFlow, OpenCV, MLflow, Docker, Linux, Slurm, Git/GitHub Actions, Streamlit, vLLM
Data/Infra: NVIDIA GPU systems, AWS, GCP, OpenStack, Spark, Hadoop, Kafka, MongoDB, Cassandra; working knowledge of C, Java, Groovy