Ajaykrishnan Selucca Muralidharan

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Summary

Researcher in **Operations & Maintenance Engineering** with a focus on applying **machine learning and statistical modeling** to railway condition monitoring. Current work involves developing analytical frameworks for **wayside detectors** (WILD, HBD/HWD), anomaly and drift detection, and cross-sensor calibration using **fiber-optic sensing (DAS)**. Combines a strong foundation in AI and data-driven methods with an interest in building interpretable, context-aware solutions for predictive maintenance. Previous experience includes designing large-scale recommendation systems and machine learning applications on cloud-based environments.

Work Experience

PhD Researcher — Luleå University of Technology (LTU) May 2024 — Present

- **Research Focus:** Machine learning and statistical modeling of railway wayside detectors including WILD, HBD/HWD, and Distributed Acoustic Sensing (DAS).
- **WILD Detector Analytics:** Designed a robust data pipeline for analyzing detector signal quality, context-aware normalization, quantile-based scoring, and unsupervised anomaly detection. Visualized reliability metrics and trends via dashboards.
- **HBD/HWD Detector Modeling:** Developed workflows for thermal event normalization, anomaly detection, and adaptive thresholding based on regression and contextual attribution.
- **Fiber-Optic Sensing Integration:** Exploring DAS signal alignment with WILD events for improved calibration and real-time tracking. Built scalable processing workflows and exploratory monitoring tools.
- **Tools:** Scikit-learn, Statsmodels, Pandera, Docker, GitHub CI, XGBoost.

Junior Associate — Primesoft Enterprise IT Services Aug 2022 — May 2024

- **Content-Based Movie Recommendation System:** Designed and deployed a scalable Flask-based recommendation engine for OTT clients using movie metadata sourced from Snowflake and BigQuery. Implemented models ranging from traditional Cosine Similarity to advanced BERT-based embeddings for "More-Like-This" recommendations. Solutions were client-adaptive, supporting multiple backend systems (BigQuery, Snowflake, Couchbase) with modular Python code packaged into Docker containers and deployed via GCP Cloud Run and GKE.
- **Churn Prediction PoC:** Developed a machine learning pipeline to identify users likely to churn based on activity data. Clustered users and predicted churn likelihood on a monthly basis to inform discount strategies and upselling efforts.
- **Advanced Genre Categorization PoC:** Addressed limitations of traditional genre tagging in Indian cinema by applying SpaCy NER models to subtitle text. Enhanced genre diversity and contextual tagging for improved personalization in recommendation systems.
- **Segment Generator PoC:** Engineered a model to identify high-engagement segments of movies from user interaction data. Proposed these segments as potential shorts/snippets on user dashboards for enhanced content engagement.
- **Hybrid Personalized Recommendation System (Production):** Built a hybrid "Because You Watched" recommendation engine integrating content-based and collaborative filtering approaches. Developed as a scalable Flask API, it served real-time recommendations using data from Couchbase and Google Datastore.
- **Personalized Dashboard Ranking PoC:** Developed a lightweight alternative to Netflix's Bandit

algorithm using unsupervised clustering of user watch histories. Generated row-wise (e.g., "Trending Now," "Because You Watched") and item-wise rankings tailored to each user segment to personalize dashboard layout.

– **Video-Based Genre Tagging PoC:** Leveraged LlAVA models for scene-level video captioning to infer genre tags in metadata-deficient films. Used output text in SpaCy NER pipelines to generate genre labels, filling gaps in legacy movie catalogs.

Intern — Applied Materials India Jul 2021 — Dec 2021

– Developed stabilization detection models using sensor-based time-series learning in semiconductor tools.

Education

2024 — Present PhD, **Operations & Maintenance Engineering**, Luleå University of Technology (Sweden)

2020 — 2022 M.Tech., **Artificial Intelligence**, Amrita Vishwa Vidyapeetham (India). *Thesis: Real-Time Health Monitoring of Bolted Joints in Machines using Predictive Analytics.*

2018 — 2019 B.E., **Electronics & Communication Engineering**, St. Peter's Institute of Higher Education & Research (India)

Publications

– *Investigating the Quality of Wheel Impact Load Detector Data for Building Predictive Maintenance Strategies: A Visualization and Statistical Approach.* In Proceedings of the **IAI 2025 Conference**, Sweden. (Proceedings to be published on December 2025.)

– *Statistical Analysis of Hot-Box and Hot-Wheel Detector Data for Context-Aware Rolling Stock Monitoring.* Submitted to the **Transport Research Arena (TRA) 2026 Conference**.

– *M.Tech. Thesis (2022):* Real-Time Health Monitoring of Bolted Joints in Machines using Predictive Analytics.

Certifications

Apr 2022 **Microsoft Certified: Azure AI Fundamentals (AI-900)** — Credential Link

Nov 2024 **Neo4j Certified Professional** — Credential Link

Skills

Machine Learning	Anomaly Detection, Clustering, Regression, Feature Engineering, Model Evaluation (Precision–Recall, ROC)
Statistical Methods	Descriptive and Inferential Statistics, Time-Series Modeling, Distribution Fitting, Uncertainty and Drift Analysis
Programming	Python (NumPy, Pandas, Scikit-learn, PyTorch, Statsmodels), SQL, PySpark for large-scale data handling
Data Analysis	Sensor Data Processing, Signal Interpretation, Context-Aware Modeling, Visualization and Pattern Exploration
Research Practices	Reproducible Notebooks, Version Control (Git), Docker-based Experiments, Structured Documentation
Computing Platforms	Google Cloud Platform (BigQuery, Cloud Run, GKE), Snowflake, Local HPC / Linux Environments
Visualization	Matplotlib, Plotly, Seaborn, and LaTeX-ready scientific figures for publication
Collaboration	Academic Writing, Literature Review, Cross-disciplinary Communication, Project Coordination