Arthur Cancellieri Pires

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Professional Summary

- AI research lead focused on predictive maintenance from sensor time-series, with 5+ years building ML pipelines and deep learning models for anomaly detection in condition monitoring applications.
- Experienced in Python + PyTorch and data workflows at scale (30k+ windows/day), translating model outputs into diagnostic tools used by maintenance teams.

Work Experience

- **Railway Laboratory (Lafer)** On-site
  AI Research Lead (PhD Candidate) – VALE partnership *January 2022 - Present*
  - **ML Pipeline:** Designed and operated a daily pipeline to ingest raw instrumented railway vehicle (IRV) data, engineer features, and generate model-ready windows for sensor-fault and track-defect detection (30k+ windows/day); maintained the codebase in Git and reviewed outputs with maintenance engineers.
  - **Sensor Defect Detection:** Developed deep learning models and batch checks to detect sensor faults and data-quality anomalies, achieving 91% precision on internally labeled events and reducing data-issue detection latency from 3 months (manual review) to 1 day; tuned and compared model variants via Optuna studies.
  - **Track Defect Detection:** Built transformer-based reconstruction models and a repeatability metric that converts residuals into calibrated anomaly probabilities to score repeatable, location-level defect candidates with sparse ground truth.
  - **Model Diagnostics (Weak Labels):** Built a diagnostic workflow using weak labels (data-quality score) and latent-space analysis to interpret anomaly clusters, linking them to specific sensors/channels and response signatures to support maintenance investigation.
  - **Technical Leadership:** Served as the technical lead for VALE's predictive maintenance program using IRVs, defining research priorities, translating stakeholder needs into ML research topics, and coordinating technical execution across a 15-person team (undergraduate, Master's, and PhD).
- **Railway Laboratory (Lafer)** On-site
  AI Researcher (M.Sc. program) – VALE partnership *June 2020 - January 2022*
  - **Supervised Learning (Regression):** Developed deep learning models to estimate vertical track geometry from IRV data, achieving 98% R^2.
  - **Optimization (Genetic Algorithms):** Developed a wheel–rail profile optimization methodology using IRV data and genetic algorithms; field-tested a wear-optimized profile, reducing wear by 20% while maintaining fatigue performance and improving the L/V ratio by ∼35%.
  - **Data Analysis / Decision Support:** Analyzed wheel reprofiling limits and recommended changing the EFVM threshold from 3 mm to 2 mm based on the wheel-profile optimization study, increasing projected wheel life by at least 29% (current profile) and 50% (proposed); recommendation adopted.
  - **Technical Leadership:** Acted as the technical lead for the AI research group, mentoring 5 junior researchers and coordinating ML experiments and data analysis on IRV datasets across multidisciplinary teams from two universities.

Projects

- **Model Deployment Demo: Time-Series Anomaly Inference Service** GitHub
  FastAPI + Docker (personal project) *2025*
  - **Serving API:** Implemented a FastAPI service for time-series anomaly inference with input validation, model versioning, and JSON responses.
  - **Deployment:** Containerized the service with Docker and documented local + container runs (docker build/run or docker compose) with example requests.
  - **Results + Reproducibility:** Included an anonymized sample dataset and a reproducible evaluation script/notebook; reported baseline metrics and example outputs in the README.

Skills Summary

- **Programming** Python, SQL, MATLAB
- **Frameworks** PyTorch, PyTorch Lightning, scikit-learn, Optuna, pandas, NumPy, SciPy
- **Tools** Git, PostgreSQL, MySQL, SQLite
- **ML Domains** Time-series modeling, anomaly detection, predictive maintenance
- **Languages** Portuguese (Native), English (Fluent)

Education

- **State University of Campinas (UNICAMP)** Campinas, Brazil
  PhD in Mechanical Engineering *Expected February 2026*
  Research focus *Deep-learning-based track defect detection for railway condition monitoring using instrumented railway vehicle data*
- **State University of Campinas (UNICAMP)** Campinas, Brazil
  Master's in Mechanical Engineering *Jan 2022*
  Research focus *Deep-learning-based estimation of vertical track geometry from instrumented railway vehicle data*
- **Federal University of Espírito Santo (UFES)** Vitória, Brazil
  Bachelor's Degree in Mechanical Engineering *May 2020*
  Research focus *Machine-learning-based prediction of wheel–rail L/V ratio to assess margin to Nadal's derailment criterion*