Automated data analysis for HV batteries with KNIME

Maximilian Mücke (Deutsche ACCUmotive) and Patryk Koryzna (DATATRONIQ)
Agenda

1. Speakers
2. Challenge
3. Initial Solution
4. Current Solution
5. Future Plans
Maximilian Mücke – ACCUmotive

• Cluster leader for data analysis at ACCUmotive
• Make testing data more accessible to his team
• Responsible for developing the teams software environment
• Currently pursuing Master’s degree in Business Analytics at Ulm University
Deutsche ACCUMOTIVE GmbH & Co. KG

• A Daimler Company
• Advanced Lithium-Ion Batteries
• Research & development based in Kirchheim unter Teck/Nabern
• Production based in Kamenz
Patryk Koryzna – Datatroniq

• Senior Software Engineer at Datatroniq
• Responsible for data processing pipelines
• Also maintainer of KNIME DSP community nodes
In complex shop floor environments relevant data is not integrated and still locked away.

- To identify *unknown patterns* all relevant data sources need to be unlocked and correlated.
- However - with every new data source the number of combinations is *growing exponentially*.
- That’s where *Machine Learning* comes into play.
DATATRONIQ synchronizes industry data for superior machine learning applications

By applying
• Anomaly Detection
• Root-Cause Analysis
• Predictive Analytics
we create value services for
• Increased Performance
• Improved Availability
• Higher Quality
• Reduced Costs
DATATRONIQ – Value Proposition

Condition Monitoring & Predictive Maintenance

Shop Floor Intelligence (OEE)

Real-time Analytics & ML

Quality Control & Continuous Process Improvement

Industrial Security & Intrusion Detection
Overview and interplay with KNIME

Access to DATATRONIQ’s Industrial Data Universe
- Raw & sampled signals
- PLC data
- Anomaly vectors
- Compressed signal features
- …
USPs

- Plug’n’play
- Scalability
- Actionable Insights

- Quick ROI
- Ease of Use
- Self-service

- Higher Availability
- Better Performance
- Higher Quality
- Reduced Costs
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Challenge

• Analysis of endurance and performance tests of HV Batteries
  • Endurance qualification under real world conditions
  • Testbed to simulate accelerated aging of equipment

• Lots of data, multiple GB per hour
  • Up to 2 weeks until the data is accessible

• Custom, in-house developed analysis methodology
  • Proprietary algorithms & intellectual property
  • Implemented on C/C++, user interface = programming API

→ Make those tools and algorithms more easily available to engineering team w/ no/little coding/programming experience
→ Automate the analyzation process
Use KNIME to orchestrate analytics workflow

- Encoding of domain knowledge
  - KNIME Workflow = process documentation
- KNIME Server
  - Proven, reliable workflow manager
  - Web Portal for “customer” self-service; mostly reporting
- Intuitive, visual interface
  - Quickly explore ideas w/ additional metrics from raw data
  - Help manage complexity
- Scalability
- Combine different tools
- Democratize access to library of proprietary algorithms
  - familiar KNIME node instead of API-only C++ access
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Initial Solution – KNIME node development

• Student project, proof-of-concept
• Inconsistent reliability
• (Very) limited parallelism
• Based on Java Native Interface
  • Tight, deep integration, needs C++-Header files, compilation steps
• Shared memory between C/C++ library and Java VM
  • Good for performance/large data
  • Requires lots of effort to get stable and robust
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Group of Nodes for AWP (“Auswerteplattform”)

• Create AWP Server – AWP Reader – Destroy AWP Server
• Inspired by KNIME Big Data: Create/Use/Destroy Spark
Easy to use with KNIME Loops

• Simple, yet effective workload manager
• Parallelize work; expose (meta-)data for flow control
• Expose status and progress data
  • Facilitate loop control: retry, skip
  • Reporting for long running workflows - some scenarios run up to 48 hrs
STDIO binary protocol instead of Java Native Interface (JNI)

• More robust, versatile
• Well suited for small chunks of data
Live demo
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Future Plans

• Replace custom binary protocol between AWP C++ library and Java wrapper with Google Protobuffers
• Improve current measurement data management
  • Currently flat files organized by naming convention
  • Based on semantics, flexible database management system
• Improve performance
  • One big machine or several medium sized machines
  • Master/slave principle like in a Hadoop cluster
• MDF reader node
Contact

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