BRAINE Use Case 3: Motif Discovery & Digital Twins for Industry 4.0

Objectives

- Advanced time-series analysis of manufacturing data online and on-premises of manufacturers in the scope of Industry 4.0.
- Automate non-intrusive Overall Equipment Efficiency (OEE) and evaluation of non-trivial equipment operations.

Requirements

- On-prem independent Edge – data must remain completely under control of customer.
- High compute performance required because the **advanced analytics** behavioural models that claim a significant amount of **computing resources**.
- Deviation detections have to be reported in **real time**, requiring low latency.
- Behavioural models carry extracted knowledge about manufacturing processes. This is sensitive data that must be adequately protected.
- For scaling the detection models, the BRAINE cluster may be physically distributed across the plant to minimize latency of collected data and consequent deviation detections.

Implementation

- Novel Motif Discovery algorithm for automated training data preparation.
- Digital Twin of production processes running locally and on a hybrid cloud
- Advanced behavioural models build on highly parallelizable PyTorch framework using Gaussian Processes as the model class of operations. This stochastic modelling approach natively yields prediction certainty claims justifying the reliability of the predictions as a whole.
- All the models are run on the BRAINE platform as a distributed application that utilizes the raw computing power of BRAINE EMDCs while remaining energetically efficient. The security of sensitive data is guaranteed within the data policy manager and the novel workload-scheduler assures optimal load balancing and the Service Level Agreement (SLA) Broker assures the required latencies of the EMDCs to the data sources.

Impact

- Automated training set preparation for operation detection.
- Advanced behavioural models of operations with detection certainty estimates.
- Scalability of detection models and their trainers in BRAINE cluster.
- MOD tool allows for easier and more focused troubleshooting of current and new manufacturing processes.
- Overview of key performance metrics (e.g. OEE) of the shopfloor in real time.
- **MOD Application** as a manufacturing supervision and analytical tool.