Graz University of Technology
Institute of Technical Informatics
Cognitive Products

Explaining Degradation of Machinery with Causal Analytics

Image created by AI (Copilot Designer)

In contemporary manufacturing environments, mechanical degradation poses a significant challenge, impacting product quality and process efficiency. Addressing this challenge necessitates a nuanced understanding of dynamic production processes and the ability to detect subtle changes indicative of degradation. This master's thesis aims to delve into methodologies for monitoring dynamic manufacturing processes, particularly those sensitive to degradation such as equipment reliability, with a focus on leveraging causal discovery techniques.

The core objective of this research is to develop robust mechanisms for identifying potential issues within dynamic manufacturing processes by analyzing changes in causal relationships over time. To achieve this, a comprehensive exploration of established causal discovery methods will be undertaken, supplemented by the application of these techniques to real industry data as well as open-source datasets. By rigorously testing the efficacy of causal discovery in monitoring degradation, this thesis seeks to provide actionable insights for enhancing process reliability and quality control.

A central aspect of this work involves a comparative analysis with contemporary methods, notably LSTM-based autoencoders, which have gained traction but lack interpretability. By comparing the results of the causal analysis with these approaches, this work aims to emphasize the advantages and validity of the proposed methodology.

Ultimately, the findings of this master thesis are poised to make significant contributions to the ongoing evolution of process optimization and quality assurance practices within manufacturing contexts. By highlighting the benefits of causal detection in recognizing and mitigating mechanical degradation, this thesis seeks to support strategic decision making and promote continuous improvement of production processes.

Goal and Tasks:

- Conduct a comparative study of methods for causal analytics.
- Writing a scientific master thesis (including related work/background and evaluation).
- Defending the master thesis in a final presentation.

Recommended Prior Knowledge:

- Experience with Data Analysis
- Programming in Python/Pandas
- Experience with LSTM-based autoencoders
- Experience with Predictive Maintenance, Anomaly Detection, Degradation Processes

Start: a.s.a.p.

Duration in months: 12 months

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