

Master's, Bachelor's and Project Theses in the Field of: **AI-Assisted Root Cause Analysis in Process Plants**

Topic Description

In automated process plants, the first alarm is often only a symptom of an upstream disturbance. Causes can propagate through material connections such as pipes, through energy flows such as heat exchangers or heating/cooling circuits, and through information connections such as sensors, controllers and control-system logic.

Alarm histories, process trends, P&IDs, operating instructions, shift logs and maintenance notes provide complementary evidence. This topic investigates AI-assisted Root Cause Analysis (RCA) that combines data-driven models with structured process knowledge and, where useful, Large Language Models.



Research Tasks

Possible theses focus on clearly defined subtopics: extracting and making process information available from P&IDs, alarm databases or operating documentation, building semantic representations such as knowledge graphs or retrieval components, and linking them with alarm and process data.

Further directions include temporal pattern analysis, data-driven or causal RCA methods, graph-based or Bayesian inference, retrieval-augmented LLMs with process knowledge and benchmarks for simulated or available plant scenarios. Results should prioritize plausible causes, model and describe causal relationships and evidence, express and quantify uncertainty and make failure cases traceable.

- 1) **Process knowledge:** extract and structure information from diagrams, text or plant structures and link it with data.
- 2) **Cause hypotheses:** combine historical data, process knowledge and AI methods to prioritize plausible causes in a traceable way.

Requirements

- Interest in process automation, fault diagnosis and trustworthy AI
- Python skills; experience with ML, time series, LLMs or knowledge graphs is beneficial
- Experience with industrial data, technical documentation or process simulation would be beneficial

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Start

by arrangement