

Master's, Bachelor's and Project Theses in the Field of:

Robust AI for Industrial Applications

Topic Description

Industrial AI models have to make decisions based on data that are rarely ideal. In real plants, data-quality issues include noise, missing values, outliers, temporal shifts, wrong class labels, class imbalance, changed operating regimes, evolving processes and ageing or poorly calibrated sensors.

This topic investigates how robustness in industrial use cases can be measured, understood and improved systematically. Possible domains include process data, alarm logs, time series, image-based quality inspection, and multisensor measurements. Relevant aspects are performance degradation under disturbances, reliability of confidence values, explainability and limits of transfer.



Research Tasks

Possible theses develop realistic, partly synthetic data-quality disturbances for industrial domains, perform robustness analyses of different AI models, or study label noise, missing values, sensor noise, process drift and rare events in a systematic way.

Based on such analyses, robustness-improvement methods may be investigated, including augmentation, robust losses, ensembles, uncertainty quantification, conformal prediction, domain adaptation, feature regularization or XAI for diagnosing systematic errors. The concrete scope is adapted to prior knowledge, data availability and planned duration.

- 1) **Robustness measurement:** develop realistic disturbances and metrics for industrial data and compare AI models systematically.
- 2) **Robustness improvement:** implement mitigation strategies and analyze their effect on performance, calibration and failure cases.

Requirements

- Interest in trustworthy and robust machine learning and industrial data quality
- Python and ML experience; PyTorch or scikit-learn knowledge is beneficial
- Experience with industrial data, time-series/image data, evaluation or uncertainty methods is beneficial

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Start

by arrangement