VIVARIUM II

Visualization of Welding Data for Anomaly Detection

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MOTIVATION & GOALS

In automated welding, manual visual inspection remains essential to ensure product quality. To better support domain experts in **data-driven quality inspection**, we develop **ML-powered Visual Analytics** approaches that leverage **sensor** and **image** data collected during the welding process. Acting as an interface between domain experts and machine learning (ML), Visual Analytics enables a **human-centered approach** to exploring process time series and **detecting anomalies**. This results in actionable insights, improved quality control, and a unified **understanding** of the entire welding process.

Project FactBox

Project Name VIVARIUM II
Project ID MFP A.3
Duration 12 Months

Area 3
Area Analytics

Project Lead
DI Dr. Belgin Mutlu

APPROACH

In close collaboration with welding domain experts, we design a **Visual Analytics** prototype that combines a Python-based backend for **ML/DL methods** with a modern JavaScript frontend. The system integrates **multi-modal** data (i.e., sensor time series and weld images) and includes **guidance features** to highlight relevant patterns. It will be prototypically deployed at Fronius to ensure practical relevance and impact.

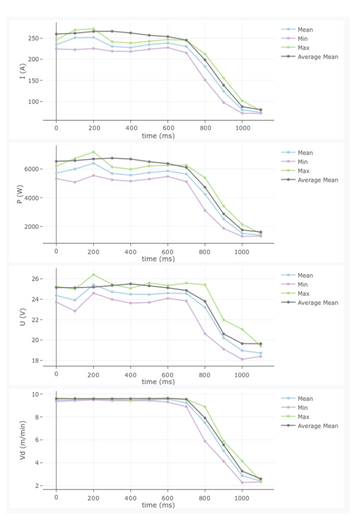
CONTRIBUTION

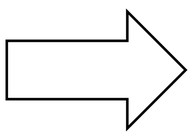
Scientific contribution
- Design and user studies for multimodal Visual Analytics
- Novel interaction and view tailored to the welding use case
- Prototype development

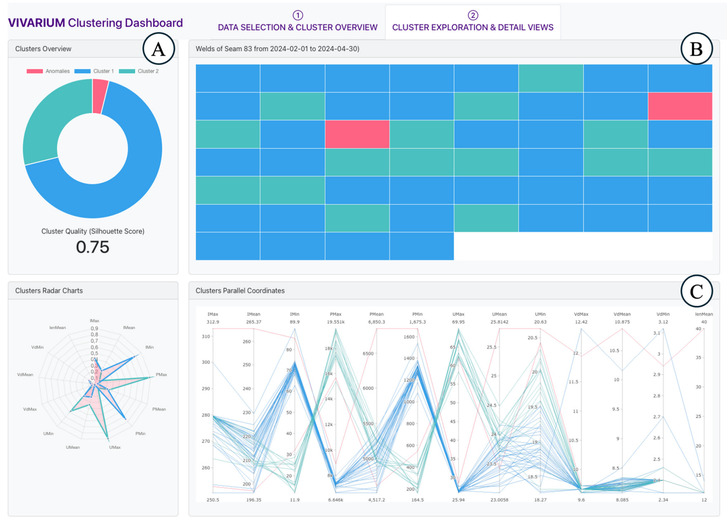
Economic contribution
- Lower manual inspection effort through data-driven quality analysis
- Streamline quality assurance workflows
- Optimize expert time usage, lowering operational costs

SYSTEM ARCHITECTURE

The system unifies **multi-modal welding data** within a backend that supports advanced analytics and **ML/DL**-based fusion. Through **interactive dashboards**, domain experts can intuitively explore **anomalies** and process dynamics, fostering **real-time insight** and **informed decision-making**.







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Acknowledgement: This work was supported by Pro²Future II (FFG, 911655) and Fronius International GmbH.