Chair of Computing in Civil and Building Engineering
TUM School of Engineering and Design
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Modeling:
Mathematics:
Programming:
Science:

Software Lab:

AI-Based Defect Detection in Extrusion-Based Additive Manufacturing

Description

Extrusion-based additive manufacturing generates rich process data that reflects the underlying material deposition behavior. Variations in material flow, motion, and execution often manifest as characteristic patterns in sensor signals, enabling data-driven defect detection.

This project focuses on ML-based analysis of a heterogeneous fabrication dataset, with an emphasis on load-cell time-series data acquired during printing. The provided dataset captures both fabrication inputs and printing behavior, as well as the target defect-related deviations. Figure 1 shows the experimental setup used to acquire the data, while Figure 2 presents an example of a manually annotated mass time series highlighting relevant patterns and anomalies.

The core objective of the project is the design, evaluation, and comparison of ML pipelines for defect detection in time-series data. As an extension, the trained ML model can be deployed for live monitoring and integrated into a Fabrication Information Modeling (FIM) [1] representation to register detected defects as semantic events.

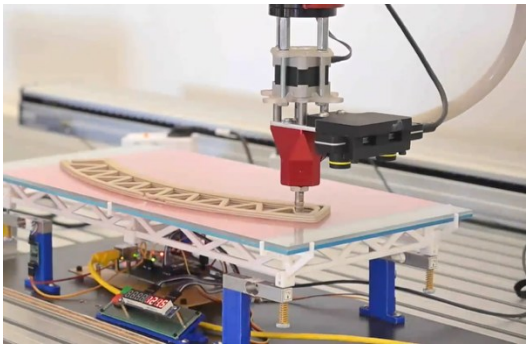

Figure 2: Clay 3D Printing on Loadcell Platform

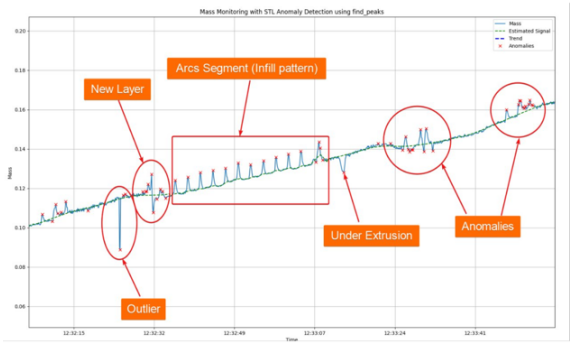

Figure 2: Manual Loadcell Time-Series Data Analysis

Tasks

- Design a data preparation strategy that transforms heterogeneous process information into ML-ready inputs.
- Develop and evaluate different machine-learning pipelines for time-series defect detection.
- Benchmark models and identify the most effective ML setup.
- Deploy the selected model for live defect detection and FIM event updates *(stretch goal)*.

Supervisor

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References

[1] Slepicka, M., Borrmann, A. (2024). *Fabrication Information Modeling for Closed-Loop Design and Quality Improvement in Additive Manufacturing*.