AI4Steel – Defect Detection Use Case

Enhancing Production and Logistics Efficiency in the Steel Industry Through Human-AI Collaboration

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MOTIVATION & GOALS

Surface-quality defects (i.e., OZE) in continuously cast slabs can trigger costly downstream treatment, including scarfing. This project investigates whether process and material data available during production can support the **early identification of OZE defects**. The project aims to deliver an **interpretable and operationally usable decision-support model** that works across casters and steel groups, addresses severe class imbalance, and makes the trade-off between precision, recall, and limited treatment capacity transparent.

Project FactBox

Project Name AI4Steel
Project ID MFP II A.1-2
Duration 48 Months

Area 3
Area Analytics

Project Lead
DI Dr. Belgin Mutlu

APPROACH

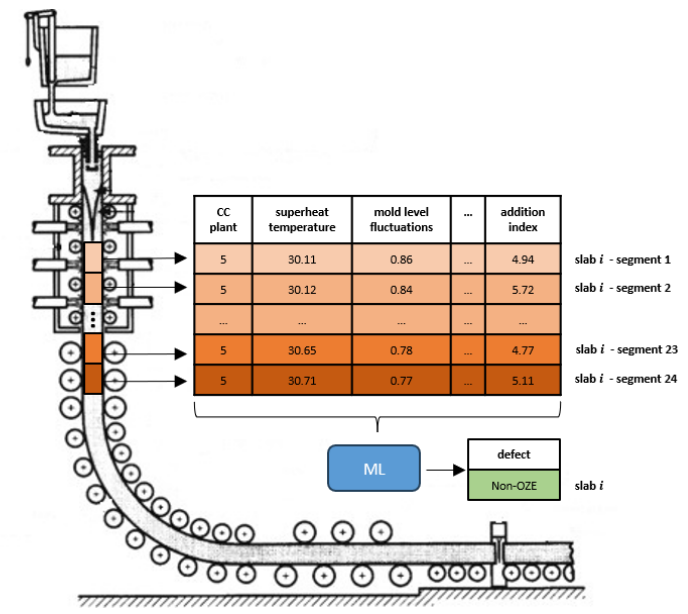
- The use case combines slab-level process characteristics with segment-level casting signals to develop an **explainable predictive model** for early OZE defect identification.
- **Exploratory data analysis** investigates the impact of caster type, steel group, scarfing practice, quality requirements, and slab thickness on OZE defect occurrence.
- A range of **interpretable machine learning models** were trained and benchmarked, with decision thresholds systematically optimized to achieve an effective trade-off between defect detection rate, false positives, and available scarfing capacity.
- Final performance is assessed on an independent test set to evaluate cross-dataset **generalization** and **operational applicability** in production environments.

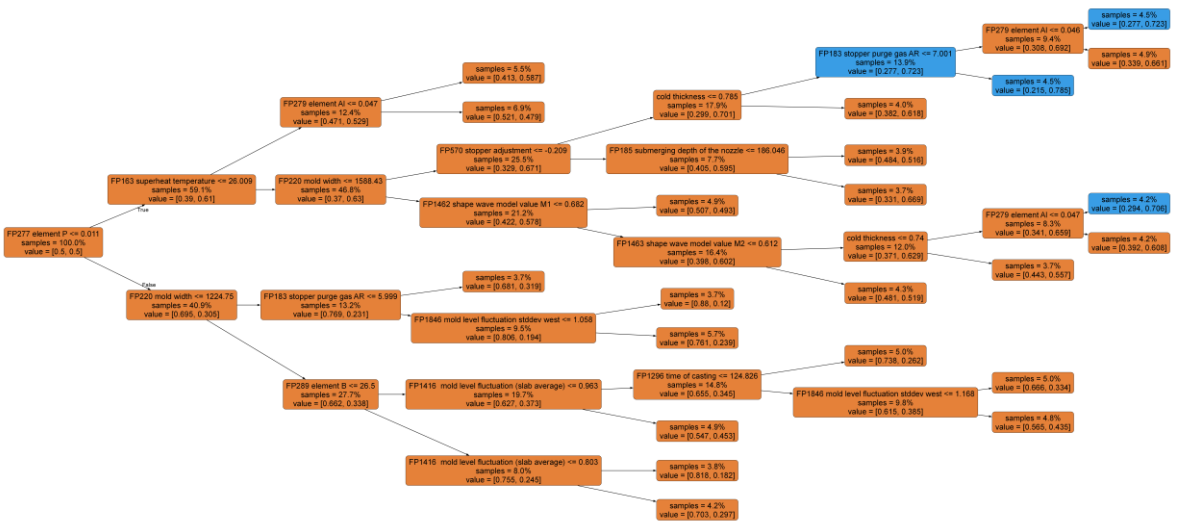
CONTRIBUTION

Scientific contribution
- Development of a benchmark framework for rare-event classification in steel manufacturing, addressing severe class imbalance.
- Comparative evaluation of interpretable machine-learning models and time-series approaches for continuous casting defect prediction.
- Improved understanding of the relationships between casting conditions, steel grades, slab characteristics, and OZE defect formation.

Economic contribution
- Earlier identification of slabs with a high likelihood of OZE defects before downstream processing.
- Reduction of unnecessary scarfing through more targeted treatment decisions.
- Enhanced decision support for production and quality engineers with transparent risk assessments.
- Foundation for future AI-driven quality management initiatives within the steel production value chain.

FRAMEWORK





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