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A Study on enhancing accuracy of AI-based RDT automatic control in hot rolling process

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In the hot rolling process, precise control of dimensional accuracy and material properties in steel plates is essential for performance and cost efficiency. However, increasing customer demands have underscored the importance of surface quality. A key determinant of surface quality is the Roughing-mill Delivery Temperature (RDT), which significantly influences scale formation and surface defects.

To address this, we developed an AI-based model for RDT prediction and optimized Roughing-mill Scale Breaker (RSB) patterns. Using the XGBoost algorithm, the model integrates process parameters, including slab dimensions, rolling load, chemical composition, reheating furnace temperature, and RSB patterns. The initial model exhibited relatively high Root Mean Square Error (RMSE), which was inadequate for industrial application. Further refinements, including feature engineering and hyperparameter tuning, improved predictive accuracy. The enhanced model achieved a lower RMSE, leading to more precise RDT predictions.

However, in dynamic industrial settings, data drift remains a challenge, as process variations can degrade model performance over time. To mitigate this, we integrated continual learning and drift detection mechanisms, enabling proactive model adaptation. A hybrid approach, combining concept drift detection (ADWIN, Page-Hinkley Test) with incremental model updating, ensures sustained predictive accuracy. Additionally, uncertainty-aware learning techniques help assess prediction reliability, guiding retraining strategies. These enhancements enable a robust AI-based RDT control system to dynamically adapt to evolving production conditions. Future research will extend its application to diverse steel grades and integrate it into a smart manufacturing framework, advancing intelligent process control in the steel industry.

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