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AI-Powered Classification and Prediction of Process Defaults in Steel Manufacturing

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To improve operational efficiency and minimize downtime, it is crucial to understand the causes leading to process defaults in the steelmaking industry. This study presents a generalized framework applicable across a wide range of metal-forming processes, which is based on an AI-powered solution designed to predict and classify breakages caused by process anomalies. The proposed solution identifies the operational phase in which failures occur as well as the key process variables (such as motor current and rolling force) that may act as breakage precursors. The objective is twofold: on one hand, to distinguish breakages attributable to process anomalies from those caused by material defects; on the other hand, to extract insights and meaningful interpretations of the mechanisms leading to plastic instability. A predictive model leveraging historical data from IoT devices is combined with statistical modelling to detect early warning signals associated with breakages. This integration of techniques allows proactive decision-making and adaptive process control. The study adopts a high-performing architecture that utilizes integrated services to process and analyze large-scale data streams in real time. This scalable infrastructure ensures efficient data handling and facilitates predictive analytics, ultimately enhancing process reliability. A practical application in the cold rolling scenario is presented, showcasing the potential of the proposed methodology in similar industrial settings.

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