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Real-time Anomaly Detection in Injection Molding: Leveraging Autoencoder Models To Define The Future Of Quality Control

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Injection molding, especially in medical device manufacturing, faces significant costs associated with manual quality control, largely due to regulatory requirements. Standard approaches using Design of Experiments combined with manual control are limited by performance, high cost and delayed detection, while other approaches like Statistical Process Control are limited by extensive need for labeled data and poor adaptability to natural variations of manufacturing floors, alongside challenges in handling injection molding data complexity, therefore leading to poor detection or high false alarm rates. Addressing these issues, this research adopts unsupervised autoencoder models for cost efficient, novel, real-time anomaly detection in injection molding. By leveraging a real-time cloud pipeline to analyze the model's reconstruction error, the system effectively identifies normal and abnormal components. The model successfully detected 7 out of 9 generated fault scenarios, achieving detection of 91% of visual and 100% of dimensional defects. This method, overcoming the class imbalance challenge of rare event problems, can then be used to cost effectively label abnormal components to tune the system to a needed performance, paving the foundation for automated quality assurance and parametric component release.

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