

RESEARCH NOTES

基于深度学习的工业过程异常检测模型研究

摘要: 本文提出了一种基于深度学习的工业过程异常检测模型,旨在提高异常检测的准确性和鲁棒性。该模型结合了卷积神经网络(CNN)和长短期记忆网络(LSTM)的优势,能够有效捕捉时间序列数据中的局部特征和长期依赖关系。实验结果表明,该模型在多个工业数据集上的性能优于传统方法,特别是在处理复杂非线性异常时表现突出。

关键词: 深度学习; 异常检测; 工业过程; 神经网络

Abstract: This paper proposes a deep learning-based industrial process anomaly detection model to improve accuracy and robustness. The model combines the advantages of Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks, effectively capturing local features and long-term dependencies in time series data. Experimental results show that the model outperforms traditional methods on multiple industrial datasets, especially in handling complex nonlinear anomalies.

Keywords: Deep learning; Anomaly detection; Industrial process; Neural network

Introduction: In recent years, with the rapid development of industrial automation, the demand for process anomaly detection has increased significantly. Traditional methods such as statistical control charts and expert systems often struggle to detect complex and nonlinear anomalies. Deep learning, with its powerful feature extraction and pattern recognition capabilities, has become a promising solution for this problem.

Methodology: The proposed model consists of a CNN-LSTM architecture. The CNN part is used for local feature extraction, while the LSTM part captures the temporal dependencies in the data. A multi-scale attention mechanism is introduced to focus on important information at different time scales. The model is trained on a large dataset of normal process data and a small dataset of abnormal data.

Results and Discussion: The model is evaluated on several industrial datasets, including process temperature, pressure, and flow rate. The results show that the proposed model achieves higher detection rates and lower false alarm rates compared to baseline methods. The multi-scale attention mechanism plays a crucial role in improving the model's performance on complex anomalies.

Conclusion: This research demonstrates the effectiveness of deep learning in industrial process anomaly detection. The proposed CNN-LSTM model provides a robust and accurate solution for detecting various types of process anomalies. Future work will focus on optimizing the model's computational efficiency and extending it to other industrial applications.

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目录
摘要
关键词
Abstract
Keywords
Introduction
Methodology
Results and Discussion
Conclusion
References