Unsupervised detecting anomalies in multivariate time series by Robust Convolutional LSTM Encoder-Decoder (RCLED)

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Résumé

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Keywords: Anomaly detection, Multivariate time series, Autoencoder, Long-Short Term Memory, Robust Principle Component Analysis, Industry 4.0.

Abstract:

Anomaly detection (AD) involves identifying patterns in the data that deviate from the expected behavior. One important application of anomaly detection techniques is in the industrial sector. These techniques help identify potential damage caused by wear and tear due to continuous use and prevent serious equipment failures (1). To build a system for automatically identifying anomalies, two main approaches can be utilized: supervised and unsupervised learning (2). The supervised approach involves applying classification models to datasets labeled as normal state and anomaly state. However, one critical problem is that only some, or even none in the real application, anomaly events are available in the historical data, making the supervised algorithms impossible. In recent years, many studies have used unsupervised techniques to detect anomalies. These techniques optimize their model parameters on datasets that contain only normal behavior and then identify deviations from this normal behavior as anomalies. The auto-encoder has emerged as a promising unsupervised solution for detecting anomalies in systems lacking explicit anomaly data in their historical records; however, its performance is usually sensitive to noisy data. This work is focused on developing a Robust Convolutional Long Short-Term Memory Encoder-Decoder (RCLED) model for multivariate time series anomaly detection. The model is designed with a convolutional LSTM encoder-decoder and robust PCA components, which allow it to handle the

*Intervenant

noise and dependencies in multivariate time series data. The performance of the RCLED model was then tested and compared to the different baseline models, such as One-Class Support Vector Machine (OC-SVM), Histogram Based Outlier Scores (HBOS), Gaussian Mixture Model (GMM), Long Short-Term Memory Encoder-Decoder (LSTM-ED), and on both synthetic and real datasets. The obtained results show that our RCLED model outperforms the other methods, and its performance is robust to unpredictable patterns and noises. The RCLED model shows great promise in the anomaly detection of industrial systems, where false positives can have significant consequences.

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