Abstract

The early detection of anomalies in time series will be a crucial part in preventive maintenance. Long Short-Term Memory (LSTM), a variety of Neural Networks, have excelled in the use of sequence data. The strength of LSTM architecture lies in its ability to remember individual events over very long, unknown periods of time and avoid the Vanishing Gradient Problem that occurs with Feedforward and Recurrent Neural Networks. In this thesis a LSTM based anomaly detection algorithm shall be implemented. The algorithm design provides a semi-supervised approach that trains the selected LSTM architecture on training data without anomalies. The predicted data points on data with anomalies can then be compared with the actual ones. An anomaly score is then calculated by the Maximum Likelihood Estimator based on the residuals. The hyperparameters of the LSTM architecture are determined by Bayesian Optimization. The results show that an LSTM based anomaly detection algorithm works well to predict time series and detect point anomalies. They also show that collective anomalies are not reliably detected by the algorithm. The use of the anomaly detection algorithm implemented here should therefore be well considered, since the advantages of LSTM are less important and the disadvantages such as long training times remain.

Keywords: Anomaly Detection, Time Series, Machine Learning, Neural Networks, Long Short-Term Memory, Bayesian Optimization