

Health Indicator Construction of Boiler Feed Pump Using LSTM-Autoencoder Based on Actual Coal-Fired Power Plant Operational Data

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Abstract:

The Boiler Feed Pump (BFP) is a critical component in coal-fired power plant operation because it delivers high-pressure feedwater to the boiler. Degradation or failure of this equipment can reduce unit reliability, cause unplanned downtime, and increase maintenance costs. Previous health monitoring and prognostics studies have often used laboratory-based or benchmark datasets, which do not fully represent real industrial data with varying operating conditions, sensor noise, and missing values. To address this gap, this study constructs a Health Indicator (HI) for BFP using actual multi-sensor operational data from BFP 1A at PT PLN Nusantara Power UP Paiton through an LSTM-Autoencoder approach. The 30-minute interval data were processed through ON/OFF state separation, data cleaning, parameter selection, and healthy baseline formation using the initial 20% of operating data. The LSTM-Autoencoder was trained to capture normal operating behavior, and reconstruction error was transformed into raw HI, smoothed HI, and a degradation envelope. A displacement vibration-based threshold was applied to classify the HI into normal, alarm, and fault levels for practical condition interpretation. The evaluation showed Spearman trendability of 0.828, Pearson trendability of 0.813, and normalized prognosability of 0.960, indicating that the proposed HI can represent BFP condition changes using actual power plant data.

Keywords:

Boiler Feed Pump, Health Indicator, LSTM-Autoencoder, Predictive Maintenance, Actual Operational Data.