Asset predictive maintenance in Hydroelectric Power Station based on convolutional autoencoder and novelty detection techniques

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ABSTRACT

Traditionally, maintenance of hydroelectric generation assets is carried out within preventive programs, gradually adjusting to current operating conditions and situations that lead to corrective maintenance, resulting in high maintenance costs for hydroelectric plants. Therefore, predictive maintenance is crucial in the electric power generation sector. This study contributes to this challenge by providing a methodology for detecting faults in assets associated with the Esmeralda Hydroelectric Power Station of the company Central Hidroeléctrica de Caldas EPM Group (CHEC). To this purpose, the data obtained by the Supervisory Control and Data Acquisition (SCADA) system is averaged over 10 minutes, and then, a convolutional autoencoder acts like a data descriptor. Several advantages of the proposed methodology include: (i) The model training uses only data of the healthy asset to address the data imbalance problem; (ii) The proposed methodology has been validated using CHEC SCADA data, demonstrating its robustness under actual operating conditions; (iii) Reliable predictions are achieved based on continuous monitoring of variables, where the mean squared error metric and the analysis of the weighted fault trend consider the asset's criticality; (iv) And finally, early alerts are provided with enough time, enabling the identification of the assets with potential fault condition and allowing to take the proper maintenance decisions. This methodology significantly enhances the maintenance practices for hydroelectric power generation, leading to increased efficiency, reduced costs, and improved asset reliability.