Prediction of remaining useful life of packing sets in plunger-type high-pressure compressor based on PCA/SVD analysis and NN model

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Abstract

A machine-learning-based prognostic strategy is developed in this paper for predicting the remaining useful life (RUL) of high-pressure packing in plunger-type hyper compressors. The proposed strategy applies principal component analysis (PCA) to identify three most important sensors out of 33 that seem relevant to the high-pressure packing. Singular value decomposition (SVD) is then performed with respect to chronological Hankel matrices reconstructed from one of these three sensor data, leakage flow. Normalized correlation coefficient between SVD eigenvalue vectors of chronological data is defined to come up with a health state assessment measurement. In order to enhance the prediction accuracy of RUL of the high-pressure packing, a linear-regression and two-term power series regression algorithms are both integrated into the NN (Neural Network) model. The effectiveness of the method is examined using the averaged difference (over thirteen data set) between the predicting and real failure events. The results showed that a maximum prediction RUL error of the model is less than 15 days and an averaged prediction RUL error is 7.23 days for 13 run-to-failure events. Furthermore, a more recent test was performed using the on-line data to examine the health states of four identical packing.

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