Fuzzy model identification based on mixture distribution analysis for bearing remaining useful life estimation

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Résumé

This research work proposes a data-driven modeling method for bearings remaining useful life estimation based on Takagi-Sugeno (T-S) fuzzy inference system (FIS). This method allows identifying the parameters of a classic T-S FIS, starting with a small quantity of data. In this work, we used the vibration signals data from a small number of bearings over an entire period of run-to-failure. The FIS model inputs are features extracted from the vibration signals data observed periodically on the training bearings. The number of rules and the input parameters of each rule of the FIS model are identified using the subtractive clustering method. Furthermore, we propose to use the maximum likelihood method of mixture distribution analysis to calculate the parameters of clusters on the time axis and the probability corresponding to rules on degradation stages. Based on this result, we identified the output parameters of each rule using a weighted least square estimation. We then benchmarked the proposed method with some existing methods from the literature, through numerical experiments conducted on available datasets to highlight its effectiveness.

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