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Abstract

Although the severity of cavitation determines the type of maintenance procedure, most of the previous studies have been focused only on the detection. This paper presents a system for detection of cavitation severity in centrifugal pumps and improving its accuracy using a hybrid feature selection technique. The vibration data used in this research is acquired from a model pump. The vibrations of the pump's outlet is measured in three different pump conditions including no cavitation, limited cavitation and developed cavitation. Then, empirical mode decomposition (EMD) method is used to decompose original signals into a number of intrinsic mode functions (IMFs). After extracting the IMFs, several statistical features are extracted from the first six IMFs. After that, a generalized regression neural network (GRNN) is used for fault classification. Correct classification rate of GRNN using all the extracted features as an input vector is 97.5%. A ten-fold cross-validation is conducted to evaluate the data. In order to increase the classification accuracy and eliminate redundant features, a hybrid feature selection algorithm is proposed. A comparison is also made between the results of radial basis function and multi-layer perceptron networks, as well. By using the selected features, not only the number of features is reduced, but also the classification accuracy is increased to 100% for all the three mentioned artificial neural networks. The selected features also determine the best IMFs that can be used in diagnosis of cavitation.

Keywords

Cavitation severity detection; Feature selection; Empirical mode decomposition; Vibration condition monitoring; Generalized regression neural network

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