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A Mechanical Diagnosis Method Based on Vibration Fault Signal down-Sampling and the Improved One-Dimensional Convolutional Neural Network

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Abstract : Convolutional neural networks (CNN) have received extensive attention in the field of fault diagnosis. Many fault diagnosis methods use CNN for fault type identification. However, when the amount of raw data collected by sensors is massive, the neural network needs to perform a time-consuming classification task. In this paper, a mechanical fault diagnosis method based on vibration signal down-sampling and the improved one-dimensional convolutional neural network is proposed. Through the robust principal component analysis, the low-rank feature matrix of a large amount of raw data can be separated, and then down-sampling is realized to reduce the subsequent calculation amount. In the improved one-dimensional CNN, a smaller convolution kernel is used to reduce the number of parameters and computational complexity, and regularization is introduced before the fully connected layer to prevent overfitting. In addition, the multi-connected layers can better generalize classification results without cumbersome parameter adjustments. The effectiveness of the method is verified by monitoring the signal of the centrifugal pump test bench, and the average test accuracy is above 98%. When compared with the traditional deep belief network (DBN) and support vector machine (SVM) methods, this method has better performance.

Keywords : fault diagnosis, vibration signal down-sampling, 1D-CNN
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