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Performance Enrichment of Deep Feed Forward Neural Network and Deep Belief Neural Networks for Fault Detection of Automobile Gearbox Using Vibration Signal

Authors : T. Praveenkumar, Kulpreet Singh, Divy Bhanpuriya, M. Saimurugan

Abstract : This study analysed the classification accuracy for gearbox faults using Machine Learning Techniques. Gearboxes are widely used for mechanical power transmission in rotating machines. Its rotating components such as bearings, gears, and shafts tend to wear due to prolonged usage, causing fluctuating vibrations. Increasing the dependability of mechanical components like a gearbox is hampered by their sealed design, which makes visual inspection difficult. One way of detecting impending failure is to detect a change in the vibration signature. The current study proposes various machine learning algorithms, with aid of these vibration signals for obtaining the fault classification accuracy of an automotive 4-Speed synchromesh gearbox. Experimental data in the form of vibration signals were acquired from a 4-Speed synchromesh gearbox using Data Acquisition System (DAQs). Statistical features were extracted from the acquired vibration signal under various operating conditions. Then the extracted features were given as input to the algorithms for fault classification. Supervised Machine Learning algorithms such as Support Vector Machines (SVM) and unsupervised algorithms such as Deep Feed Forward Neural Network (DFFNN), Deep Belief Networks (DBN) algorithms are used for fault classification. The fusion of DBN & DFFNN classifiers were architected to further enhance the classification accuracy and to reduce the computational complexity. The fault classification accuracy for each algorithm was thoroughly studied, tabulated, and graphically analysed for fused and individual algorithms. In conclusion, the fusion of DBN and DFFNN algorithm yielded the better classification accuracy and was selected for fault detection due to its faster computational processing and greater efficiency.

Keywords : deep belief networks, DBN, deep feed forward neural network, DFFNN, fault diagnosis, fusion of algorithm, vibration signal
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