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Classification and Fault Detection in Induction Motors Using DDACMD for Electrical Signal Analysis

Nesrine Abderrahmani

Identification, Command , Control and Communication Laboratory, University of Biskra, Algeria

INTRODUCTION & AIM

The aim of this research is to test the effectiveness of DDACMD (Data Driven adaptive chirp mode decomposition) in predicting faults in electrical machines, specifically in asynchronous motors, and its ability to distinguish between different types of faults. We tested it on broken rotor bar faults, which are one of the most common and significant faults. To clearly observe the results and differences, we apply classification, where the resulting percentage clearly indicates the quality of the outcomes.

METHOD

There are three types of signals: a signal for a healthy motor, a motor with one broken bar, and a motor with two broken bars. Each type includes three load levels: 20%, 50%, and 100%.

The steps of the work can be summarized as follows:

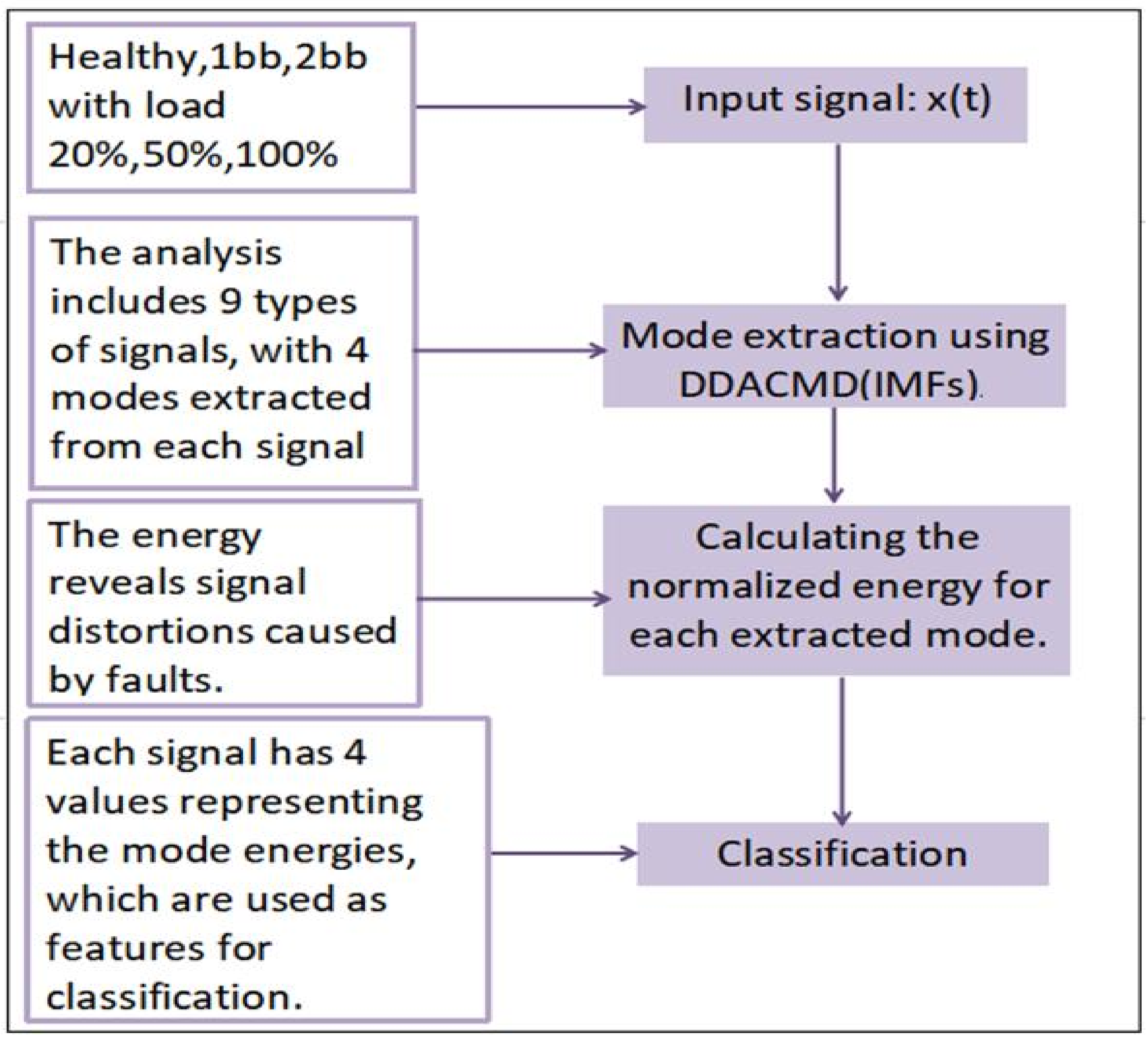

Fig 1: flowchart summarizing the proposed

RESULTS & DISCUSSION

The data was obtained from the Electrical Engineering Laboratory of Biskra (LGEB) at Mohamed Khider University of Biskra, Algeria.The following table provides an example of the normalized energy for each type of signal used at a 20% load. The energy of the fourth mode was neglected as it approaches zero.

Tab 1: Example of the resulting energies at 20% load

	IMF1	IMF2	IMF3
Healthy motor	0.0104	0.0054	0.8103
1 bb motor	0.0165	0.0026	0.8031
2 bb motor	0.0167	0.0022	0.8057

From the table, we observe a clear distinction between the three cases, particularly in the second mode. However, the values are very close in the cases of 1bb and 2bb.

Tab 2: The percentage accuracy of various classification models

Model	%	Model	%
Fine Tree	91.7	Fine Gaussian SVM	77.5
Medium Tree	88.9	Ensemble Boosted Trees	87.3
Kernel Naïve Bayes	84.1	Ensemble Bageed Trees	91.7
Fine KNN	83.2	Optimizable Tree	92.1

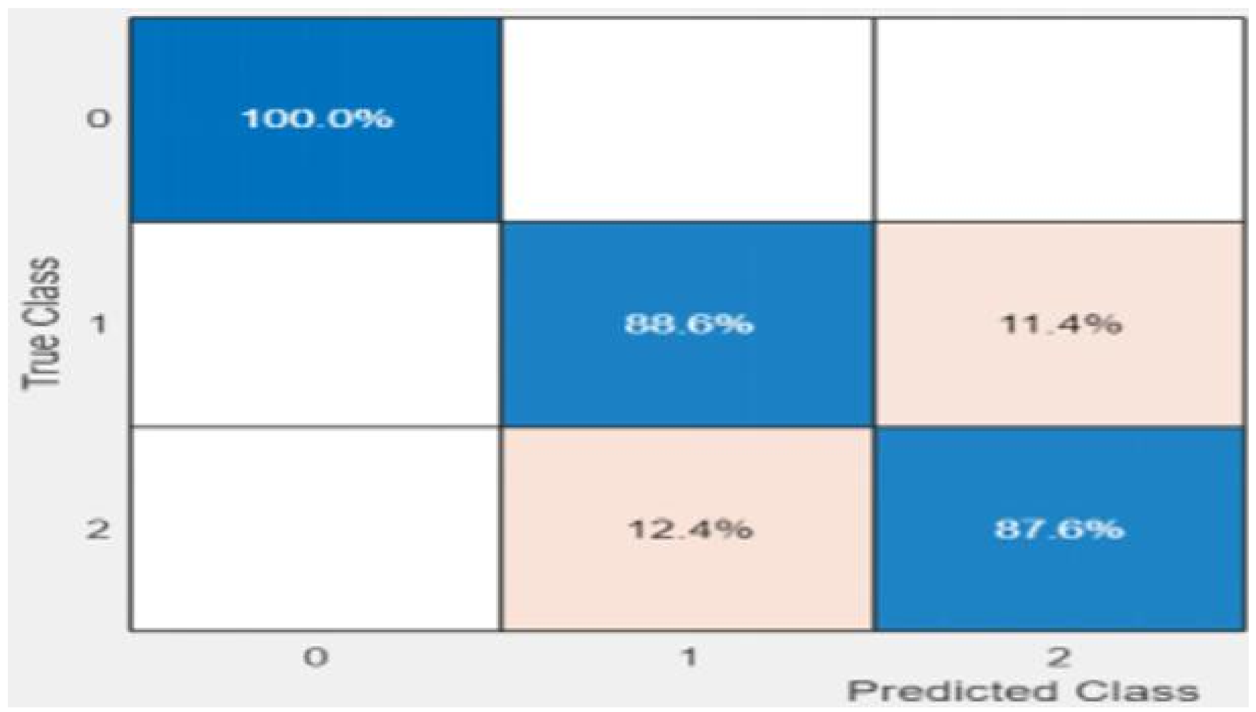

Fig 2: The classification result using Optimizable Ensemble.

We observe from Table 02 and Figure 02 that the classification results were good but did not achieve the percentages we were aiming for.

CONCLUSION

The diagnostic results using the DDACMD method showed good efficiency in distinguishing between the healthy motor condition and fault conditions. However, it was not sufficiently effective in differentiating between the single-bar break and double-bar break conditions, as the method was able to detect the fault but was not able to accurately distinguish between the two types of faults.

FUTURE WORK / REFERENCES

We hope in the future to experiment with better methods that will enable us to accurately predict various faults in electrical machines.

Wang, H., Chen, S., & Zhai, W. (2023). Data-driven adaptive chirp mode decomposition with application to machine fault diagnosis under non-stationary conditions. *Mechanical Systems and Signal Processing*, *188*, 109997.