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Finite-Sensor Fault-Diagnosis Simulation Study of the Gas Turbine Engine Using Information Entropy and Deep Belief Networks

Key words: Deep belief networks (DBNs), Fault diagnosis, Information entropy, Engine

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Motivation

- Precise fault diagnosis is an important part of prognostics and health management. It can avoid accidents, extend the service life of the machine, and also save on maintenance costs.
- For gas turbine engine fault diagnosis, we cannot install too many sensors in the engine because the operating environment of the engine is harsh and the sensors will not work in high temperatures, at high rotation speeds, or under high pressure. Thus, there is not enough sensory data from the working engine to diagnose potential failures using existing approaches.

Main idea

1. Joint complexity entropy

2. Deep belief networks based on an information entropy (IE-DBNs)

1. The framework of deep belief networks

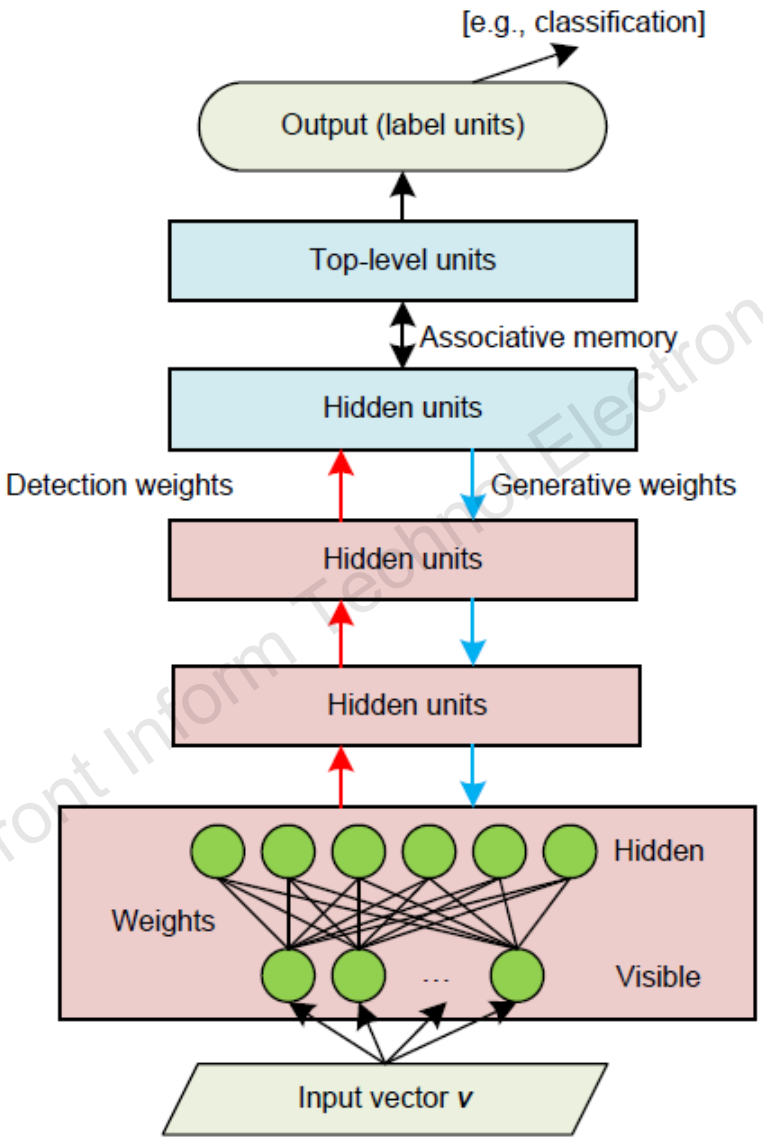

Fig. 5 The framework of deep belief networks

2. Gas turbine engine fault diagnosis using deep belief networks (DBNs) based on information entropy and a logistic regression method

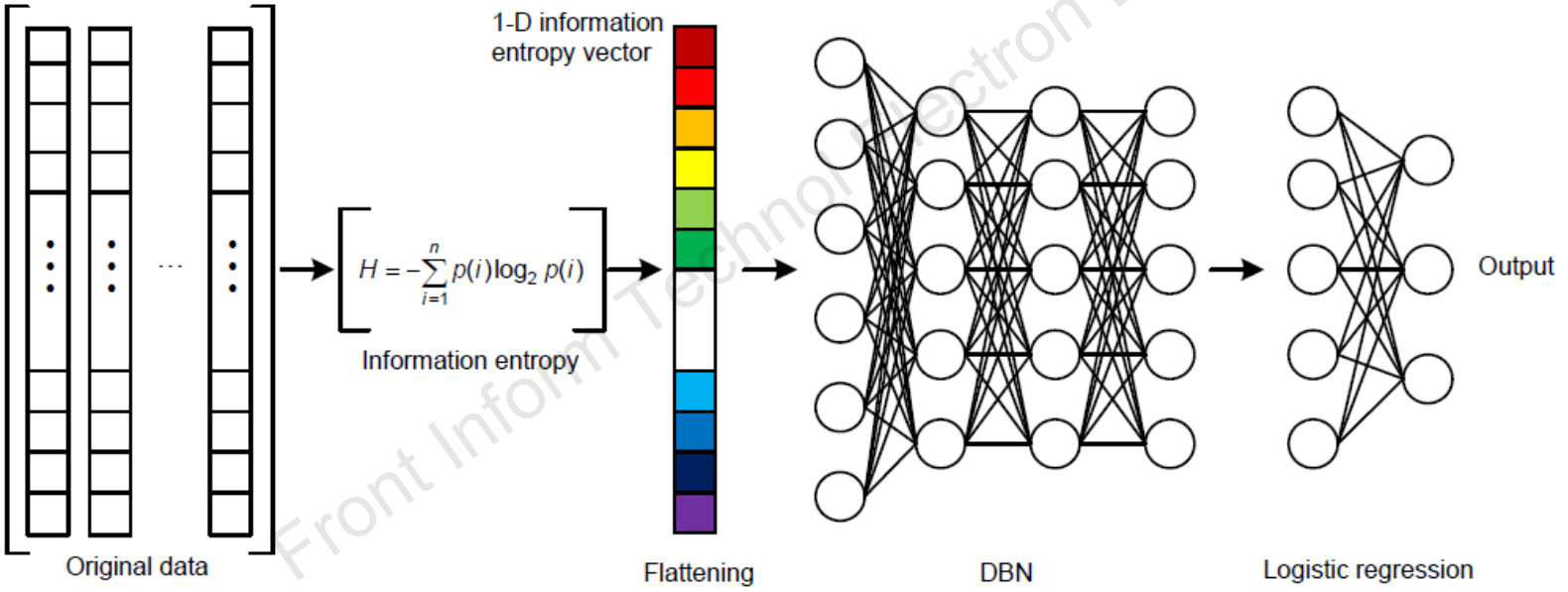

Fig. 6 Gas turbine engine fault diagnosis using deep belief networks (DBNs) based on information entropy and a logistic regression method

3. Procedure for preprocessing the engine simulation data

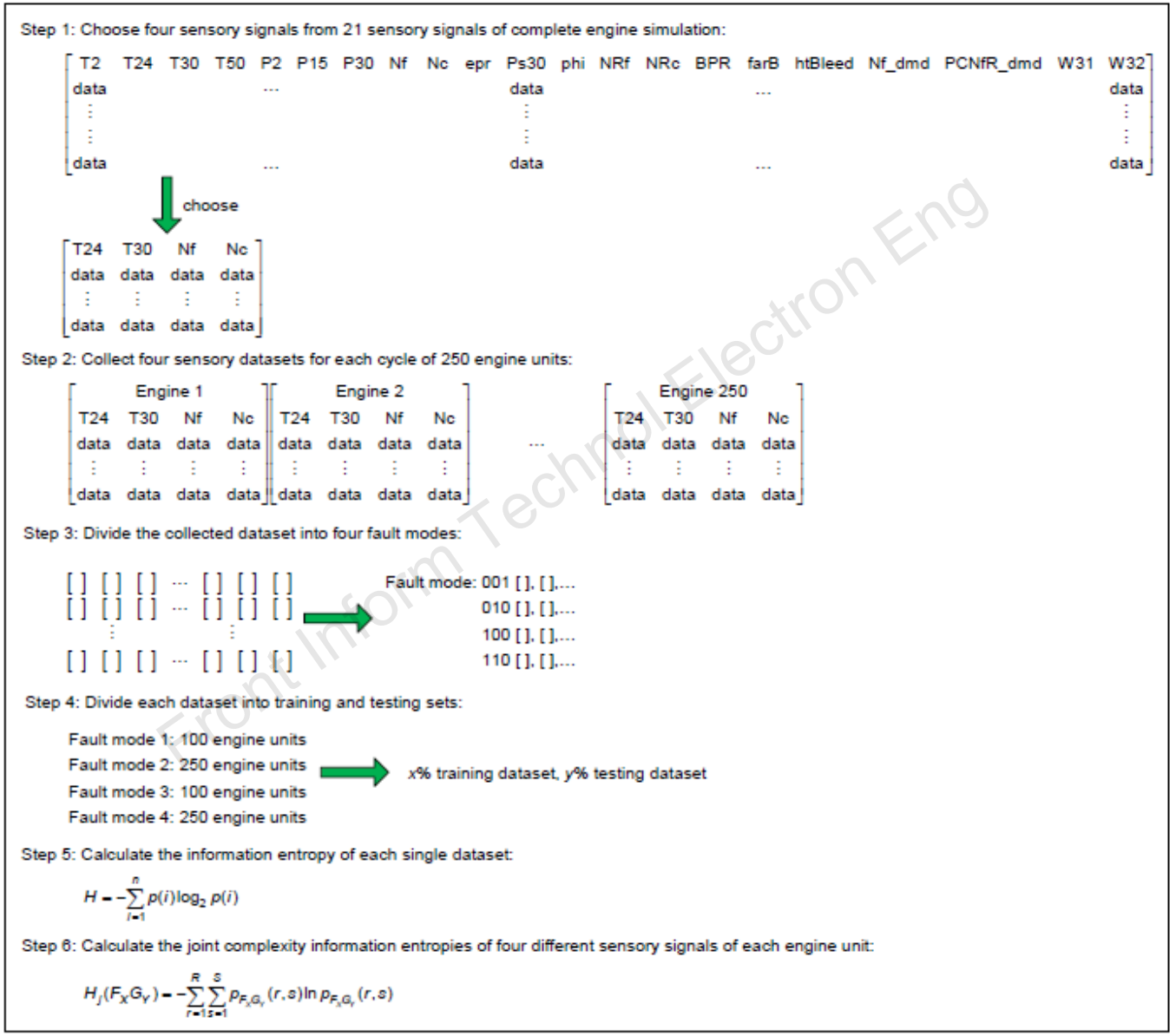

Fig. 7 Procedure for preprocessing the engine simulation data

Illustrative demonstration

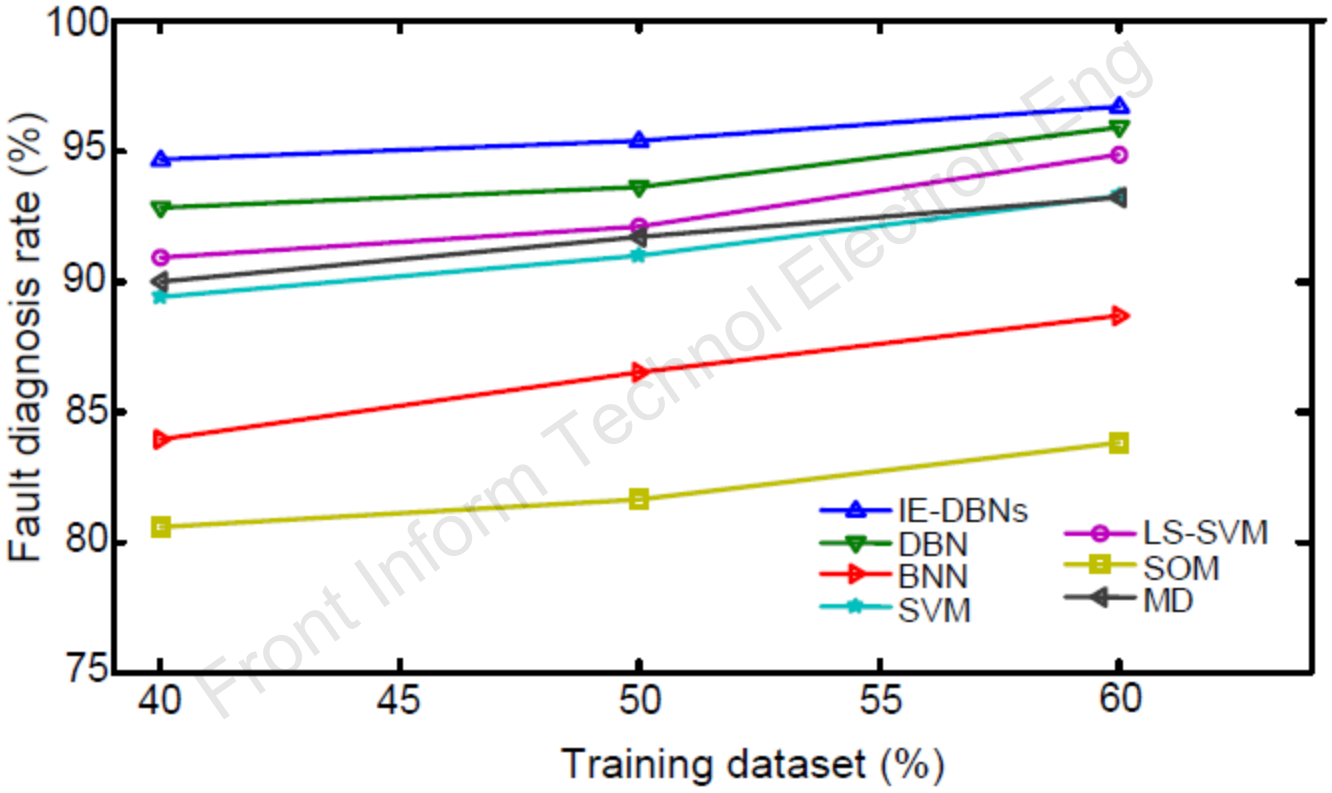

Fig. 11 Fault diagnosis results from the training

Illustrative demonstration

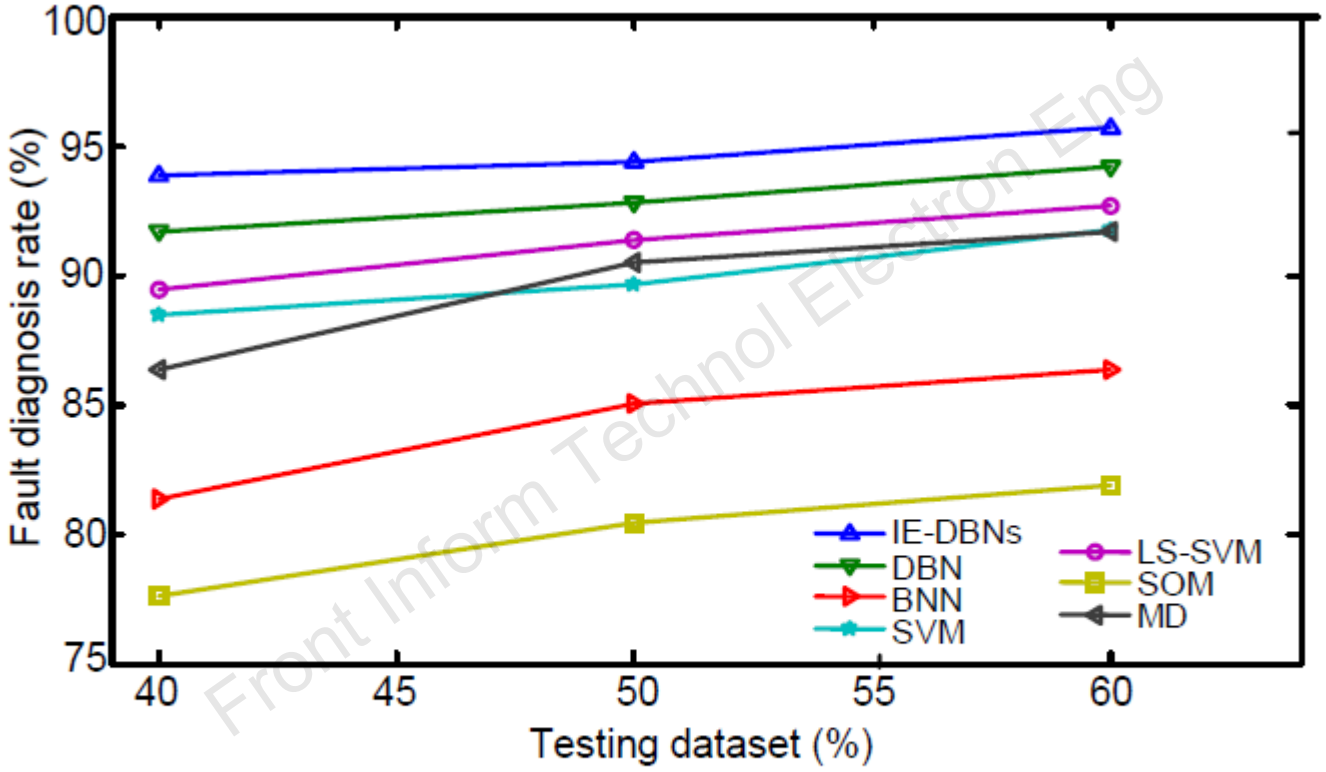

Fig. 12 Fault diagnosis results from the testing

Illustrative demonstration

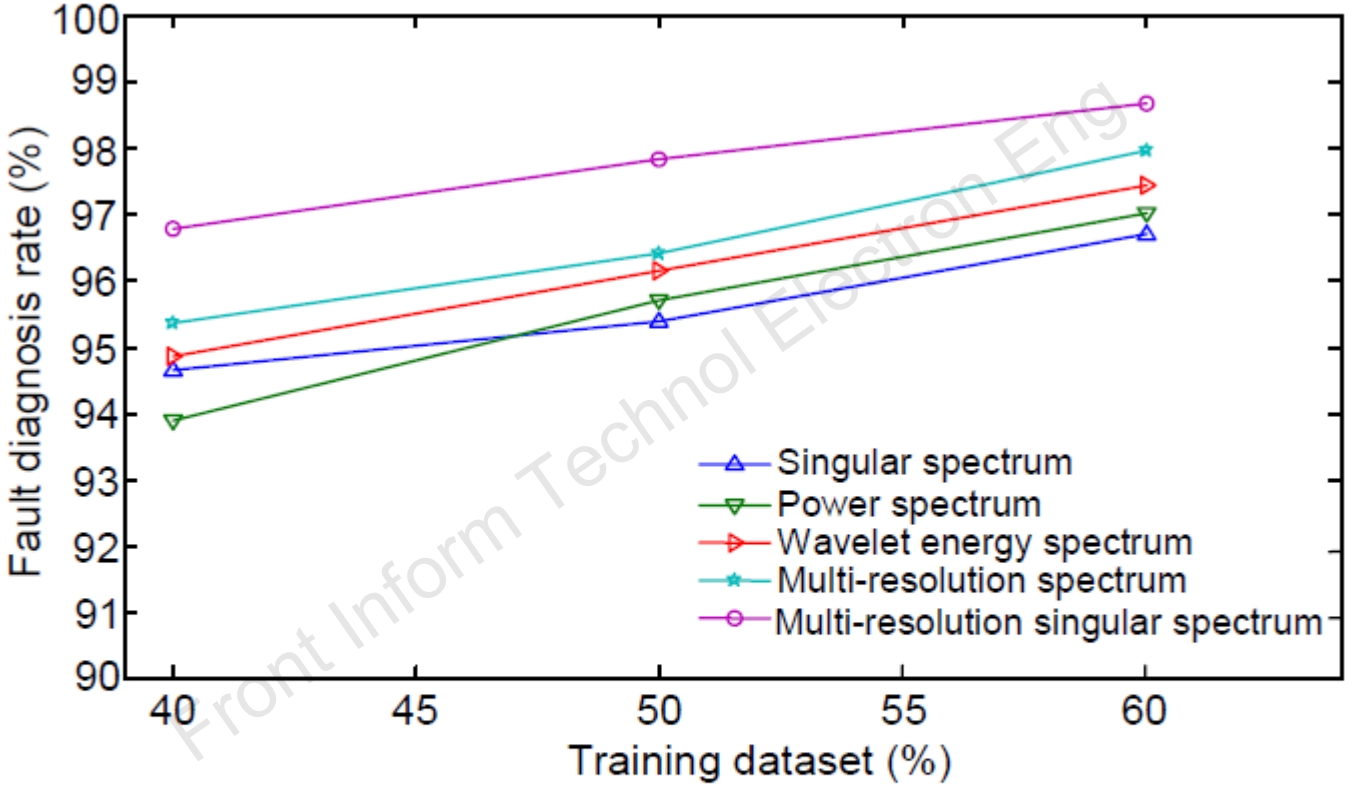

Fig. 13 Fault diagnosis results using the IE-DBNs method based on the five different information entropies from the training

Illustrative demonstration

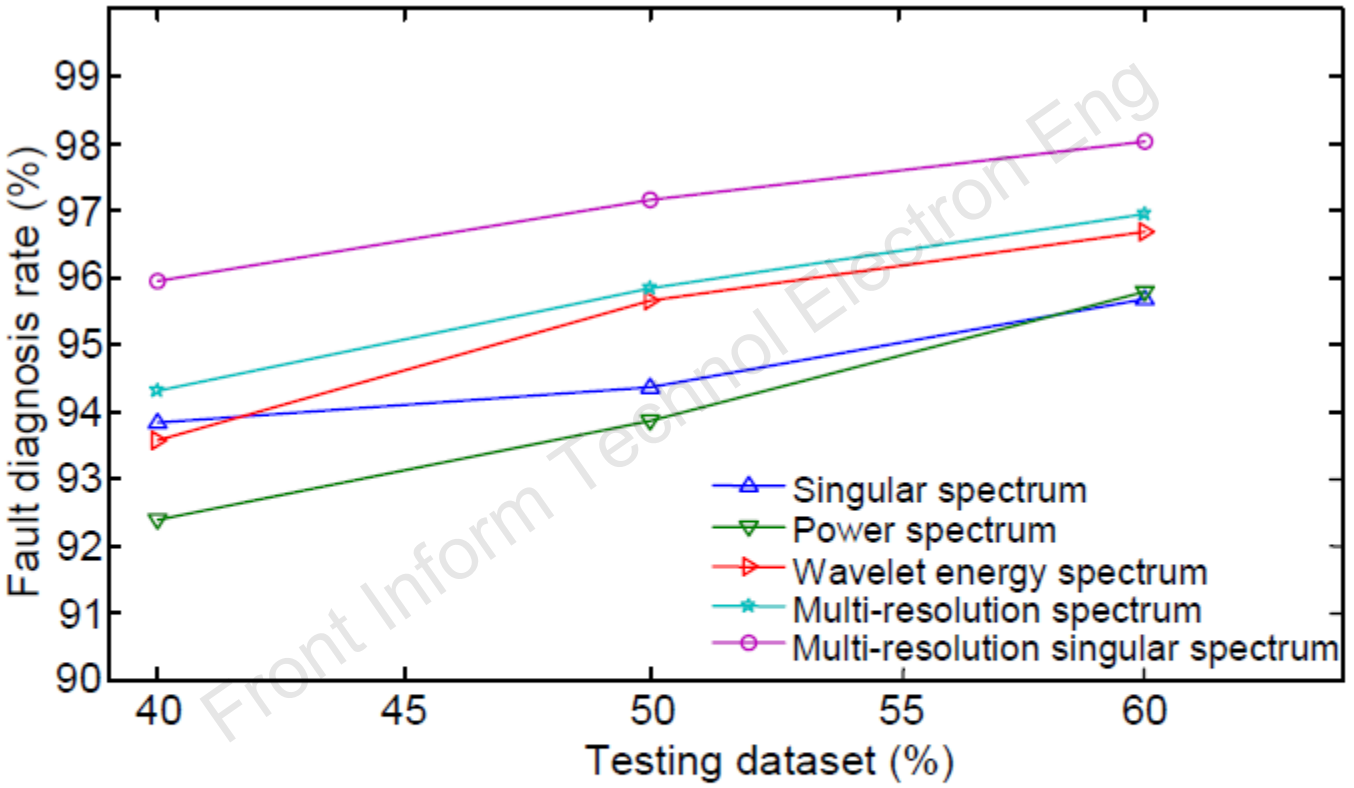

Fig. 14 Fault diagnosis results using the IE-DBNs method based on the five different information entropies from the testing

Conclusions

- Proposed the IE-DBNs method and provides some novel contributions to the domain of engine fault diagnosis.
- Joint-complexity information entropy is proposed as a way to process multi-sensory signals and describe a nonlinear feature between two signals..
- From the experiment results, the accuracy of IE-DBNs is higher than other existing methods, such as SVM, BNN, DBN, and so on.