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Opinion

Novelty detection versus traditional fault detection methods

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Novelty detection is a method that defines the existence of a defect in a system without the need for prior training by data corresponding to the defect and simply by training by the data corresponding to the "*normal assumed*" function of the system. In the other words, in this method, the condition monitoring system is trained by purely normal (assumed) data and further, announces any deviation of the new system data from normal data. Therefore, it can be said that this method can detect and reveal the occurrence of any kind of fault and phenomenon, provided that there is a footprint or effect on the data which is extracted from the operation of the system. In the other words, this method is inherently unlimited in identifying the existence of any defect or phenomenon in a system. However, the term "*normal assumed*" is used here, if the term is merely "normal", it might be a challenge that if traditional methods (other methods) do not have the ability to identify the rare and emerging defects and the novelty detection method is also in the training phase, how the normality of data is confirmed. So, in this way, the data sets that the condition monitoring system trains with them is the "*normal assumed*" data of the system.

Various studies have shown that novelty detection is practically very challenging. That's why there are a lot of novelty detection models that each has a proper performance on specific data. It can be said that there is no optimal model for novelty detection, and success is not just related to the type of novelty detection method, but also to the statistical characteristics of the data. In many applications, classifier systems need to act more as detector than classifiers, so that they can determine that a new input is part of the data that the classifier system was trained by it or an unknown data. It should be noted that we can never train a learning machine with all possible conditions for defect in the system. So, in many cases, there is no alternative to using novelty detection [1]. In fact, this method is designed to cover the weaknesses of traditional conventional fault detection techniques that are trained only by famous defects and are unable to detect new and rare defects. In complex systems, traditional classification methods cannot be used only, because most of the abnormal phenomena are very rare or there is no data that describes the defect condition. But the novelty detection methods, by modeling the normal data and using a distance measurement and definition of a threshold, provide solutions to detect the abnormal phenomena. This technique is used in applications such as troubleshooting, radar target detection, mass detection in mammography, the Internet, e-commerce, control of statistical processes and many other fields.

References

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