Abstract Title:

Online wind turbine condition monitoring using a local empirical mode decomposition approach

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Abbreviations

EMD: empirical mode decomposition
IMF: intrinsic mode function

Introduction

Wind turbines today, particularly offshore, are experiencing numerous reliability challenges. How to make wind industry profitable via condition monitoring has become a hot research topic in both academic and industry communities. To instantly understand the actual health condition of a wind turbine, much effort has been spent in the past few years to develop various types of online wind turbine condition monitoring techniques. However, these techniques are mainly based on traditional spectral analyses and, therefore they cannot meet the requirement of interpreting non-linear, non-stationary wind turbine condition monitoring signals. The empirical mode decomposition (EMD) approach provides a potential solution for this challenge.

Approach

The standard EMD approach decomposes the non-linear, non-stationary signal into a finite number of intrinsic mode functions (IMFs) via a number of iterated sifting calculations. As a consequence, this standard approach requires long calculation times when processing lengthy data and is, therefore, not suited for online use. In order to overcome this issue, the use of a local EMD approach is studied in this paper to investigate its potential application to online wind turbine condition monitoring.

Main body of abstract

Firstly, a sliding window function is applied to continuously select a local block size signal. Then, to improve the local extrema points detection ability, a local EMD algorithm, which uses a weighting function on the connected time structures with a soft decay, is proposed instead of a global method to generate intrinsic mode functions (IMFs). Moreover, the Hilbert transform is also used to perform envelop analysis to extract component condition related characteristic features and by studying the selected characteristic features, the condition of components can be deduced accurately.

Conclusion

The effectiveness of the proposed approach has been validated by using experimental data which is discussed in the paper. It is these same experiments that show that local EMD can potentially be a powerful tool for conducting online wind turbine condition monitoring.

Learning objectives:

It would expect that interested reader to learn how to use local EMD to perform online fault characteristic information extraction. In the meantime, this approach can help maintenance engineers to assess wind turbine condition and fault detection and isolation by observing the appearance of fault related characteristic frequency.

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