# Chapter 59
# Big Data and Web Intelligence for Condition Monitoring:
## A Case Study on Wind Turbines

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## ABSTRACT

*Condition Monitoring (CM) is the process of determining the state of a system according to a certain number of parameters. This 'condition' is tracked over time to detect any developing fault or non desired behaviour. As the Information and Communication Technologies (ICT) continue expanding the range of possible applications and gaining industrial maturity, the appearing of new sensor technologies such as Macro Fiber Composites (MFC) has opened a new range of possibilities for addressing a CM in industrial scenarios. The huge amount of data collected by MFC could overflow most conventional monitoring systems, requiring new approaches to take true advantage of the data. Big Data approach makes it possible to take profit of tons of data, integrating in the appropriate algorithms and technologies in a unified platform. This chapter proposes a real time condition monitoring approach, in which the system is continuously monitored allowing an online analysis.*

## INTRODUCTION

Condition monitoring (CM) is defined as the process of determining the state of system according to a parameter of the system. The main propose of CM in this chapter is to identify a significant change of this condition of the system which is indicative of a developing fault. It is usually considered as part of a predictive maintenance strategy, in which maintenance actions, and therefore preventive maintenance tasks, are scheduled to prevent failure and avoid its consequences. The objective is to extend the life cycle of the system analysed, and to avoid major failures, resulting in considerable cost and associated downtime reduction.

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The so called Information and Communication Technologies (ICT) have grown up with no precedents, and all aspects of human life have been transformed under this new scenario. All industrial sectors have rapidly incorporated the new technologies, and some of them have become de facto standards like supervisory control and data acquisition (SCADA) systems. Large amounts of data started to be created, processed and saved, allowing an automatic control of complex industrial systems. In spite of this progress, there are some challenges not well addressed yet. Some of them are: the analysis of tons of data, as well as continuous data streams; the integration of data in different formats coming from different sources; making sense of data to support decision making; and getting results in short periods of time. These all are characteristics of a problem that should be addressed through a big data approach.

This chapter proposes a real time condition monitoring approach, in which the system is continuously monitored allowing online analysis and actions. The system is fed by data streams received from different sensors adequately located on the machine.

The proposed methodology is applied to the industry of wind energy, in particular to the detection of failures in the blades like surface cracking, scuffing, pitting, etc.

Other interesting application is the detection of ice on wind turbine blades. It is known that icing causes a variety of problems for wind turbines, increased fatigue of components due to imbalance in the load or power reduction due to disrupted aerodynamics (Homola, Nicklasson, & Sundsbø, 2006).

All the information analysed by the system is obtained through non-destructive techniques using transducers, which are being used in wind power industry with great success. However, it is worth to mention that wind power is just as an illustrative example of application, while the methodology is applicable in many different scenarios across several industries.

## BACKGROUND

Wind energy is inexhaustible, ecologically and environmentally friendly. It is becoming one of the most widespread and productive methods for generating electrical energy (see Figure 1). Today, it is a mature

*Figure 1. Wind turbine research center in Ohio.*