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 technology and this energy source is applied to both large scale and small installations. It certainly has become a mainstay within the energy systems of many countries, and is recognized as a reliable and affordable source of electricity (Beattie & Pitteloud, 2012).

In 2013, wind energy represented 3.5% of total energy demand. And by 2016 is expected to be the global installed capacity of 500,000 MW. In addition to onshore wind farms, wind farms are built in the sea (offshore), several kilometres from the coast, to take advantage of the best wind conditions to overcome the negative relief effects. In these installations it is common to find much more powerful machines than which are installed onshore. The diameter of the turbine is a crucial parameter: longer blades, more swept area and more energy produced.

This trend to building ever larger blades carries out certain problems. The blades have to bear more and more weight and strength due to its greater sweep area. This means an increased fatigue in the blade structure, and therefore any blade failure entails very high costs. It has been estimated that the time between failures in wind turbine blades is 5 years. The time spent in repairing one of these blades is 2 days on average in onshore wind turbines. However, in the case of offshore wind turbines the downtime could increase up to a month.

The repair costs of a wind turbine blade may vary between 20000€ to 50000€ depending on the required operations, e.g. if it is necessary to take it down and if it can be repaired in the field or it has