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Neural Networks Applications for Fault Detection on Wind Turbines

R. F. Mesquita Brandão[1], J. A. Beleza carvalho[1] and F. P. Maciel Barbosa[2]

[1] Department of Electrical Engineering
ISEP, Oporto Polytechnic Institute
Rua Dr António Bernardino de Almeida, 431, 4200-072 Porto (Portugal)
Phone:+351 228 340 500, e-mail: rfb@isep.ipp.pt, jbc@isep.ipp.pt

[2] FEUP&INESC Porto, Oporto University
Rua Dr Roberto Frias, s/n, 4200-465 Porto (Portugal)
Phone:+351 220 413 349, e-mail: fmb@fe.up.pt

Abstract. Wind energy is the renewable energy source with a higher growth rate in the last decades. The huge proliferation of wind farms across the world has arisen as an alternative to the traditional power generation and also as a result of economic issues which necessitate monitoring systems in order to optimize availability and profits. Tools to detect the onset of mechanical and electrical faults in wind turbines at a sufficiently early stage are very important for maintenance actions to be well planned, because these actions can reduce the outage time and can prevent bigger faults that may lead to machine stoppage. The set of measurements obtained from the wind turbines is enormous and the use of neural networks may be useful in understanding if there is any important information that may help the prevention of serious failures. The training of the Neural Networks however is not easy because the measurement set used for training must represent a period of time with no faults in the equipment of the turbine that is being monitored.

Key words

Condition Monitoring, Maintenance, Neural Networks, Wind Energy, Wind Turbines.

1. Introduction

Wind is nowadays one of the most important sources of energy in the world. From a worldwide viewpoint, installed capacity reached 159213 MW in 2009, out of which, 38312 MW were added in that year, showing a growth rate of 31,7%, the highest since 2001 [1].
In Europe wind has overtaken all other sources of power and has become Europe's number one in terms of new installed capacity and accounted for 39% of all new power capacity in 2009 [2].

Despite the world financial crisis, wind energy continues to be the most popular renewable power technology in many parts of the world. The reasons for this are climate changes, the will to hedge against volatile fossil fuel prices, speed of deployment and energy security.
An efficient maintenance of wind generators is very important to minimize the operational costs of a modern wind farm.

Table I. – New installed and de-commissioned capacity in EU in 2009 [2]

Source of Energy	New Capacity (MW)	De-commissioned Capacity (MW)
Wind	10163	115
Natural Gas	6630	404
PV	4600	0
Coal	2406	3200
Fuel Oil	573	472
Biomass	581	39
Waste	442	24
Nuclear	439	1393
Large Hydro	338	166
CSP	120	0
Small Hydro	54,5	0,6
Other Gas	12	0
Geothermal	3,9	0,5
Ocean	0,40	0
PEAT	0	0

In most of the wind parks covered by the warranty, maintenance is carried out by the wind turbine producer. In the other parks, the wind park owner has his own maintenance teams to do the job or contracts out this specific job. The maintenance is preventive and done in pre-defined periods of time. Normally a minor service is done every 6 months and a major maintenance every 12 months. When the turbine stops or major problems occur,