PO.ID 091

Diagnostics and parameters estimation of Wind Energy Generator

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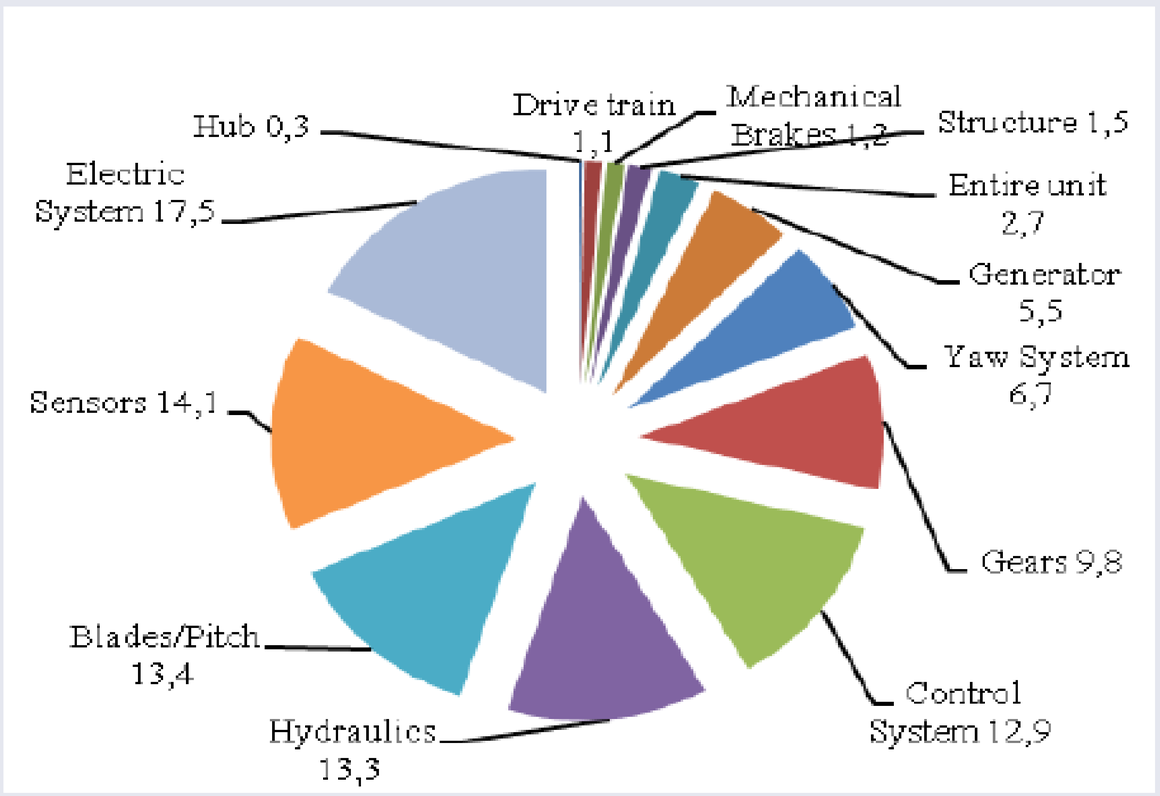
Abstract

(2.4)

This paper, the authors propose a methodology of diagnostics and parameters estimation of a wind energy generator using wavelets transform. This method consists in applying wavelet transform to stator and rotor currents in order to identify and localize any occurring fault. After presentation of characteristics of wavelet transform, authors choose the algorithm of Morley, Gabor and Wigner-Ville to classify different faults affecting the stator and rotor currents.

Failures statistics of WT



Diagnosis methodologies

The monitoring of the turbine requires careful monitoring of its different processes. In this study, it has been shown that the most failures were linked to the electric system followed by sensors, and blades/pitch components.
Diagnostic methods to identify the above faults may involve several different types of fields of science and technology. Several methods were applied to detect the faults in induction motors such as the following:

- Electromagnetic field monitoring,
- Temperature measurement,
- Infrared recognition,
- Radio frequency (RF) emissions monitoring,
- Noise and vibration monitoring,
- **Motor current signature analysis (MCSA),**

Doubly fed induction generator modeling

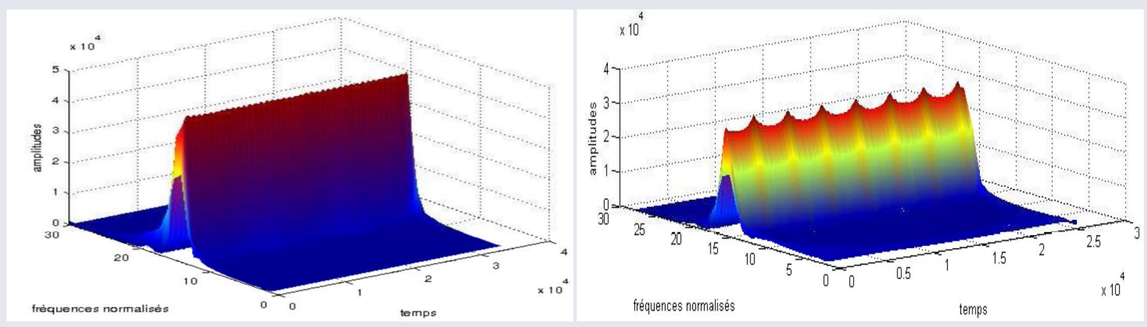
$$\begin{bmatrix} V_{ar} \\ V_{br} \\ V_{cr} \end{bmatrix} = R_r \begin{bmatrix} I_{ar} \\ I_{br} \\ I_{cr} \end{bmatrix} + \frac{d}{dt} \begin{bmatrix} \varphi_{ar} \\ \varphi_{br} \\ \varphi_{cr} \end{bmatrix} \quad \begin{bmatrix} V_{as} \\ V_{bs} \\ V_{cs} \end{bmatrix} = R_s \begin{bmatrix} I_{as} \\ I_{bs} \\ I_{cs} \end{bmatrix} + \frac{d}{dt} \begin{bmatrix} \varphi_{as} \\ \varphi_{bs} \\ \varphi_{cs} \end{bmatrix}$$

the state-space form of the dynamic equations is:

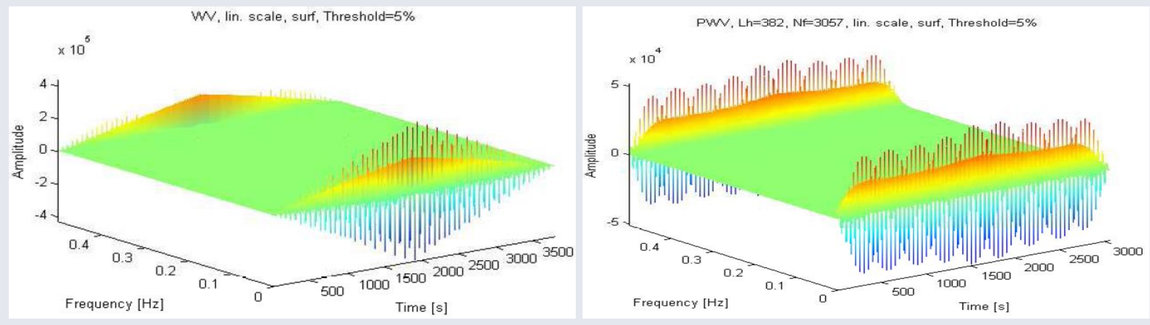
$$V(t) = \begin{bmatrix} i_{qs} & 0 & pi_{qs} + wi_{ds} & 0 & p(i_{qs} + i_{qr}) + w(i_{ds} + i_{dr}) \\ i_{ds} & 0 & pi_{ds} - wi_{qs} & 0 & p(i_{ds} + i_{dr}) - w(i_{qs} + i_{qr}) \\ i_{0s} & 0 & pi_{0s} & 0 & 0 \\ 0 & i_{qr} & 0 & pi_{qr} + (w - w_r)i_{ds} & p(i_{qs} + i_{qr}) + (w - w_r)(i_{ds} + i_{dr}) \\ 0 & i_{dr} & 0 & pi_{dr} - (w - w_r)i_{qs} & p(i_{ds} + i_{dr}) + (w - w_r)(i_{qs} + i_{qr}) \\ 0 & i_{0r} & 0 & pi_{0r} & 0 \end{bmatrix} \begin{bmatrix} r_s \\ r_r \\ L_{ls} \\ L_{lr} \\ L_M \end{bmatrix}$$

Results

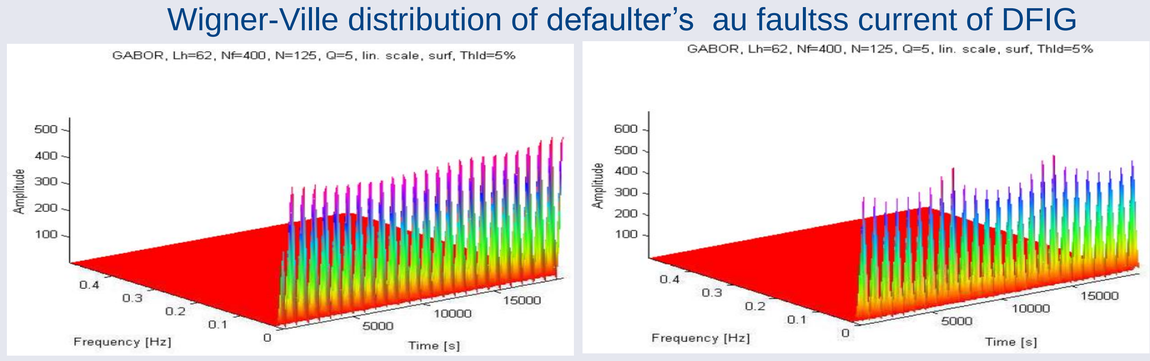
Wavelets Transform



Morlet distribution faultles and defaultles current of DFIG

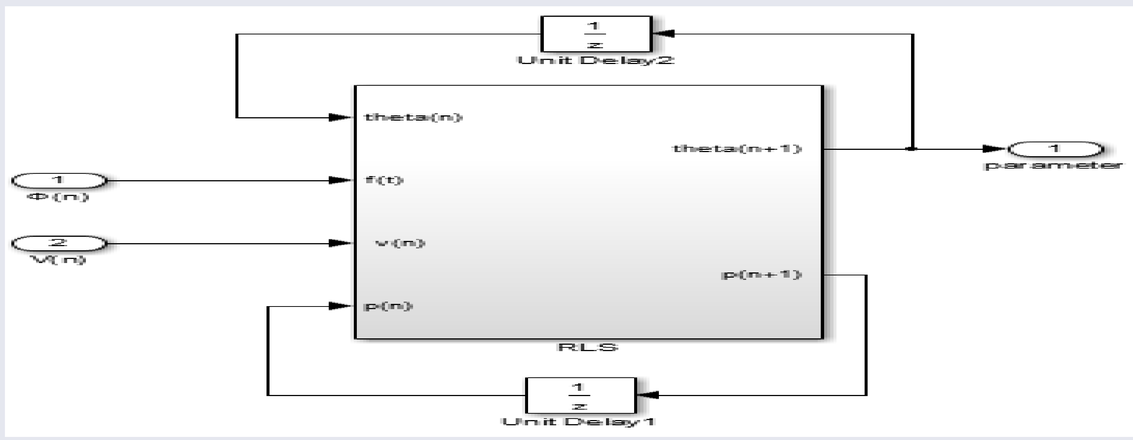


Wigner-Ville distribution of defaulter's au faultss current of DFIG

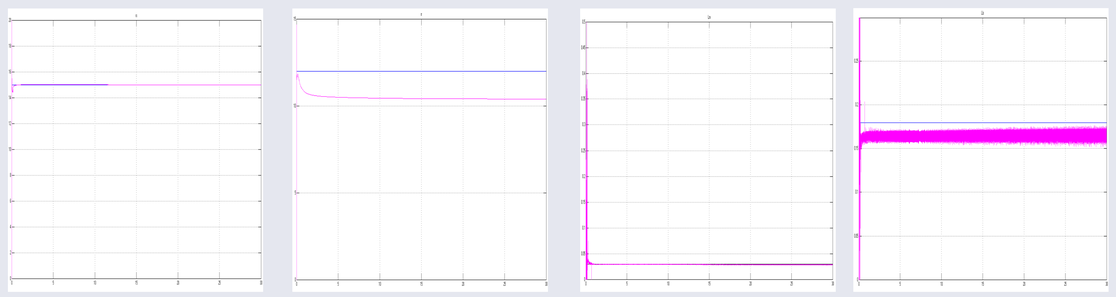


Gabor distribution of defaulter's au faultss current of DFIG

Parameters estimation



RLS estimator model



Convergence of Rs Rr Lm and Ls using RLS from simulation.

Conclusions

In this work fault signature on current wind turbine generator has been demonstrated and clarified both theoretically and empirically.
Whatever time–frequency distribution the faulty generator would change packet nature through prior choice of function analysis.
Implementing wavelet distribution of motor oscillating signal may give important results regarding the surveillance of wind generator.
algorithm for the system identification were presented analytically and simulated. Based on the results and given the fact that the nature of the system is relatively slow, we can say that the RLS is suitable in this application since it performs well and provides relatively fast convergence.

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