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Simulation of Sensor Fault Diagnosis for Wind Turbine Generators DFIG and PMSM Using Kalman Filter

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Abstract

The fault detection and isolation of generators used in wind turbines gathering interest as to maximize the reliability and avail of distributed energy systems with recent unmatched growth in construction of offshore wind farms. In particular it is interested in performing fault detection and isolation (FDI) of incipient faults affecting the measurements of the three-phase signals (currents) in a controlled DFIG and PMSG. Although different authors have dealt with FDI for sensors in induction machines and in DFIGs, most of them rely on the machine model with constant parameters. However, the parameter uncertainties due to changes in the operating conditions will produce degradation in the performance of such FDI systems. The robust techniques to detect faults are exist but there is a need of extra sensor. This paper proposed a systematic methodology for the design of sensor FDI systems with the following characteristics: i) capable of detecting and isolating incipient additive (bias) faults, ii) robust against changes in the references/disturbances affecting the controlled DFIG and PMSG as well as modeling/parametric uncertainties, iii) residual generation system based on a multi-observer strategy to enhance the isolation process, The designed sensor FDI systems have been validated using measured voltages, as well as simulated data from a controlled DFIG. First the state space models of DFIG and PMSM explained followed by kalman filter introduction and current sensor fault detection using a bank of kalman filter named dedicated Observer Scheme and generalized Observer scheme to detect simultaneous and multiple faults was theorized and simulated using MATLAB simulation tool .The simulation results were summarized with and without Sensor fault.

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Keywords: Wind turbine; kalman filter;Generalized Observer Scheme,;Dedicated Observer Scheme; Fault detection and isolation; current sensor fault.

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1. Introduction

In modern times wind-turbines proffer to a greater part of the world's power production, thereupon the reliability of these turbines is foremost salient. Their down time must be low. The prominent slot of achieving this is to providing thorough advanced fault detection, isolation systems in the wind turbines. Normally Condition monitoring is used to monitor the mechanical parts like gear box etc., an observer centered scheme to identify faults in current sensor was furnished. To test different detection, isolation and accommodation schemes on the wind turbine application [**1**] the functions of the automated control techniques are of following:

Nomenclature

V_{ds}, V_{qs}	Three phase voltage in d-q reference frame
I_{ds}, I_{qs}	Three phase stator currents in d-q reference frame
V_{dr}, V_{qr}	Three phase voltage in d-q reference frame
i_{dr}, i_{qr}	Three phase stator currents in d-q reference frame
R_s, R_r	Stator and rotor resistance of machine per phase
L_s, L_r, L_h	position of Stator, rotor and mutual inductances of machine
ω_r, ω_s	Supply and rotor angular frequencies

- **Monitoring**: Quantitative variants are probed with feature to tolerances, and alarms are mitigated for the operator.
- **Automatic protection**: Whenever in situations of alarming process state, the monitoring function automatically invokes an appropriate countermove;
- **Control with fault diagnosis**: According to the measured values of variables, characteristics are computed, indications are generated through change detection, a fault diagnosis is performed and decisions for balance are built.

Indeed, the summate misstep of a component can escalate the number of accidental break downs of a system. A system, which admitted with the scope of detecting, isolating, identifying, or distinguish faults, is called a fault diagnosis system or fault detection and isolation FDI. The good functioning of the FDI unit is very important to decision making phase. There are many methods to analyze the consistency of the measurements acquired from the monitored system. In ideal conditions the residuals running nearly zero under un-faulty condition and it is very less reactive to noises and disturbances where maxes to faults. The following important step is evaluation of it which attained by proper design of decision rule base termed according to residuals In this paper, we explore dynamic process to validate the measurement using a soft computing algorithm as well shown in Fig.1.

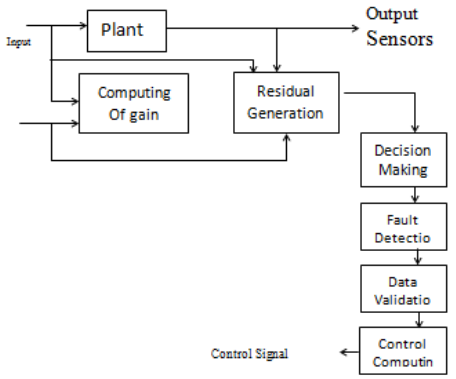

Fig.1 Fault evaluation method